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RESEARCH ARTICLE

STUDIES ON IMPROVEMENT IN SENSORY QUALITY AND ACCEPTABILITY OF FROZEN SQUID (*SEPIOTEUTHIS LESSONIANA*) UPON TREATMENT WITH IMPORTED CHEMICALS

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ABSTRACT

Cephalopods (including squids) are rapidly perishable like fishes and crustaceans and require some treatment to maintain the quality for export. However the information on the effectiveness of chemicals being used in the industry is limited. Keeping this in mind, an attempt was made to study the improvement in sensory quality of frozen squid (*Sepioteuthis lessoniana*) upon the treatment with the imported food grade chemicals (Hidratech_4A and Whitech_3). The sensory quality of squids was evaluated for flavour, odour, appearance, texture and overall acceptability. Samples were tested after pre-processing, treatments and freezing and during storage at monthly intervals for 7 months. Sensory scores revealed a better quality of treated samples than control. Scores favoured the application of freshwater than saltwater in maintaining the sensory quality.

INTRODUCTION

The production and trade of cephalopods are in increasing trend during the recent years. Squids, cuttlefishes and octopuses constitute important species, yielding 4 million tonnes in 2012 worldwide (FAO, 2014). In the same year, Indian landings of squids were 92,241 tonnes. Squid constituted 25 % of cephalopod (22,639 tonnes) catch in Tamilnadu. Along Tuticorin coast, *Sepioteuthis lessoniana* (Lesson, 1830) was dominant (64%) (CMFRI, 2013). Furthermore, squid contributed significantly to the Indian seafood export basket. Export of frozen squid from India contributed a share of 9.93%, 6.28% and 6.16% in terms of quantity, rupees value and US $ value respectively and was increased by 21.02%, 27.55% and 12.60% compared to 2012 million (MPEDA, 2014). Freezing is the most important method of preservation of squid (Kreuzer, 1984) and frozen storage is the only large scale preservation method that facilitates exports (Makri, 2009). However, protein denaturation, fat oxidation and desiccation during cold storage can lower product quality (Kreuzer, 1984) and the squid products are likely to produce various off-odour during refrigerated and frozen storage (Gou *et al*., 2010).

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The yellow discoloration of the tubes and fillets is another important problem in frozen squid (Hassan, 2011; Kumar, 2011). However, high quality products are required for export market. For the measurement of quality in squid, analysis of sensory quality is useful (LeBlanc and Gill, 1984). The quality standard (IS 8076) of frozen squid established by Indian Standards Institution (BIS, 2000) also emphasizes improvement in sensory quality (Mohanan, 2004). Several studies have been reported on various aspects of the application of food additives and preservatives (Khan, 2003; Mohanan, 2004; Agrafioti and Katsanidis, 2012 and Benjakul *et al*., 2012). However the study on the application of imported food grade chemicals in improving the sensory quality of frozen squid is scanty. Therefore, in the present study, an effort was made to analyse the improvement in sensory quality of frozen squid upon treatment with imported chemicals.

MATERIALS AND METHODS

Palk Bay Squid or Bigfin Reef Squid (*Sepioteuthis lessoniana*) procured from Thoothukudi fishing harbour was used in the present study. A total of 25 kg squid (average size 450 g. each) placed in ice with a squid/ice ratio of 1:1 (w/w) was transported to processing hall of the shore laboratory campus of Fisheries College & Research Institute, Thoothukudi within 1h. Crushed block ice was used during the procurement and transportation.

Raw squid (25 kg) was pre-processed (de-skinned, gutted and ink sac, viscera, tentacles and squid pen removed) into tubes (8.5 kg) and was divided into three lots of equal weight. First lot was treated with Hidratech_4A (0.4 %), Whitech_3 (0.25%), common salt (2%) in 3.6 litre of freshwater (chlorinated to <2 ppm level of available chlorine) and 2.4 kg of ice. It was stirred for 20 minutes and then maintained at 4±1^{o} C for 20h with intermittent stirring (5 min.) for every 2h. Second lot was treated similarly but in saltwater (2 ppt saline). The third lot was kept as control in ice for 20h without any chemical treatment. Good quality flake ice (Ziegra flake ice maker, Germany) was added to lower the temperature.Squid was wrapped in LDPE films (225 micron thick) and was frozen in horizontal contact plate freezer in commercial condition (-40ºC, 90 min.) at an EU approved seafood freezing plant (M/s. Edhyam Frozen Foods Pvt. Ltd., Thoothukudi). Subsequently, it was stored in deep freezer (Blue Star, India) maintained at -20±1ºC.

