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Note

Preliminary screening and process standardisation of edible sausage casing from fish viscera

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ABSTRACT

Fish viscera rich in protein components can be utilised for the preparation of sausage casing which will serve as a means of fish processing waste management. A study was conducted on preliminary screening and selection of fish viscera for sausage casing, comparison of the selected casing with goat casing and quality analysis of the sausage during storage at -21°C for 60 days. Viscera from *Saurida tumbil, Katsuwonus pelamis, Labeo rohita, Pangasius hypophthalmus* and *Scomberomorus guttatus* were collected and salt treated to improve quality. A standard recipe was followed for the preparation of sausage using meat of *S. tumbil*. Fish sausages were processed at 70°C for 15 min. Lizard fish gut was selected as best for sausage casing *via* sensory analysis and was compared with goat casing by texture profile analyser. There was significant difference in textural qualities except springiness and cohesiveness ($p<0.5\%$). The quality parameters like pH, peroxide value, free fatty acid, total volatile base nitrogen, trimethyl amine and total plate count were analysed. A gradual increase in all parameters was observed as storage proceeded but was within the acceptable limit except pH.

Keywords: Alternative casing, Fish processing, Fish sausage, Fish waste management

Fisheries sector in India has been one of the major contributors to foreign exchange earnings through export. The fish processing sector has transformed into a modern industry which is more competitive in the market of protein based value-added products and convenience food due to advances in technology and the development of sophisticated processing equipment. The most important value added products are battered and breaded products, surimi-based seafood products and precooked seafood products. Sausage is a popular processed meat product, traditionally consisting of chopped meat and spices which are stuffed into natural or artificial casings prior to cooking (Whiting and Miller, 1992). Fish sausage prepared from the mince of under-utilised fish or low cost fish would be able to serve consumers with a product that is good in taste and good nutrition profile at cheaper prices. Sausage casings are used to cover sausage products and protect them from UV light, microbial contamination and moisture loss in order to maintain quality and safety until they are consumed or repackaged (Feiner, 2006). Natural casings are obtained from the stomach, intestine and bladder of hogs, sheep and cattle (Harper *et al.,* 2012). Collagen, cellulose and plastic are some of the artificial casings used in the preparation of sausages. Collagen casings were developed as an alternative to natural casings because of numerous advantages in mechanical and physical properties compared to natural casings (Adzaly, 2014). However, the gas barrier and antimicrobial properties essential for enhancing the quality and safety of sausages are lacking in collagen casings. Cellulose casings are widely used in the sausage industry due to their strength and heat stability (Nicholson, 1991). Cellulose casings must be removed from the finished product after cooking as they are non-edible.

Sausage casings produced from fish viscera are advantageous in terms of low cost, easy availability, digestibility and reduced microflora which makes fish casings more acceptable than animal casings. Fish processing wastes comprises muscle cuts (15-20%), skin and fins (1-3%), bones (9-15%), heads (9-12%), viscera (12-18%) and scales (5%) (Martinez-Alvarez *et al.,* 2015). Though casings are produced synthetically and also naturally from animals, production of natural casings from fish viscera has not been attempted so far. In this backdrop, an attempt was made in screening of fish gut and air bladder as a source of edible sausage casing and process standardisation.

For the preparation of sausage casing, gut from lizard fish (*Saurida tumbil)*, skipjack tuna (*Katsuwonus pelamis),* bassa fish (*Pangasianodon hypophthalmus*) and spotted seerfish (*Scombromorous guttatus*) as well as air bladder from rohu (*Labeo rohita)* were chosen. Viscera from *S. tumbil*, *K. pelamis, P. hypophthalmus* and *S. guttatus* were collected from the nearby fish processing plants. *L. rohita* was procured from the nearby market. Viscera of all the fish were removed aseptically and washed in

running water 2 to 3 times followed by scraping of mucous layer using a sterile knife. The viscera were again washed in running water. The yield calculated for lizard fish, skipjack tuna, rohu, bassa fish and spotted seer fish were 13; 17; 12; 12 and 16% respectively. Cleaned casing was treated in 1, 2 and 3% salt solution at 4°C for 3 days prior to processing in order to reduce microorganisms present in the viscera (gut and air bladder). The best treatment in terms of lowest microbial load (total plate count) (USFDA, 2011) was selected. Selected treatment was examined for presence of *Vibrio cholerae, Escherichia coli, Salmonella* and *Staphylococcus aureus* (USFDA, 2011) for ensuring quality of casing prepared. Salted casings were desalted for 1 to 2 h prior to processing in chilled water. In order to improve the quality of fish casing, a temperature below 4°C was maintained during the preparation.

