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Effect of Vacuum Packaging on the Shelf life of Fried Mussel, *Perna viridis* (Linnaeus) in Flexible Packaging Material

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A method for preservation of fried mussel, *Perna viridis* (Linnaeus) at ambient temperature was developed. Live mussels from rocky structures of the North Kerala waters were collected, and the meat shucked from them was used for preparation of samples. The cleaned meat was deep-fried in refined vegetable oil at 170-180°C for 6 minutes in an electric fryer. Roasted condiments were added to fried mussel meat and was packed under vacuum and in air in flexible pouches made of 12 µ plain polyester laminated with 118 µ LD-HD co-extruded films. The samples packed under vacuum had a storage life of 9 months and those packed in air were acceptable for a period of 6 months.

Key words : Fried mussel, vacuum packaging, storage

Seafood scenario the world over is witnessing vast changes. Present market trends are indicative of extensive growth in demand for ready-to-cook or ready- to- serve 'convenience' products processed out of a variety of fish and shellfish. Increase in expendable family income, increase in number of working women, awareness of the different types of convenience products, and overall improvement in standards of living have contributed to this change. Value addition and diversification of products have been identified as the need of the day. Technology upgradation and value addition have been instrumental in processing several products from shellfish and successfully marketing them in overseas countries and in urban domestic markets.

Green mussel *Perna viridis* is an important item of food for the people of North Kerala. It is found in abundance along the rocky coastal belt. Normally the local population consumes mussel in fresh condition. Mussels are also exported to different countries in chilled and frozen condition.

Different types of products have been developed from mussel meat. However only very few mussel products are available in the consumer market. Hence attempts were made to develop a condiment incorporated, ready-to-serve fried mussel product packed under vacuum for domestic and export market. This product is easy to prepare, has a good shelf life, can be stored at room temperature and is very convenient for use.

Materials and Methods

Live mussels collected from their natural beds in Thikkoti (Kozhikode Dt.) were transported to the CIFT laboratory in Cochin. The mussels were washed thoroughly in potable water chlorinated to a level of 5 ppm. The meat was shucked after heating in an open vessel. The shucked meat was cleaned free of guts, washed and thoroughly drained. It was then fried in refined groundnut oil at 170°-180° C in an electric fryer for about 6 minutes. The fried mussel was then allowed to cool to room temperature and mixed with the ingredients.

Ingredients added to the meat (in % of meat weight)

Chilly Powder	3.0
Turmeric Powder	0.2
Refined Salt	2.0
Pepper Powder	0.2
Ascorbic Acid	0.1

The ingredients except ascorbic acid were mixed and roasted in a hot pan for 2 min. It was then cooled and mixed with ascorbic acid. This mixture was applied evenly on fried mussel meat and kept overnight for equilibration of moisture. About 100 g each of the fried meat was then packed hygienically in 12 μ plain polyester laminated with 118 μ LD-HD co-extruded pouches of the size (15cm x 12cm). Samples were divided into two portions. One portion was packed under vacuum and the other portion packed in air to serve as control. The packed samples were stored at ambient temperature. Moisture, fat, protein and ash content of the samples were estimated according to AOAC (1984). Carbohydrate was estimated by the method of Umbreit *et al* (1959). Microbiological parameters viz. total plate count, coagulase positive *Staphylococci* and faecal *Streptococci* were determined using standard methods (APHA, 1980). Total volatile base nitrogen (TVBN) content of the samples was estimated by the micro diffusion method of Conway (1947), Thiobarbituric acid value (TBA) was estimated by the method of Tarladgis *et al*, (1960).

Sensory evaluations were carried out by a trained taste panel and the scoring was done using a 10 point hedonic scale, 10 being very good, 0 being bad and 4 being just unacceptable taking into consideration the changes in appearance, colour, odour and flavour of the samples. The humidity-moisture relationship was studied at room temperature (27-30 °C) by exposing weighed quantities of the sample to different relative humidity ranging from 11% to 92% in desiccators using appropriate salt solutions (Kumar *et al.*, 1974). Testing of packaging materials for contact application was determined as per IS: 9845 (1981) and FDA (1983), water vapour transmission rate as per IS: 1060 Part II (1960) and Oxygen transmission rate as per ASTM (1975). A tensile strength tester was used to determine the heat seal strength as per ASTM (1973). Tensile strength and elongation at break in machine and cross directions were determined as per IS: 2508 (1984). Texture profile analyses of fried mussel was done by using the food texture analyser of Lloyd Instruments, U.K. Model LRX plus, with software Nexgen. Parameters like hardness1 and hardness1 (peak of the two curves), cohesiveness (area of curve 2/ area of curve 1) gumminess (average hardness x cohesiveness) chewiness (gumminess x springeness) were calculated by using the software programme.