Imported food grade chemicals (trade name - Hidratech_4A and Whitech_3) from M/s. Fishandtech Laboratory, Barcelona, Spain, being used in the industry, were used for the treatment of samples. Hidratech_4A (powder) is composed of sodium tripolyphosphate (STPP), potassium carbonate and salt. The chemical component of Whitech_3 (liquid) includes water, citric acid, phosphoric acid and ozone water. The chemicals had no limitation other than Good Manufacturing Practices (GMP) (ECFR, 2014). Samples were tested after pre-processing, treatments, freezing and during storage at monthly intervals for 7 months. Sensory analysis of squid was performed by a panel of six experts on a 10-point scale (Woyewoda and Ke, 1979).

The sensory attributes for the organoleptic evaluation included flavour, odour, appearance, texture and overall acceptability. Overall acceptability was the mean of scores of all the sensory attributes. The mean panel score for each attribute was calculated and recorded. Table for quality and acceptability was obtained with modification from Selvaraj *et al*. (1991) and Howgate (1978) for their corresponding organoleptic scores. Experiments were carried out in triplicate. Two way Analysis of Variance (ANOVA) was followed (Snedecor and Cochran, 1962). ANOVA was performed using standard statistical package (SPSS 20.0) and the significance of difference was defined at P<0.01.

RESULTS AND DISCUSSION

Raw material showed slightly lower (9.50±0.10) score for appearance when compared with other attributes (10.0±0.00). Overall acceptability was 9.88±0.00.

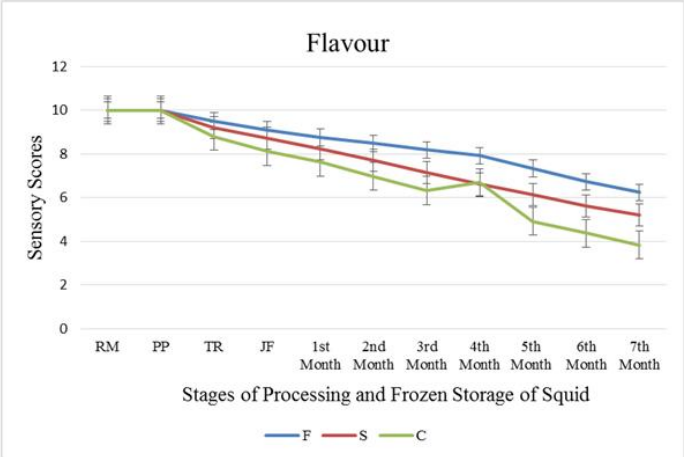
Table. Quality and acceptability for the corresponding organoleptic scores

Organoleptic Scores	Quality	Acceptability
10-9	Excellent	Highly acceptable
8-7	Good	Acceptable
6-5	Fair and acceptable	Poorly Acceptable
4-3	Poor	Unacceptable
2-1	Very poor.	Unacceptable

After all, raw material showed the excellent quality with high acceptability. The results were similar with the findings of Lakshmanan *et al*. (1993). Sensory score of pre-processed squid was higher (10.0±0.00) than raw squid (9.50±0.10) for appearance. It indicated the improvement in appearance of raw material upon pre-processing. Further, Warrier *et al*. (1975) reported the maintenance of good quality during frozen storage upon pre-treatment in sodium chloride or sodium tripolyphosphate.

In unison with the above finding, the chemicals treatment in the present study also improved the overall quality, acceptability and shelf life of squid compared to the control. Similar extended shelf life of additional 4 weeks was documented by Joseph *et al*. (1977). There was a decreasing order of sensory scores for flavour (Fig. 1), odour (Fig. 2) and appearance (Fig. 3) of treated squid in freshwater, saltwater and control. Better quality of treated samples than control could be attributed to the preservative effect of chemicals. However, lower sensory score of flavour, odour and appearance for treated samples in saltwater could be due to interference of chemical components in saltwater with the chemicals. The texture (Fig. 4) of treated squid in saltwater showed a highest sensory score (9.70±0.17) than that of control and treated squid in freshwater. This can be attributed to the role of salt in saltwater in maintaining the texture. Agrafioti and Katsanidis (2012), however, found the citric acid to increase toughness.

Fig. 1. Changes in flavour during stages of processing and frozen storage of squid



(RM= Raw material, PP= Pre-processed, TR= Treated, JF= Just Frozen)

