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# Physico-chemical and sensorial characteristics of commercial seafood pickles of Tuticorin super markets, Tamil Nadu, India

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**Abstract**

The nutrient composition and quality of different seafood pickles from Tamil Nadu and Kerala were analysed. Protein, lipid and mineral content were higher in the samples from Kerala than Tamil Nadu. The spoilage indicators (FFA, pH, TMA -N and TVB-N, PV, TBA) and the bacterial and fungal load and *E. coli* were within the limit, whereas *Vibrio* and *Salmonella* were not detected. The organoleptic characters were good but, comparatively the pickles from Kerala got high score and the seafood pickles of both origins are safe for human consumption.



## Introduction

Pickling is an ancient method of food preservation (Nicholson, 1930). Pickles are the preserved food and it retains its wholesomeness, nutritive values and has long shelf life (Chandrasekhar *et al.*, 1978; Chandrasekhar, 1979; Tanuja and Shahul Hameed, 1998) and is used as an important side dish in India. At present there is an expanding market potential for pickles in the countries where Asians live (Gopakumar, 1997). Normally pickles are prepared from fruits and vegetables with the addition of salt, spices and its shelf life is generally 8 to 10 months. Compared to the vegetarian pickle, the seafood pickle acts as a table enricher and is becoming popular. The seafood pickle is delicious and constitutes a good source of protein, glycogen and minerals compared with vegetarian pickles (Durve and Bal, 1962; Giese, 1966; Ansari *et al.*, 1981). Just like salting and sun drying, pickling also one of the preservative methods for improving the shelf life of the seafood products preserved for long time (Jamila Patterson and Ayyakannu, 1997). Many kinds of seafood such as marine fishes (Abraham and Jeyachandran, 1993), Prawn (Jawahar Abraham *et al*., 1996), Clams (Vijayan *et al*., 1982), green muscle (Muraledharan *et al*., 1982), blood clams (Gupta and Basu, 1985), low cost marine fish (Vijayan *et al.*, 1989), gastropods (Dhanapal *et al*., 1994; Jamila patterson *et at.*, 1995; Jamila Patterson and Ayyakannu, 1997; Emilin Renitta and Jamila Patterson, 2013) and edible oyster (Sugumar *et al*., 1994) have been used for the preparation of seafood pickles.

Seafoods are traditionally been a popular part of diet and main supply of animal protein in many parts of the world (Speedy, 2003). Sea foods are prone to contamination at various stages of handling and processing and the quality is a major concern to food processors and public health authorities. Seafood in India has been pickled using salt as a pickling agent. Nowadays seafood pickle prepared using organic acid with salt as pickling agents along with spices. The pickled product maintains the quality for long time (Jawahar Abraham *et al*., 1996). Seafood pickles are safe without any harmful bacteria and are having long shelf life period for more than 6 months at ambient temperature (Chandrasekar, 1979). Jawahar and Shetty (1994) conducted a detailed study on the preparation of pickles from crustaceans and reported shelf life for 6 months.

In Tuticorin, seafood pickles packed in bottles and pouches are available in some supermarkets. The suppliers are mainly from local manufacturers and from other states and kept at room temperature for sale. There is no monitoring on the quality and nutrient content of the pickles produced by different pickle manufacturers, even if there is a possibility to use unauthorized ingredients. So far, there has been no attempt to evaluate the nutrient content, biochemical and microbial quality of the seafood pickles available in the local supermarkets. Therefore, the present study is aimed to assess the nutrient composition and quality of seafood pickle manufactured in Tamil Nadu and Kerala states which are commonly available in Tuticorin super markets.

## Materials and Methods

### *Collection and preparation of samples for analysis*

The seafood pickles packed in glass bottles with

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air tight sealing and stored at ambient temperature (30±2°C) were bought from super market in Tuticorin. The samples include Prawn, Fish and Crab pickles of Tamil Nadu and Prawn and Fish pickles of Kerala. The required amount of samples was taken from the bottles for subsequent nutritive and quality analysis.

