Sabaragamuwa University Journal
Volume 13 Number 1; May 2014, pp 57-64
ISSN 1391-3166

Development of New Processed Mussel Product Using Local Mussel Species (*Perna viridis*)

M. C. N. Jayasooriya[1], Vigith S Jayamanne[2] and M.T.N Ranathunge[3]

[1]Dept. of Food Science & Technology (MFST), Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. *niroshanmcn@gmail.com*
[2] Faculty of Agriculture, University of Ruhuna, Kamburupitiya.

Abstract

Perna species (Perna perna and Perna viridis) are commonly found edible mussel species around the margin of territorial sea of Sri Lanka It is seasonal seafood available only in few months per year have being experimentally cultured not commercialized as a processed mussel product yet. In this research, three mussels products (321, 654 and 987) were developed only vary with added citric acid amount (3g, 4g and 5g) and organoleptic properties of three citric acid treated bottle mussel products were investigated; nutritional and shelf-life were determined only for best product. Mussels (Perna viridis) harvesting was done in consecutive three days; extracted mussel flesh was stored under -10 0C. The processed product is having net weight of 115 g of cooked mussel and 85 mL of brine solution. Hot filling was done in all the time and stored in the room temperature. Semi trained 30 sensory panelist were used to determine the organoleptic qualities of the products subjectively and the best product was selected through Friedman non-parametric test. The color and texture sensory attributes were shown only the significant different ($P<0.05$) such as 0.001 and 0.035 respectively; sensory attributes such as appearance, odor, taste, after taste and overall acceptability have received to the P values which may higher than to the 0.05 significant levels ($P > 0.05$) such as 0.093, 0.152, 0.099, 0.850 and 0.106 respectively. The product 654 has received the highest sum of rank in all the time and considered as the best product. It having 6 months of expected shelf-life; no quality defects recorded until 20th week of shelf-life and having 73.70%, 16.65% and 2.60% of moisture, crude-protein and crude-fat percentages respectively.

Key words: Mussels Product, Citric acid, P value, Shelf-life

Introduction

Sri Lanka is an island, located in the Indian ocean on the southeast of India, between 5°55'and 9°51' N latitude, and 79°41' and 81°53' E longitude. Its area is approximately 65,000 km2 and having 1,620 km costal line (Joseph, 2008) *Perna* species are commonly found edible mussel species around the

margin of territorial sea of the country, among the *Perna* species *Perna perna* and *Perna viridis* are more common. These mussels are less salinity tolerated; *Perna viridis* is a commonly found in North-West cost from Negambo to Mannar and Southern cost area especially from Galle to Panadura. *Perna perna* is commonly found in eastern coast of the country. There are more than 100,000 species under the phylum Mollusca generally about 90,000 named living species and 70,000 fossil species (Gosling, 2003). *Perna* species have being experimentally cultured in the country but not commercialized yet as a value added processed mussel product. The formulation of new mussel product will facilitate to expand the shelf life, increase the market availability throughout the year, product differentiation, and marketing of consumer convenient product. It will be facilitated to implementation of better income generation by selling processed product than selling of raw product.

At present more than 95% of mussels or mussel products imported from India and other southeast countries to fulfill the demand of local and foreign consumers (NARA, 2012). The FAO 2010 year book has shown that the decline of world mussel production in both global capture production and aquaculture production during last 5 years. Generally, mussel has being harvested by fishermen in off season of the year and sell as a raw product, not be a processed product. This research finding is facilitated to identify the feasibility use of basic food preservation techniques to increase the shelf-life of consumer convenience ready to eat bottled mussel product.

Methodology

Mussel harvesting

Mussels were harvested during the early morning (0700 – 0900 hr) with low tidal wave at sea side (6°18'N and 80° 'E) of the Ahungalle town, located in Southern province of Sri Lanka. Harvesting was repeated in consecutive three days; 4.5 cm – 6 cm size mussels were sorted and rest of small mussel replaced again in the shallow water rocky side of the sea. All the dirty materials adhered to the shell were removed and washing was carried out by using filtered sea water that conformed free from possible microbial, chemical and physical hazards (Codex Alimentarius, 1993).