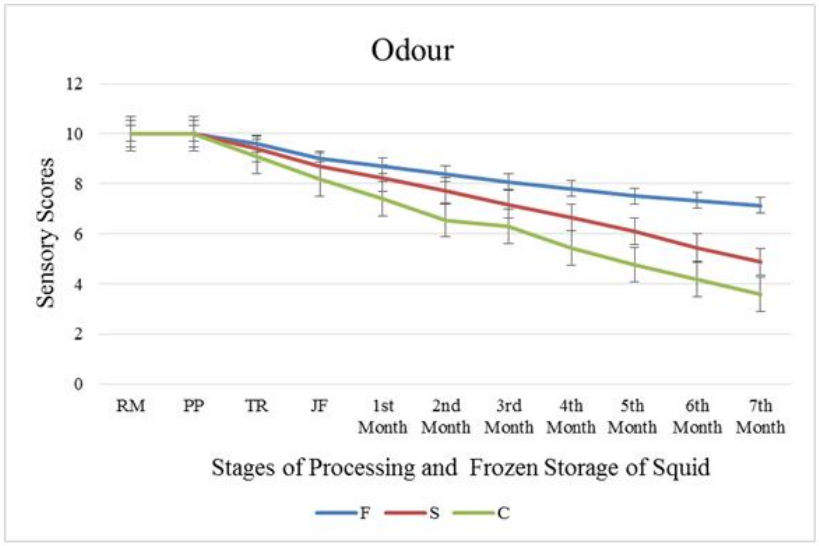


Fig. 2. Changes in odour during stages of processing and frozen storage of squid

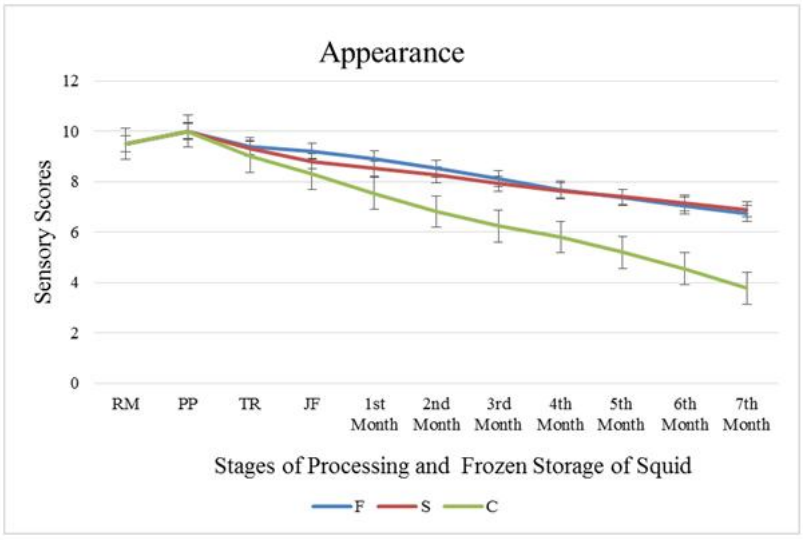


Fig. 3. Changes in appearance during stages of processing and frozen storage of squid

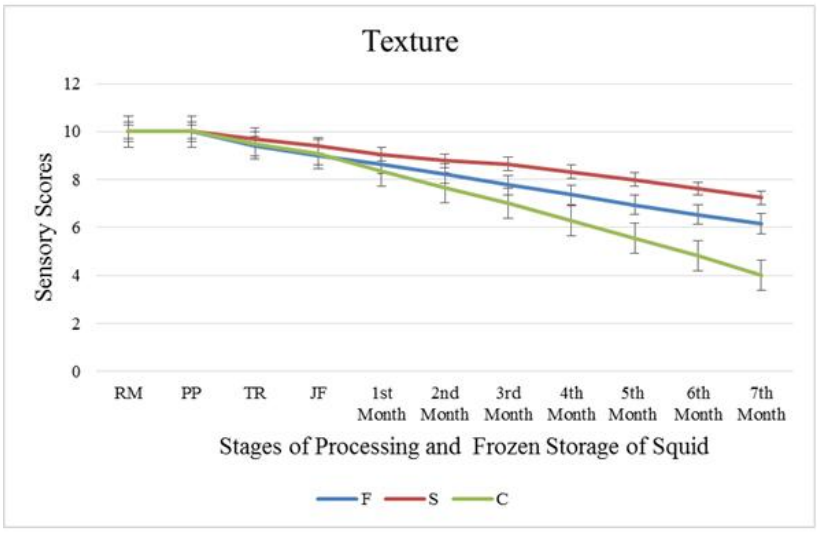


Fig. 4. Changes in texture during stages of processing and frozen storage of squid