*Analytical methods*

The proximate composition of the samples was analyzed by following standard procedures. Triplicate samples were used to determine the following chemical compositions. Moisture was determined by keeping in a hot air oven at 105°C for 24 hours (AOAC, 1975). The amount of protein present in the sample was estimated by mixing the sample with analytical and Folin-Phenol reagent and measured the absorption of the colour in a spectrophotometer at 660 nm (Lowry, 1951).

The lipid content was estimated by following the method of Folch *et al.* (1957). The dried samples were finely grinded and the fat was extracted with chloroform and methanol mixture. After extraction, the solvent was evaporated and the extracted materials were weighed and the percentage of the fat content was calculated. Ash content was determined by overnight igniting the samples in a muffle furnace at 450°C (AOAC, 1975).

Calcium, potassium, sulphur and sodium content were determined quantitatively using Atomic Absorption Spectrophotometer (AOAC, 1999). For phosphorus determination, ammonium molybdate and sodium chloride were used and assayed by using a spectrophotometer. The total volatile base nitrogen (TVB-N) and trimethylamine nitrogen (TMA-N) were determined by following the micro diffusion method of Conway (Beaty and Gibbons, 1937). Free fatty acid (FFA) content of the samples was estimated by following the method of Ke *et al*. (1976). Hydrogen ion concentration (pH) was determined by the (AOAC, 1975) method.

Peroxide value (PV) was determined according to Egan *et al*. (1997). The thiobarbituric acid (TBA) (mg malondialdehyde /kg fish flesh) was determined by following the method of Kirk and Sawyer, 1991. The total plate count (TPC) was determined using plate count agar (Himedia) medium by spread plate method (AOAC, 1990). Total fungal count was enumerated on Potato dextrose agar after incubation at 25°C for 3 - 5 days (AOAC, 1990). *Escherichia coli* were enumerated using standard most probable number (MPN) technique (Surendran *et al.*, 2006). Pathogenic bacteria such as *Salmonella* and *Vibrio* were enumerated as per the method of (APHA, 1976).

Various organoleptic characteristics such as appearance, flavour, texture, saltiness, sourness, acceptability of the seafood pickles were evaluated by a group of 9 panellists using 9 point hedonic scale according to the guidelines of (Lin and Morrissey, 1994) for edible commercial product. The limit of acceptability was fixed at 5.0.

**Result and Discussion**

The present study was undertaken to understand the quality and quantity of nutrient content of different commercial seafood pickles available in the super markets of Tuticorin. The quantity of protein, lipid and ash content of the seafood pickle were presented in Figure 1. The protein content varied with different pickles, however higher protein content of 48.2% was obtained for prawn pickle of Kerala. The protein level variations are probably due to the quality and quantity variation in seafood, the level of salt used and the period of preservation, which determined the degree of proteolytic activity during processing. High crude lipid was observed in pickle (2.03 - 3.21) from Kerala than the one from Tamil Nadu (2.29 - 2.96). Deep frying and addition of high quantity gingili oil increase lipid content of seafood pickles (Emilin Renitta, 2005).

The ash content varied in different seafood pickles. In the present study, the ash content of seafood pickle was less due to removal of skeleton of seafood samples during the processing. Seafood pickle of Tamil Nadu had high ash content due to the addition of high salt (Sikorski *et al*., 1995) and this is also in confirmation with organoleptic analysis of the pickles.

Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and sulphur are important for human nutrition (Erkan and Ozkan, 2008).The results of mineral contents of the seafood pickles is also shown in Figure 1 and it was in the order of sodium> sulphur> potassium> calcium> phosphorus. However, the food companies did not provide upper or lower limits for mineral contents in foods.