Extraction of fresh mussel meat

Removed all damaged mussel and the mussel which had been having opened shell when tap to the shell. Then detached the byssus manually and washed the mussels using portable water; dipped in the boiling (100 0C) water as a batch of 350 mussels per time. Boiling was continuing to 20 min – 25 min until mussel shell was opened. Then remove the unopened mussels;

rests of mussels were washed using chilled water and extracted the cooked mussel meat. The extracted mussel meat packed in numbered freezer bags and subjected to frozen storage (< -10 0C) in refrigerator immediately. Same procedure repeated at every time of mussel meat extraction from the fresh mussels.

Preparation of mussel products

Three cooked bottled mussel products were developed according to the following three recipes (Table 1) and name them as 321, 654 and 987 and spice mixture was prepared by according to the recipe (Table 2). All the products were prepared according to the SLS guidelines and fulfilled the codex alimentarius guideline for fish and fishery products and hygienic practice for the low acidic and acidified low acidic canned food. Prepared bottled mussel products were subjected to sensory evaluation by using 30 none trained sensory panelist; results collected through the nine point hedonic scale sensory ballet sheet.

Table 1 Three recipes use to preparation of ready to eat cooked bottled mussels products

Ingredients	Units	Sample 321	Sample 654	Sample 987
Eviscerated mussels	g	115	115	115
Table Salt (powder form)	g	5	5	5
Coconut vinegar	ml	5	5	5
Treated Garcinia	g	2	2	2
Blend spice mixture	g	1	1	1
SMS	g	0.75	0.75	0.75
Citric acid	g	3	4	5
Brine solution	ml	85	85	85

Table 2 Blend spice mixture recipe

Ingredients	Unit	Amounts
Cinnamon (Elba)	g	25
Cardamom (Lanka Green)	g	15
Cloves (Grade 1)	g	2
Nutmeg (Grade 1)	g	2
Herbs (oven dry)	g	6

The frozen pre-cooked mussels were subjected to thawing; dipped the frozen product in hot water (80^0C) for 10 min. Prepared the brine solution according to the three recipes given in the table 1; ingredients were mixed well with boiling water for 5 minutes then filtered to got clear brine solution. The 115g (±5 g) of thawed pre-cooked mussels were packed into sterilized 200 mL bottles and filling the remaining space by using prepared brine solution up to neck of the bottle; nearly 80ml of brine was needed. Then closed the bottled by using pre-sterilized lid (not tightly closed) and subjected to wet steam sterilization in pressure cooker (Mitshu, SK 6L model, China) for 1hr under 110 0C. Exhausting of the taped air in the mussel bottle was taken place during the wet sterilization; lids were again tightly closed at the end. The ten mussel bottles were prepared for each formula and named the samples according to its recipes.

Sensory evaluation

Evaluation was carried out to select the best mussel products out of three products based on subjectively through sensory attributes such as Appearance, Color, Texture, Odour, Taste, after taste and Overall acceptability. It was evaluated by 30 untrained sensory panelists; perception of the three products (321, 654 and 987) was evaluated using nine point hedonic scale and collected data were statistically analyzed using MINITAB-16 statistical analysis package according to the Freedman nonparametric test at 5% level of significance. The best product was only subjected to further analysis.

Proximate analysis of best product

The total moisture percentage, crud protein percentage and crud fat percentage were measured according to the AOAC procedures described in AOAC 985.14, AOAC 955.04, and AOAC 960.39 respectively (Neilson, 2003). The pH of the samples was measured by a calibrated electronic pH meter (CT6020-A model, Shenzhen kedida Eletcronic Co. Ltd, China).

Shelf-life evaluation

Shelf life evaluation was done only with the selected best sample, through a continuous assessment method. The sample was examined for any gas formation, discoloration, pH changes, Total plate count (AOAC 966.23) and Coli-form (AOAC 966.24) detection for three months of storage period under room temperature with controller with sterilized distilled water on behalf of sample. It was done with dilution series starting from 100 to 10-5; each having five replicate.

