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## Sensory evaluation and proximate composition analysis of pasteurized crab meat and determination of its peroxide and free fatty acid value during storage at 4° Celsius

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### Abstract

In the present findings, the range of Free Fatty Acid formation was found to be between  $0.53 \pm 0.002$  and a final value of  $2.11 \pm 0.006$  for control sample and between  $0.43 \pm 0.002$  to a final value of  $1.45 \pm 0.002$  in the sample with VP+1%O respectively. Peroxide Values increased from an initial value of  $0.84 \pm 0.001 \text{ mEqO}_2/\text{kg fat}$  to  $12.87 \pm 0.004 \text{ mEqO}_2/\text{kg fat}$  in the control sample and  $0.70 \pm 0.004 \text{ mEqO}_2/\text{kg fat}$  to  $5.59 \pm 0.006 \text{ mEqO}_2/\text{kg fat}$  in the sample with vacuum packing (VP+1%O). Proximate composition analysis revealed the moisture content  $76.3 \pm 2.5\%$ , protein content  $19.1 \pm 1.7\%$ , fat content  $0.86 \pm 0.1\%$  and ash content  $1.7 \pm 0.1\%$  and the present differences between compositions might be related to variations in temperature, nutrient availability, migration behaviors, animal physiology and reproductive strategies. The sample with a combination of oregano oil and vacuum packaging showed value well below the acceptability limit. The sensory scores were recorded to go down during the chilled storage period especially for the control sample in which rate of decrease was the most rapid ( $p < 0.05$ ) to each other in terms of lowering of sensory attributes. The end results showed a greater sensory acceptability of the samples treated with oregano oil.

**Keywords:** proximate composition, peroxide value, free fatty acid, chilled storage and sensory evaluation

### Introduction

Richness in protein, amino acids and mineral contents, the crab meat serves as an excellent source of nutrition. Amino acids play a central role as the building blocks of proteins and as intermediates in metabolism and further help to maintain health and vitality. There are 22 amino acids important in human nutrition. Eight amino acids cannot be synthesized by humans and other mammals and hence must be supplied in the diet; therefore, they are called essential amino acids [1]. The crab fishery in India is fast developing and there is a vast scope for the crabmeat market due to its delicacy and nutritional richness. Crabs ranked third after shrimp and lobster for their esteemed delicacy and also the value of fishery [2]. In India, best crab fishing potentials are seen along the coasts of Tamil Nadu, Kerala and Karnataka and to a certain extent in Maharashtra and Gujarat. Most of the marine crabs found all along the Indian coast belong to the family of Portunidae [3]. Marine fish landings in India were 37.27 lakh tonnes during 2019-20 [4]. Among the crustaceans, crabs ranked third in their landing with 56679 tonnes [5]. The crabs have a continuous demand all over the world and the landing of crabs is third among the crustaceans in India [4]. They are rich in omega-3 fatty acids, mainly eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and  $\alpha$ -linolenic acid, which have reflect positively on human health as the omega-3 fatty acids are known to decrease the risk of heart attacks, lower blood pressure and triglyceride concentration in blood [6, 7] help in brain and retina development, enhance the immune system and even are able to protect body against cancer [8]. Pasteurization is yet another natural preservative method applied to eliminate the resistant pathogenic bacteria of public health concern present in food when stored under normal and moderate abuse conditions. Natural products, especially essential oils are considered safe and natural additives for food preservation [9]. Essential oils are mainly phenolic compounds which are free radical scavengers and contain terpenes as well and have a great perspective of application in foods as they improve both safety and shelf-life of foodstuffs [10]. Oregano, a leafy perennial herb of the mint family that is indigenous to the Mediterranean region is rich in the phenols mainly carvacrol, thymol, phenolic diterpenes and

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monoterpene hydrocarbons-  $\gamma$ -terpinene and p-cymene<sup>[11, 12]</sup> of which carvacrol and thymol possess the highest antioxidant<sup>[13]</sup> and antimicrobial properties<sup>[14]</sup>.