The spoilage indicators of the seafood pickles were analysed and the results are presented in Figure 2. The pH of the pickle ranged between 4.02 and 5.2. High pH value was observed in the pickle sample from Tamil Nadu than the sample from Kerala.The low pH of the seafood pickle may be due to the addition of acid as preservative during processing of the seafood and it absorbs the acid and retains for long time. Sugumar *et al.* (1995) reported that low pH inhibits most of the bacterial activity. Collins *et*

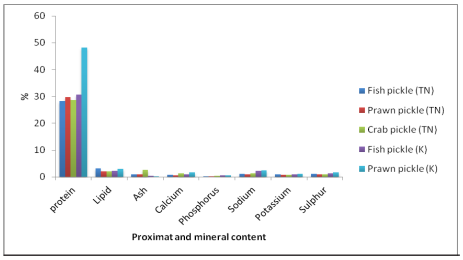


Figure 1. Proximate composition and mineral contents of different sea food pickles (% dry matter basis)
TN - Tamil Nadu, K- Kerala

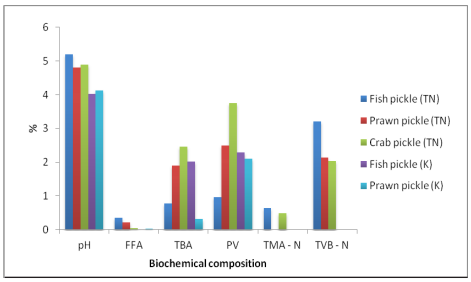


Figure 2. Biochemical quality of sea food pickles
TN - Tamil Nadu, K- Kerala

*al.* (1989) had an opinion that if the pH of the vinegar added pickled seafood product was 4.5 or less, there is no further precaution against bacterial pathogens. Similar decreasing trend in pH in pickles was reported by many authors (Gupta and Basu, 1985; Behanan *et al*., 1992; Dhanapal *et al*., 1994). In the present study, low pH was observed for Kerala pickles and it had good shelf life.

The level of TMA-N and TVB-N has ranged between 0.49 - 0.65 mgN/100 g and 2.03 - 3.21 mg N/100 g and were within the acceptable limit of 10 -15 mgN/100 g for TMA-N and 30 - 45 mgN/100 g described by (Connell, 1995; Huss, 1988). Seafood pickles from Kerala and Tamil Nadu had no protein degradation by bacterial enzymes, so that there was no TMA-N, TVB-N content. The seafood pickle from Tamil Nadu had low TVB-N content. The layer of oil and sealed cap of pickle bottles are against protein degradation and non protein nitrogenous compounds and Connell (1975) suggested that these compounds are responsible for the production of TMA-N, TVB-N.

Lipid hydrolysis occurred in all seafood pickle samples. High level of free fatty acids is an indication of microbial spoilage activity (Pearson, 1976). Most fat acidity begins to be noticeable when the free fatty acid values calculated as oleic acid. In the present study, the release of FFA was high in pickle from Tamil Nadu but both the pickle was not exceeding the acceptable limit of 1.5% (FAO, 1971). The accumulation of FFA could be attributed to lipases and phospholipids activity occurs in pickle samples. Extra cellular lipases produced from certain microorganism may also contribute the lipolysis in

Table 1. Microbial quality of sea food pickles available in super market

| Name of the pickle | Place of manufacturing | TPC (cfu/g) | TFC (cfu/g) | *E. coli* (MPN/100 ml) | *Salmonella* (25g) | *Vibrio* (25g) |
|---|---|---|---|---|---|---|
| Fish pickle | Tamil nadu | $3.1\times10^2$ | - | 25 | Absent | Absent |
| Prawn pickle | Tamil nadu | $3.1\times10^4$ | - | 15 | Absent | Absent |
| Crab pickle | Tamil nadu | $4.7\times10^3$ | $1.0\times10^2$ | 9 | Absent | Absent |
| Fish pickle | Kerala | $2\times10^1$ | - | 7 | Absent | Absent |
| Prawn pickle | Kerala | $1.1\times10^1$ | - | - | Absent | Absent |