S. tumbil (length range 20 to 25 cm and weight range 250 to 300 g) procured from local market at Thoppumpadi, Kochi was brought to the laboratory in insulated container in iced condition and maintained at a temperature below 4°C. The method followed for the processing of fish sausage was as per George (2012) with minor modifications. The materials were ground into a paste using a silent cutter. The meat and the ingredients (refined wheat flour, cane sugar, table salt, refined vegetable oil, chopped onion, pepper powder, chilli powder, coriander powder, garlic paste, ginger paste and sodium tripolyphosphate) were weighed out according to the total paste requirement. Ice flakes in small amount was added intermittently during grinding for keeping the temperature below 4°C. The resulting paste was stuffed into fish gut casings using a sausage stuffer, sealed using twine and washed in chilled water. The net weight of sausage was 30-50 g with a diameter of 1-2 cm. Casings from bassa fish and spotted seerfish were too thin to be filled.

Sausages were developed using different heat treatments *viz*., 70, 80 and 90°C and a heat treatment of 70°C for 15 min was found to be optimum for sausage preparation. Sausages after preheating were cooled at room temperature and subjected to freezing in contact plate freezer at -35°C for a period of 90 min and cooled to room temperature. After freezing, the sausages were organoleptically tested by sensory analysis using 9 point hedonic scale. The scale had scores of 1 to 9 for the quality grade description of dislike extremely, dislike very much, dislike moderately, dislike slightly, like slightly, like moderately, like very much and like extremely respectively. For the sensory analysis, sausages prepared with different casings were cut into 1 to 2 cm length and flash fried. The frying temperature was between 180 to 200°C for 20 to 30 s. The casing which scored the best in sensory analysis was selected for quality analysis and storage study.

Animal (goat) casing was commercially purchased and it was filled with the prepared sausage. The sausage using animal casing was compared with that of fish casing employing a texture analyser (TA-XT Plus, Stable Micro Systems, UK).

Proximate analysis of the final product was done by standard methods (AOAC, 2005). Lizard fish sausage was stored at -21^{0}C for 60 days. Biochemical quality parameters like peroxide value (AOCS, 1989), free fatty acids (AOAC, 1975), trimethylamine (Conway, 1947), total volatile base nitrogen (Conway, 1947) and total plate count (TPC) (USFDA, 2011) were determined during storage at 6 days intervals. For pH analysis, sausage homogenate was prepared by blending 4 g of sausage with 40 ml of distilled water (AOAC, 1990). The pH of the resultant suspension was measured using a pH meter (Horiba, Japan).

Data was analysed statistically using Excel software and SPSS 20.0 (IBM Corp., NY) using one way ANOVA. Sensory score was analysed using the non-parametric Kruskal-Wallis test.

In order to reduce the microbial load, the viscera of different fish were salt treated in different concentrations. Though the microbial load decreased upon increase in salt concentration, the texture was also affected upon high salt concentration. So, 2% salt concentration was selected and this was examined for the presence of *V. cholerae, E. coli, Salmonella* and *S. aureus* for ensuring quality of casing prepared and was found to be within the prescribed limits (Table 1). Jan (2009) also studied about the antimicrobial properties of salt (NaCl) used for the preservation of natural animal sausage casings.

Sausages were prepared using different fish casings (Fig. 1a-c) following standard procedure with some modification in heat treatment from 90^{0}C for 1 to 2 h to 70°C for 15 min. During heating the proteins coagulate with water entrapment resulting in a cooked product with typical texture and elasticity (Verma, 2016). The fish casing is composed of collagen and excess heat lead to the conversion of collagen to gelatin which is a high viscous liquid there by resulting in loss of structure and breakage of the casing. Hence modification in heating time and temperature was used to maintain the structure of the sausage casing. The adopted temperature was 70^{0}C for 15 min which resulted in adhesion of the casing to the mince and resulted in appropriate structure of the casing over the sausage. Sausage from lizard fish with a sensory score of 9.0 was selected, while the score for sausage from skipjack tuna and rohu were only 6.0 and 7.0 respectively. Mechanical properties of casing such as

Table 1. Microbiological quality analysis of lizard fish casing

Name of microorganism	Observed count	Acceptable limit
Vibrio cholera	Absent per 25 g sample	Absent per 25 g sample
Salmonella sp.	Absent per 25 g sample	Absent per 25 g sample
Staphylococcus aureus	Less than 100 cfu g^{-1}	Less than 1000 cfu g^{-1}
Escherichia coli	Absent	Less than 10 coliforms g^{-1}

(a) (b) (c)

Fig. 1. Edible sausage casings from (a) *L. rohita;* (b) *K. pelamis*; (c) *S. tumbil*

tension strength, elasticity, temperature resistance and transparency are responsible for the structural integrity, size, shape, volumetric changes, texture and appearance of the finished product (Djordjevica *et al.,* 2015).