Results And Discussion

Formulated three "Mussel" products appeared with uniformed consistency free from any undesirable colour development or any sedimentation in the bottom of the bottle.

Sensory evaluation

Sensory evaluation data obtained through the nine point Hedonoic evaluation assessment, revealed that there were significant difference in color (P=0.0010) and texture (P=0.0350) by receiving P values less than to α significant level ($P<0.05$) among the three "*Mussel*" products. However, there were no significant different in the other sensory attributes such as appearance (P=0.0930), odour (P=0.1520), taste (P=0.0990), after taste (P=0.8500) and overall acceptability (P=0.1060) among the samples by receiving the P values higher than to α significant level ($P>0.05$). The sample code 654 gained the highest sum of rank for the all the sensory attributes (Table 3); therefore code 654 was selected as the best sample for further studies.

Table 3 Sensory attributes of the *bottled mussel* samples

Sensory attributes	P values	Sum of ranks			Best bottled mussel product
		321	654	987	
Appearance	0.093	53.5	64.5	56.0	654
Color	0.001	52.5	70.5	51.0	654
Texture	0.035	52.0	66.0	56.0	654
Odour	0.152	53.0	63.0	57.0	654
Taste	0.099	52.0	66.0	56.0	654
After taste	0.850	57.5	60.0	56.5	654
Overall acceptability	0.106	54.5	66.0	53.5	654

Proximate analysis results of the best sample (code 654)

The best mussel product was recorded the 73.70%, 16.65% and 2.6% of average moisture percentage, crude protein percentage and crude fat percentage respectively. The product remained 4.32 pH at the three months of shelf-life.

Shelf-life

The sample was not shown any bulging of bottle lid, internal mould growth and any other sensory quality changes and microbiological aspects such as total plate count was not exceeded to the maximum limit as 5 X 105cfu/g

mention in the SLS standard and Coli-forms gave the negative results during the shelf-life period.

DISCUSSION

The high moisture content has recorded as 73.70% of average moisture percentage. It is nearly 10% higher than to the moisture percentage of moist heated blue mussel nearly 61.15% (US National Nutrient Database, 2012) and 76% - 84% of moisture percentage was recorded by the Asian hard clams of *Meretrix lusoria* (Karnjanapratum, *et al., 2013)*. *It* was containing 16.65% of average crude protein percentage. Therefore, prepared product has recorded less crude protein percentage than moist heated blue mussels recorded 23% of crude protein percentage (US National Nutrient Database, 2012), 20.5% of protein percentage was recorded in *Perna perna* mussel cultivated in Ubatuba, Sao-Paulo state in brazil (Tavaras, *et al., 1998) and 9% - 12.75% of crude protein level recorded by the Asian hard clams of Meretrix lusoria in* coast of Andaman Sea (Karnjanapratum, *et al., 2013)*. The reasons for recorded less protein percentage of product was explained as, denatured of the protein due to two times heat application, thawing before bottling and low pH level of the brine solution. The best product has recorded less fat percentage as 2.6% of average crude fat percentage than to fat percentage of moist heated blue mussels recorded as 4.48% of crude fat percentage (US National Nutrient Database, 2012), 3.24% of crude fat percentage was recorded in *Perna perna* mussel cultivated in Ubatuba, Sao-Paulo state in Brazil (Tavaras *et al., 1998) and 1.58% - 6.58% of crude fat percentage recorded by the Asian hard clams of Meretrix lusoria* (Karnjanapratum *et al., 2013)*. It having average 4.32 pH value which was complied with the codex alimentations hygienic requirement for the low acidic and acidified low acidic canned food (CAC/RCP 23-1979) and SLS standards for Molluscus and Shell fish product (SLS 1004:1993); the total plate count was not exceeded to the maximum limit as 5 X 105cfu/g mention in the SLS standard and coli-forms were almost negative. Mussel is one of seasonal sea food in Sri Lanka which has gained less attention as a commercial sea food such as tuna or shrimp. The high amounts of postharvest losses have been seen due to use of traditional harvesting technique and production depending with the natural mussel beds in the continental shelf of the country. The raw mussel flesh is better to stored under frozen condition to minimize the lipid oxidation. The Citric acid and less amount of sodium-metabisulphite were only added to the product as preservatives; has facilitated to preserve its original organoleptic properties as it is in fresh; The remaining shell recorded more than 90% of CaCO3 (Rosa, *et al., 2012)* can be utilized as a calcium supplement for animal ration formation especially in poultry feeds. This innovation proposes to use of hurdle technology to extend the shelf-life of the cooked mussel products as a ready to eat sea food although traditional cottage cooked mussel product having 24hr of shelf-life.