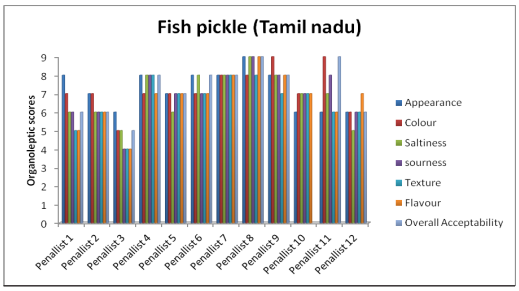


Figure 3. Organoleptic properties of Tamil Nadu fish pickle

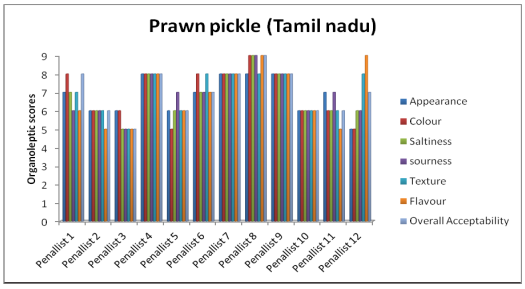


Figure 4. Organoleptic properties of Tamil Nadu prawn pickle

the pickle sample. The levels had a high correlation with the TVB-N and pH (Table 3) showing that it could act as good assessment of a freshness of edible product.

Primary lipid oxidation was evaluated by means of PV. In the present study, PV values were not affected the pickles holding at ambient temperature. Molecular oxygen reacts with unsaturated lipid form lipid peroxide and is catalysed by some factors such as temperature, water activity, pH of the environment (Nayak *et al*., 2003). A slight lipid oxidation occurred in the present study, but did not exceed the acceptable limit of 10 - 20 meg per kg of fat (Connell, 1995) in all the seafood pickles.

TBA is widely used for the assessment of degree of secondary lipid oxidation (Nishimoto, 1985). TBA values were found to be quite low for all five types of seafood pickles. This TBA factor is responsible for rancid flavour, off odours, colour as well as texture deterioration (Nawar, 1996). Formation of secondary oxidation products in the seafood pickle were low and it was below the acceptable level of <3 mg MDA/ $kg^{-1}$. The results of the present study indicate that the seafood pickles are good quality fishery products.

The microbial quality of the seafood pickles is shown in Table 1. Total bacterial count did not exceed the acceptable limit. Pickle from Kerala had low bacterial count and Mukundan *et al.* (1981) reported