All the proximate constituents were analysed for the selected sausage and the results are given in Table 2. Similar results were reported by Jitesh *et al.* (2011) and Meena *et al.* (2015) in lizard fish and fish products respectively. Churi *et al.* (2016) and Huda (2012) also reported similar proximate constituents in fish sausage. Fish sausage in the present study had fat content comparatively lower than the fat content (14.3%) of chicken sausage (Jokanovic, 2014) indicating that fish sausage is healthier than traditional meat sausages, because of the long chain unsaturated fatty acids and protein of marine origin (Oliveira, 2014).

The textural quality attributes *viz*., hardness, adhesiveness, gumminess, chewiness and resilience showed significant difference ($p<0.05$). However, the parameters such as springiness and cohesiveness exhibited no significant difference ($p>0.05$) between lizard fish casing and goat casing.

The results of analyses of quality parameters of fish sausage are presented in Fig. 2a-f and that of sensory analysis is given in Table 3. An increasing trend was noticed for all parameters upon storage but within the acceptable limit except in the case of pH and sensory analysis, which was found to be reduced. A sensory score of 5 was taken as border line of acceptability**.** After 30 days, the fish sausage was organoleptically unacceptable which was mainly due to the texture which was also seen in texture analysis. There was significant difference ($p<0.05$) in all parameters as storage proceeded and after 54 days, the sensory acceptance was found to be low.

Although the fish used was lean, certain amount of oil was added to the paste which could be particularly responsible for the oxidation process. Raju *et al.* (2003) and Yousefi and Moosavi-Nasab (2014) also observed that peroxide values and free fatty acid values were increasing in threadfin bream fish on storage. Fuentes *et al*. (2011) and Verma (2016) in their studies noticed variations in

Table 2. Proximate constituents of lizard fish sausage

Proximate constituents	Content (%)
Moisture	72.15±0.30
Crude protein	20.48±0.04
Crude fat	5.38±0.02
Ash	1.77±0.10

Table 3. Sensory score of lizard fish sausage stored at -21°C as per Kruskal-Wallis test

Days of storage	No. of judges	Mean rank
0	10	90.50
6	10	87.05
12	10	82.75
18	10	73.35
24	10	54.30
30	10	63.15
36	10	48.50
42	10	22.55
48	10	22.55
54	10	28.25
60	10	22.55