Conclusion

Flesh of raw mussels can be heat treated and utilized to produce ready to eat value added bottled mussel product. It has recorded 73.70%, 16.65% and 2.6% of average moisture, crud protein and crud fat percentage respectively. The product can be stored in room temperature; having six months of expected shelf-life. The mussel can be heat processed with minimum changes of its nutritional and organoleptic properties by use of Citric acid as a preservative. The manufacturing cost for 200mL bottle is around Rs 130.50 (0.90 USD).

References

Association of official analytical chemist (1980) Official Methods of Analysis Washinton DC 20044; Association of official analytical chemist. pp285-306.

Codex Alimentarius International Food Standards (1993) The codex of hygienic practice for the low acidic and acidified low acidic canned food (CAC/RCP 23-1979), H-1581 Budapest, Hungary, Food & Agriculture Organization and World Health organization.

Codex Alimentarius International Food Standards (2012) the code of practice for fish and fishery products, (CAC/RCP 52- 2003) H-1581 Budapest, Hungary, Food & Agriculture Organization and World Health organization.

Gosling. E., (2003) Bivalve Molluscs: Biology, Ecology and Culture, pp 7-80, Oxford, UK, Blackwell Publishing Ltd. pp 7-80.

Food & Agriculture Organization (2012) Fisheries and Aquaculture Statistics -2010, Rome, Food and Agriculture Organization of the United Nation.

Karnjanapratum, S., Benjakul, S., Kishimura, H., and Tsai, Y., (2013).Chemical compositions and nutritional value of Asian hard clam (Meretrix lusoria) from the coast of Andaman Sea. Journal of Food chemistry, 141(4), pp 4138-4145.

Leslie Joseph (2008) National Report of Sri Lanka on the formulation of a Transboundary Diagnostic Analysis and Strategic Action Plan for the Bay of Bengal Large Marine Ecosystem Programme.

Liu J.H, Kueh C.S.W (2005) Biomonitoring of heavy metals and trace organics using the intertidal mussel Perna viridis in Hong Kong coastal waters, Journal of Marine Pollution Bulletin, (Volume 51, Issues 8–12); pp 857-875.

National Aquatic Resources Research and Development Agency, (2012). Fisheries outlook, Colombo, National Aquatic Resources Research and Development Agency.

Mussel Industry Council of North America (2010) Nutritional breakdown of Fresh Blue Cultured Mussels grown in Atlantic Canada, Mussel Industry Council of North America.

National Aquatic Resources Research and Development Agency (2011) Fisheries outlook, Colombo, National Aquatic Resources Research and Development Agency.

Nielson, S.S (2003), Food Analysis.3rd ed. Indiana: Purude University press.

Rosa, M.R., Balzer, P.S., and Becker, D., (2012) Characterization of Calcium carbonate obtained from oyster and mussel shell and incorporation in polypropylene. Journal of material research, 15(2), pp 204-208.

Sri Lanka Standard Institute on SLS Standards for code of hygienic practices for molluscan and shellfish, 1993 (Cmnd). Colombo: Sri Lanka Standard Institute.

Tavares, M., Amaral mello, M.R.P., Campos, N.C., Morais, C., and Ostini, S., (1998) Proximate composition and caloric value of the mussel *Perna perna*, cultivated in Ubatuba, São Paulo State, Brazi. Journal of food chemistry, 64(40), pp. 473- 475.

U S Agriculture research Service of National Agricultural Library, (2012) National Nutrient Database for Standard Reference, (Nutrient data for 15165, Mollusks, mussel, blue, cooked, moist heat). Beltsville MD, U S National Agricultural Library.