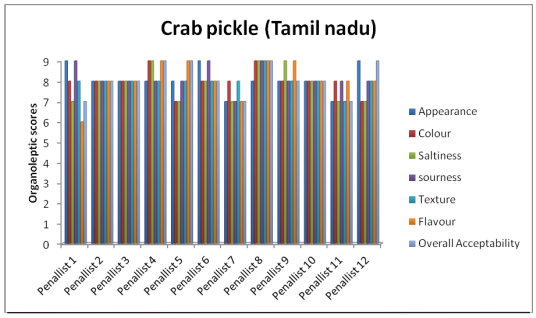


Figure 5. Organoleptic properties of Tamil Nadu crab pickle

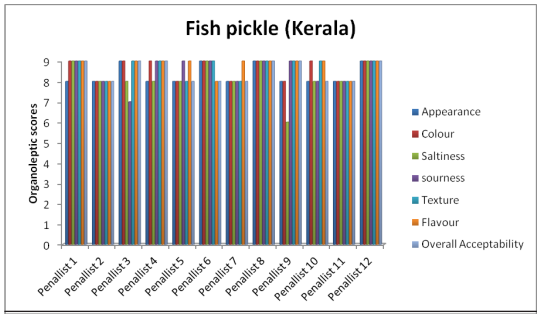


Figure 6. Organoleptic properties of Kerala fish pickle

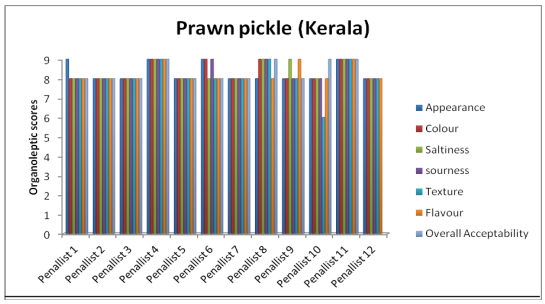


Figure 7. Organoleptic properties of Kerala prawn pickle

that the very low bacterial counts were due to the inhibitory action of low pH and high salt content of the pickles. The pickle from Tamil Nadu had little more bacterial count compared to other pickles and this increase might be due to the lack of proper preservatives, delayed processing of seafood and proper environment for multiplication of acid tolerant bacteria and similar observation was also made by Vijayan *et al.* (1989). But Erichsen (1967) reported that pickled fish normally carry low level of bacteria in the range of $10^1$ to $10^3$ $g^{-1}$. However, in present study, pickle of Tamil Nadu had above $10^3$. Chandrasekar (1979) reported total plate count in seafood pickle within the range of $10^3$ to $10^5$ $g^{-1}$. Jawahar Abraham (1996) reported initial total bacterial count of seafood pickle was 6.45% but during the storage of 270 days it increased to more than 90% of the total population. The bacterial population of seafood pickles are salt and acid tolerant (halophiles). Karunasager *et al.* (1988) have reported a viable count in the range of $10^6$ to $10^7$ $g^{-1}$ was halophiles. The aerobic spore formers comprised more than 50% of the viable bacterial population (Chandrasekar *et al*., 1978) and these have been reported to be the dominant group in seafood pickle. No fungal colonies were observed in all the pickles except crab pickle of Tamil Nadu and this result is in accordance with the results of Behanan *et al.* (1992). This may be due to the preservative action of vinegar and salt and the maintenance of anoxic condition of the pickle.

The pathogenic bacteria such as *Salmonella* and *Vibrio* were not encountered in seafood pickles (Table 3). Jawagar Abraham (1996) reported that seafood pickles had no pathogenic contamination like *Salmonella* and *Vibrio*. Glaton *et al*. (1968) reported that low bacterial counts in some seafood pickles and absence of pathogenic organisms are due to inhibitory action of low pH and high salt content. These pathogenic organisms are reported to be either killed or fail to multiply in the presence of acetic acid fish preservatives. The results of the present study are in line with the observations of (Emberger, 1972; Chandrasekhar *et al*., 1978). Most probable number (MPN) technique of *E. coli* count showed more variation between seafood pickle samples collected from super market. Contaminated seafood, water and ingredients for making pickle imparts considerably to the reason for *E. coli* contamination. Seafood is a reservoir of large number of micro organism, some are inherent coming from where the seafood is caught and other are to contaminations at various stages of handling, from the time of catch, processing till it reaches the consumer. Majority of these microorganisms are non pathogenic causing only spoilage to the seafood but some which are pathogenic bacteria causing food poisoning (Sugumar *et al*., 2004). Quality standards have been prescribed for fish and fishery products meant for export and they are monitored strictly (Valsan *et al*., 1985). The quality of fishery products sold in the retail market of Bombay was not good (Varma *et al.*, 1986). There are reports available on the incidence of some pathogenic micro organism in fishery by products available in the retail market (Iyer and Shrivastava, 1989; Sanjeev and Surendran,1996). The incidence of *Salmonella* and some faecal indicator bacteria in fishery by - products sold in retail market of cochin was reported by (Narayanan Nambiar and Surenderan, 2003). The quality deterioration of food during processing, storage and distribution is mainly caused by micro organisms. The type of micro organism present in foods is closely connected to the micro flora of the surrounding environment. Micro flora of fish and shellfish are closely connected to the water and sediment of the environment (Kadota, 1990).

The sensory attributes like appearance, colour,

texture and saltiness, sourness, flavour of pickles from Tamil Nadu and Kerala were organoleptically assessed and the results are presented in Figure 3, 4, 5, 6 and 7. The panel scores for all the organoleptic characteristics remained within the acceptable limit for all the pickles. The seafood pickles of Kerala had maximum organoleptic scores and the scores showed a decreasing trend with the seafood pickle of Tamil Nadu. The saltiness and sourness of the pickle received low scores for Tamil Nadu pickle. The texture of the seafood pickle of Kerala got good scores since it contains many pieces. An appearance is very good for all types of seafood pickle, but Kerala pickle had good flavour. According to the opinion of the taste panel, the pickles from Kerala had good taste similar to that of Tamil Nadu pickle. However, the seafood pickles of Kerala comparatively had more number of seafood pieces, good microbial, biochemical and organolepeptic qualities than the pickles from Tamil Nadu.

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