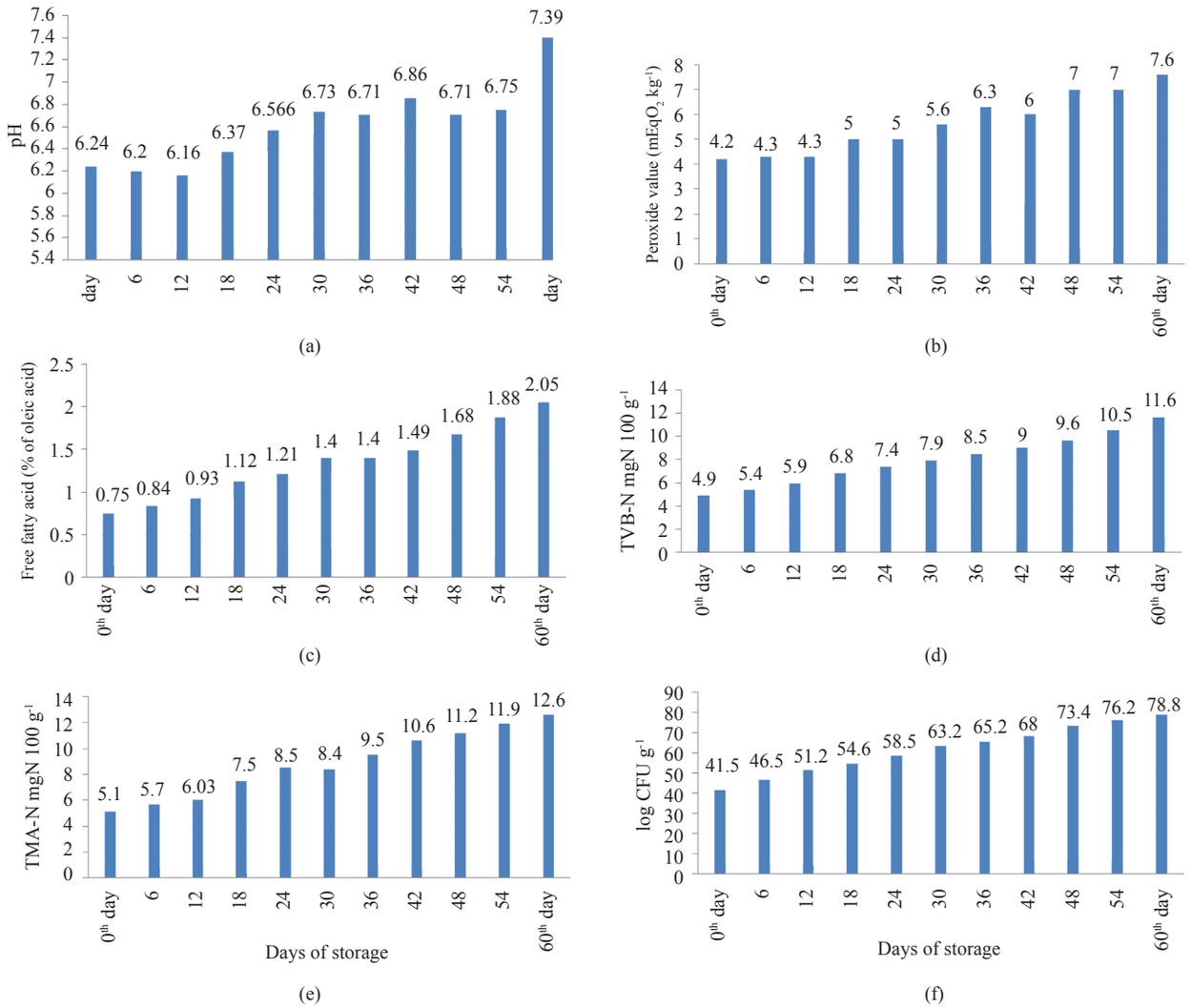

Fig. 2. Change in quality parameters of lizard fish sausage during different storage periods. (a) pH; (b) Peroxide value; (c) Free fatty acids; (d) Total volatile base nitrogen (TVBN); (e) Trimethyl amine (TMA); (f) Total plate count

TMA and TVBN values in smoked seabass and sausage prepared from Japanese threadfin bream during storage respectively. Hegde *et al.* (1990) observed a shelf life of 33 days for the cooked sausage prepared from croaker fish packed in PVC casing and stored under refrigeration and the shelf life of same preparation at room temperature (28±2°C) was three days. According to Churi *et al.* (2016) the shelf life of fresh fish sausage at ambient temperature (33±2°C) in natural sheep casing was one day and under frozen condition (-12±2°C) it may be extended up to 14 days. The shelf life of the sausage kept under frozen condition (-21°C) recorded acceptable values for peroxide value, free fatty acid, total volatile base nitrogen, tri-methyl amine and total plate count except pH and sensory acceptance up to 60 days.

According to Gheisari (2011) the maximum permissible counts for total bacteria and mould-yeast for sausage products according to the Iranian Standard Institute are 1×10^5 and 1×10^2 cfu g^{-1}, respectively. According to the EU directives also, the maximum permissible counts for total bacteria and mould-yeast for sausage products are 1×10^5 and 1×10^2 cfu g^{-1} respectively. Verma (2016) indicated that the TPC values increased and fungal count was nil during storage. TPC at the beginning of storage was 41.5 x 10^2 cfu g^{-1} and it increased to 78.8 x 10^{-2} cfu g^{-1} at the end of storage.

It can be concluded that the casing from fish viscera could serve as an alternative to artificial and natural animal casing as well as serve as a tool for fish waste management.

Proper utilisation of fish processing waste can make a major contribution in minimising loss of valuable protein (Gopal, 2018). However, future studies regarding the preparation of casing from different species of fishes have to be conducted to find out suitable and identical casing in terms of length and width. Among the different fish viscera taken for the study, lizard fish viscera due to its consumer acceptability and mechanical properties could be used as a good choice for the development of sausage casing. Moreover, additives or other methods could be used to improve the textural and keeping quality of the product. The application of different heat treatments also needs to be studied to find out the best heat treatment to increase shelf life of the sausage.

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