Results and Discussion

Shucked mussel meat contained 76.69% moisture, 2.57% fat, 12.55% protein, 4.6% carbohydrate and 2.06% ash. Earlier trial experiments had shown that frying the mussel meat for 6 minutes at 170°-180° C produced optimum colour, flavour and texture in the product The proximate composition of the fried mussel sample is given in Table 1. However the carbohydrate content of the fried mussel could not be estimated due to the interference of chillie oleoresin in the spectrometer readings.

Table 1. The proximate composition (%) fried mussel samples.

Parameters	Fried
Moisture	5.25
Fat	38.86
Protein	43.20
Ash	4.60

Sorption isotherm characteristics (Fig 1) of the sample revealed that 25% moisture equilibrating to 94% RH is critical with respect to the development of mold growth

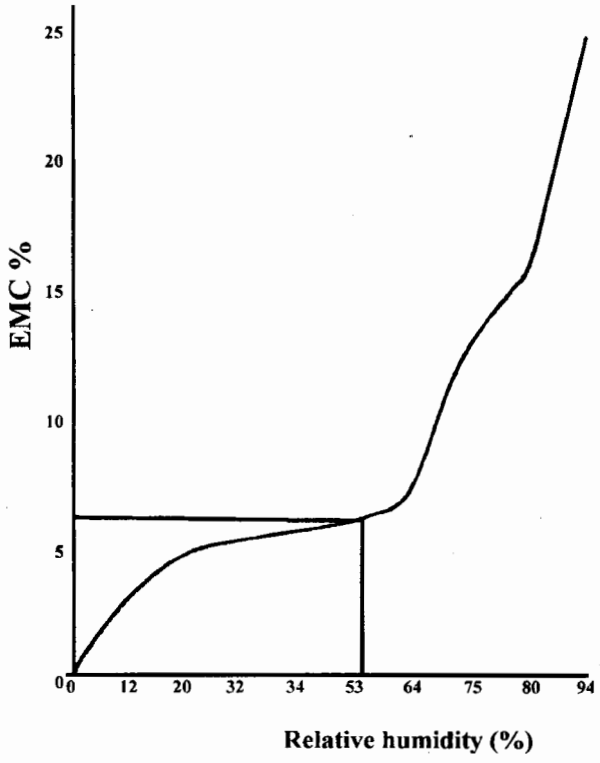

Fig 1. Sorption isotherm characteristics of fried mussel meat

and softness of the fried mussel meat. The packaging material should have low water vapour transmission rate and oxygen transmission rate for longer shelf life of the product. The sigmoid type isotherm suggests that the product is sensitive to changes in humidity and absorbs/desorbs moisture at different humidity conditions, the temperature remaining constant. The critical moisture content of the product for the development of mold growth was found to be 25%.

The physical properties of the packaging material used are presented in Table 2. Configuration of the film used is 12 m plain polyester laminated with 118m LD-HD coextruded films. The packaging film used had low water transmission rate of 1.60 g/sq. m/ 24 h at 90 % RH and 37°C and oxygen transmission rate of 75 ml/sq.m/24h/atmosphere making it ideal for vacuum packaging application. The average water and heptane extractives of the pouch were below the prescribed limits of 50 mg/litre (FDA, 1983) and hence suitable for food contact application.

Table 2. Physical properties of packaging film used in the experiment

Sl. No.	Details	Values
1	Tensile strength (kg/cm^2)	
	Machine direction	340
	Cross direction	300
2	Elongation at break (%)	
	Machine direction	55
	Cross direction	85
3	Heat seal strength (kg/cm^2)	
	Machine direction	310
	Cross direction	275
4	Water vapour transmission rate g/m^2 /24h/37°C/90% RH	1.6
5	Oxygen transmission rate cc/ m^2 /24h/atmosphere/20°C	75
	Overall migration residue (mg/litre)	
6	Water extraction	6.0
	n-Heptane	17.0

The changes in chemical characteristics of fried mussel during storage are given in figures 2 and 3. TVBN indicated a gradual increase during storage. However this increase was comparatively less in samples packed under vacuum compared to that in control probably due to slightly higher bacterial activity in control samples during the initial period of storage. TBA values