## Materials and methods

### Collection of Essential oil and chemicals

Oregano Essential Oil was obtained from Synthite Industries LTD, Synthite Valley, Kolencherry, and Kerala. It is steam distilled oil. The oil (100% pure essential oil) was stored in a dark carton (12x12x30 cm) and kept refrigerated below or at 4 °C.

### Collection of crab sample

Freshly landed 25 kg blue swimming crab samples were procured from a commercial fish landing center at Thoppumpady in Kochi, Kerala, India. Crabs were brought to the Department of Fish Processing Technology, Kerala University of Fisheries and Ocean Studies (KUFOS) immediately within 1 hour after landing in iced condition (in the ratio of 1:2; w/w) in an insulated high density polyethylene (HDPE) container. Upon arrival, crabs were de-iced and washed with chilled potable water (1 °C – 2 °C) and stored in ice till further processing.

### Proximate composition analysis of blue swimming crab

Moisture, protein, fat and ash contents were determined according to the Association of Official Analytical Chemists procedures<sup>[15]</sup>.

### Pasteurization

The lots were then subjected to pasteurization (Instrument-Omni, DTC 72) and packs were placed in a boiling water pasteurizer for cooking, and cooking was continued for 1 min when the core temperature reached 85 °C. As per USFDA (2000), the crab meat was cooked to a cumulative lethality of  $F_{185^\circ\text{F}} (F_{85^\circ\text{C}}) = 31 \text{ min.}, z=16^\circ\text{F} (9^\circ\text{C})$ . Core temperature was monitored using a data recorder (Ellab CFT9008) and to monitor the core temperature of the product, thermocouples (Ellab SSA-12050-G700-TS stainless steel, EllabCo., Reodovre, Denmark) were used which were kept immersed in the center of the product carefully. After heat processing, the products were immediately chilled by immersion in ice cold, potable water (1–2 °C), and cooling was continued for 10 min. After the chilling was over, all of the packs were iced immediately with flake ice at the ratio of 1:1 (crab:ice) in an insulated high-density polyethylene box. All the samples were then stored at 4 °C. Samples were withdrawn from the separately packed slots every 3 days interval for free fatty acid and peroxide value up to 28 days respectively.

### Determination of Free Fatty Acid (FFA) value

FFA was calculated as percentage of oleic acid<sup>[16]</sup>.

1 mL of 1 N sodium hydroxide = 0.28 g of oleic acid in 1 L

$$\% \text{ of FFA as oleic acid} = \frac{\text{Volume of NaOH used} \times 0.01 \times 0.28}{\text{Weight of fat in chloroform extract}} \times 100$$

### Determination of Peroxide Value (PV)

PV was estimated by American Oil Chemist's Society<sup>[17]</sup> method. PV was calculated as follows.

$$\text{Peroxide Value} = \frac{\text{Volume of } 0.01\text{N Na}_2\text{S}_2\text{O}_3 \text{ used} \times \text{N}}{\text{Weight of fat in chloroform extract}} \times 100$$

### Where,

N – Normality of sodium thiosulphate

It is expressed as milliequivalent O<sub>2</sub>/ kg (mEq O<sub>2</sub>/ kg) of fat.

### Sensory evaluation

Sensory evaluation was based on characterization and differentiation of the various sensory characters such as appearance, texture, odor and overall likeness. The samples from four treatments (Control, VP, VP+0.5%O and VP+1%O) were provided to a team of 5 trained panelists and were coded using letters and randomly presented to the panelists every week under proper environmental conditions. Score was given based on 9-point hedonic scale as described (18) where, 9: like extremely; 8: like very much; 7: like moderately; 6: like slightly; 5: neither like or nor dislike; 4: dislike slightly; 3: dislike moderately; 2: dislike very much; 1: dislike extremely. A sensory score of 4 was taken as the borderline of acceptability. Kruskal Wallis test was used for calculation. Evaluations were made individually and the panelists were instructed to rinse their mouths with water before starting and between sample evaluations.