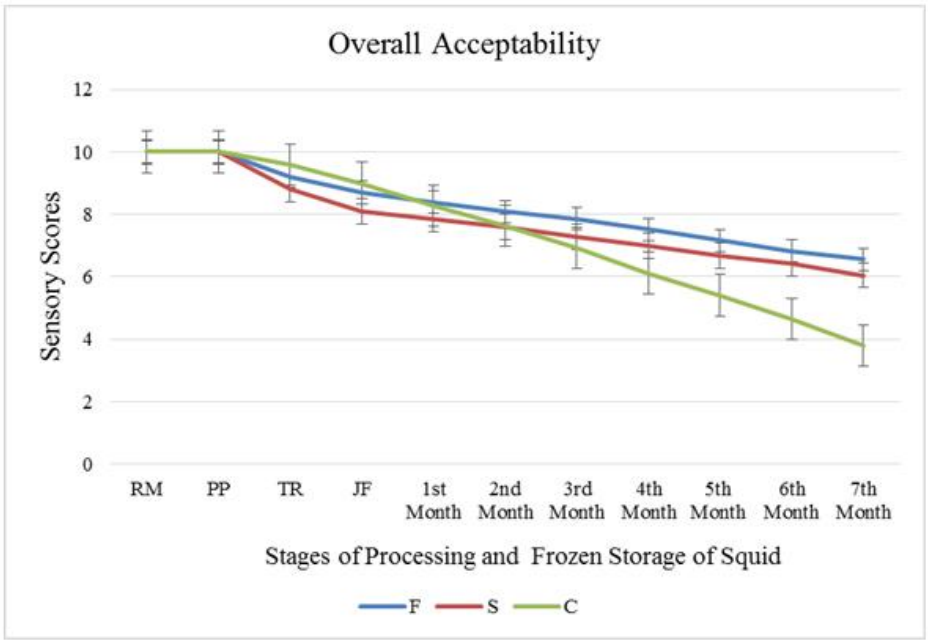


Fig. 5. Changes in overall acceptability during stages of processing and frozen storage of squid

The overall acceptability (Fig. 5) showed a decreasing score of samples treated in freshwater, saltwater and control, respectively. It indicated the role of chemicals in preserving the sensory quality. The result was similar with that reported by Selvaraj *et al*. (1991) for ascorbic acid treated samples. Overall acceptability remains higher for just frozen squid treated in freshwater followed by saltwater and control. There were significant ($P<0.01$) decrease in sensory scores of all the attributes after freezing, in accordance with the findings of Moral *et al*. (1983). The analysis of the sensory scores of frozen stored squid, in the present study, indicated the decreasing trend of all the sensory attributes including overall acceptability. At the end of 7th month of frozen storage, control was unacceptable for all the attributes except texture that just touched the score for the limit of acceptability i.e. 4.00±0.00. Scores remained within acceptable limit for all other sensory attributes. Thereby, it indicated the improvement in overall quality, acceptability and shelf life of squid upon chemicals treatment. The result was similar to that reported by Selvaraj *et al*. (1991), who reported that the treated samples were acceptable after 9 months storage unlike the control which was acceptable up to 6 months only. Result was also in line with that of Joseph *et al*. (1977) for treatment with salt and polyphosphate.

Changes in sensory quality during frozen storage

There was significant ($P<0.01$) changes in sensory quality during frozen storage. For flavour, the study reported the reduction in sensory scores from 10.0±0.00 (raw material) to 6.23±0.03, 5.19±0.01 and 3.83±0.00 (at the end of 7th month) in frozen stored squid treated in freshwater, saltwater and for control respectively. There was a significant difference ($P<0.01$) in flavour of squid between treatments and the months of frozen storage.

The flavour was unacceptable for control sample at the end of 7th month of frozen storage. Moreover, frozen stored squid treated in freshwater and saltwater samples, were though poor but acceptable. Squid was excellent and highly acceptable till 3rd month for frozen stored squid treated in freshwater, 1st month for squid treated in saltwater and just frozen for control.

Quality was good and acceptable for frozen stored squid treated in freshwater, saltwater and control till the end of 7th month, 5th month and 3rd month of storage respectively. It remained fair and acceptable at the end of 7th month, 6th month of frozen storage for saltwater treated squid and control respectively. Similar findings were reported by Mohanan (2004) and Borderias (1982) in squid. There was significant difference ($P<0.01$) in odour of squid between treatments and months of frozen storage. The study reports the reduction in sensory scores for odour in frozen squid treated in freshwater, saltwater and control at the end of 7th month. Quality was good and acceptable for frozen squid treated in freshwater, saltwater and control till the end of 7th month, 5th month and 3rd month of frozen storage respectively. Similar impact of pre-process and on process intervention by external inputs on the quality of frozen stored squids was also reported by Moral *et al*. (1983).

Conclusion

Evaluation of sensory quality revealed marked variation between treatments and the months of storage. Upon storage, the overall sensory scores decreased significantly ($P<0.01$) for all samples. Chemicals were effective in preserving the quality with the progression of storage, especially in samples treated in fresh water, as revealed by better score compared to control. The overall sensory scores revealed better acceptability of treated samples than control.

Therefore it was concluded that there was an overall improvement in sensory quality and acceptability of frozen squid upon the treatment of chemicals, Hidratech_4A and Whitech_3.

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