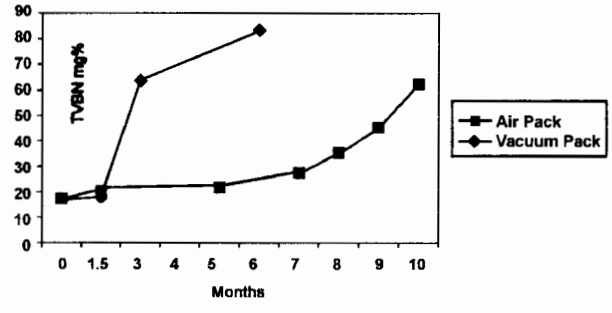

Fig 2. Changes in TVBN content of fried mussels during storage

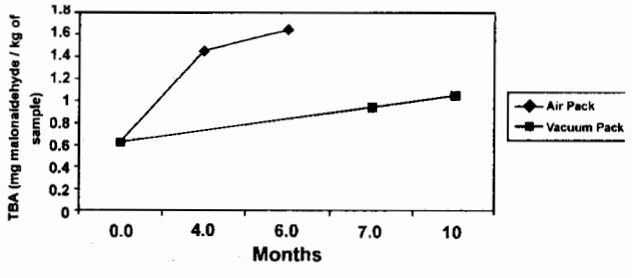

Fig 3. Changes in TBA value of fried mussels during storage

indicated a rapid increase in control samples due to the presence of oxygen in air, whereas in samples packed under vacuum this increase was not significant due to the absence of oxygen.

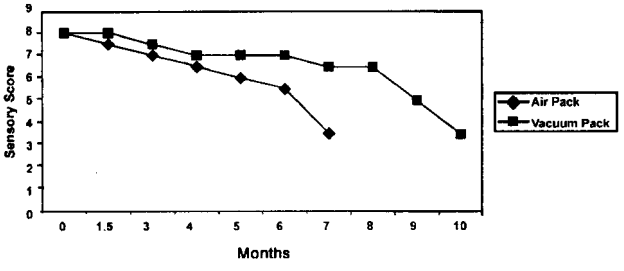

Fig 4. Changes in Sensory Score of fried mussels during storage

The organoleptic score (Fig. 4) of the product showed that the overall acceptability decreased gradually in both the samples during storage. In the case of control samples, rancidity had developed after six months and became unacceptable and hence discarded. Samples packed under vacuum became rancid and unacceptable only after nine months of storage and they also exhibited better texture and flavor attributes compared to that of control samples.

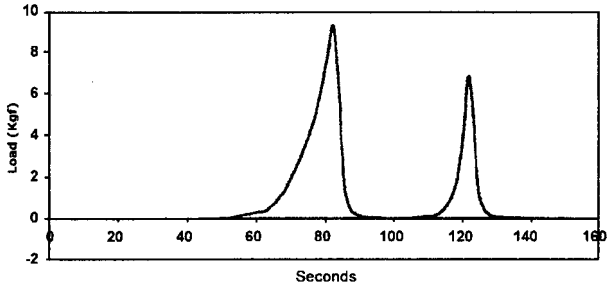

Fig 5. Texture Profile Analysis of Fried Mussel

The samples on testing had Hardness1 of 9.37 kgf, Hardness2 of 6.81 kgf, cohesiveness of 0.17, gumminess of 1.37 kgf and chewiness of 2.47 kgf.mm.

Faecal streptococci, coagulase positive staphylococci and fungi were not detected in both the samples throughout storage. Total aerobic plate count indicated only a slight increase during the initial period of storage in both the samples with slightly higher values for control samples. Thereafter the counts remained almost stationary in both cases. This may be due to very low moisture content of the samples.

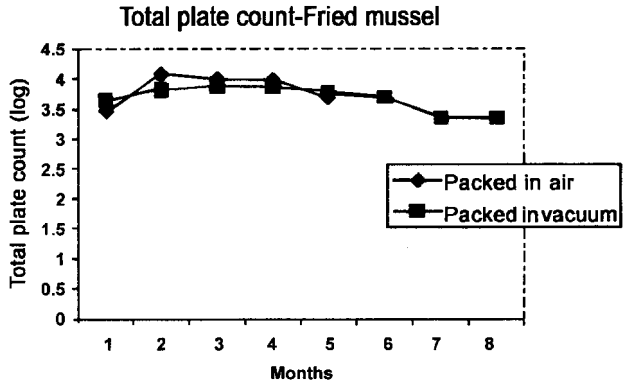

Fig 6: Changes in total plate count during storage

The study has indicated that the fried mussels packed under vacuum in flexible packaging material had a shelf life of 9 months at ambient temperature. Compared to this, the control samples packed in air had a keeping quality of only 6 months under identical conditions.

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