### Statistical Analysis

All experiments were carried out in triplicate and the results were expressed as mean value  $\pm$  standard deviation (SD). Data excluding sensory were subjected to analysis of variance (ANOVA) using the standard software IBM SPSS-Version 20. P value less than 0.01 ( $p < 0.01$ ) were considered as statistically significant.

## Results

### Proximate composition analysis of blue swimming crab

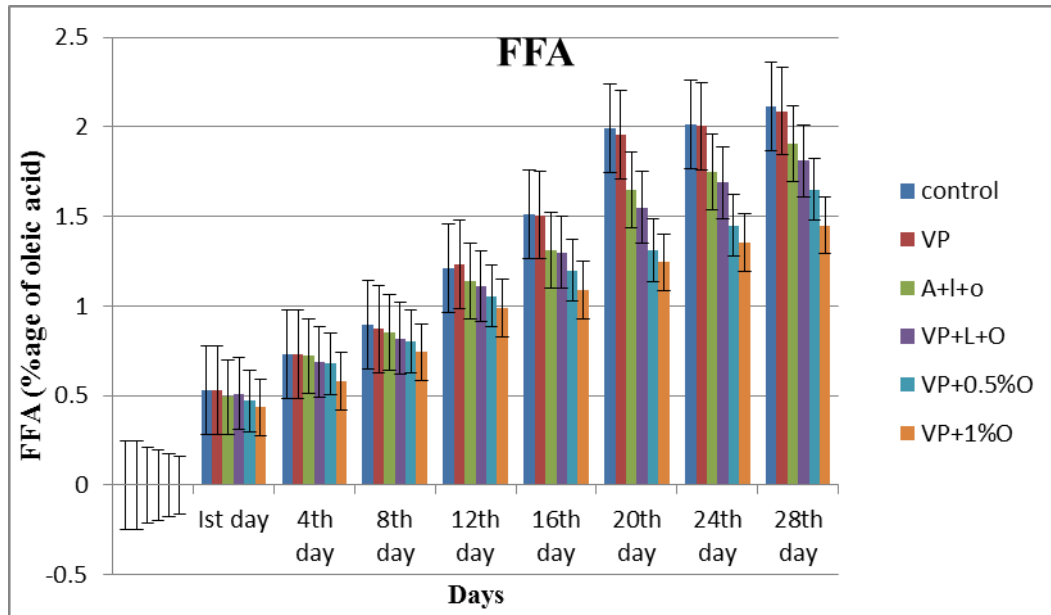
The proximate composition (Table 01) of blue swimming crab (*P. pelagicus*) is as follows: the moisture content was  $76.3 \pm 2.5\%$ , protein content was  $19.1 \pm 1.7\%$ , fat content was  $0.86 \pm 0.1\%$  and ash content was  $1.7 \pm 0.1\%$ . The differences between compositions are likely due to variations in temperature, nutrient availability, migration behaviors, animal physiology and reproductive strategies.

**Table 1:** Proximate composition of blue swimming crab

Proximate analysis	
Moisture content	$76.3 \pm 2.5\%$ ,
Crude protein content	$19.1 \pm 1.7\%$ ,
Crude fat content	$0.86 \pm 0.1\%$
Ash content	$1.7 \pm 0.1\%$
(n=3, mean $\pm$ sd)	

### Determination of Free Fatty Acid (FFA) value

Lipid or enzymatic hydrolysis is one of the main causes of rancidity in seafood and during this study the range of FFA formation was between  $0.53 \pm 0.002$  (expressed as percentage of oleic acid) and a final value of  $2.11 \pm 0.006$  for control sample. The trend followed by FFA for the samples is depicted in Figure 01.

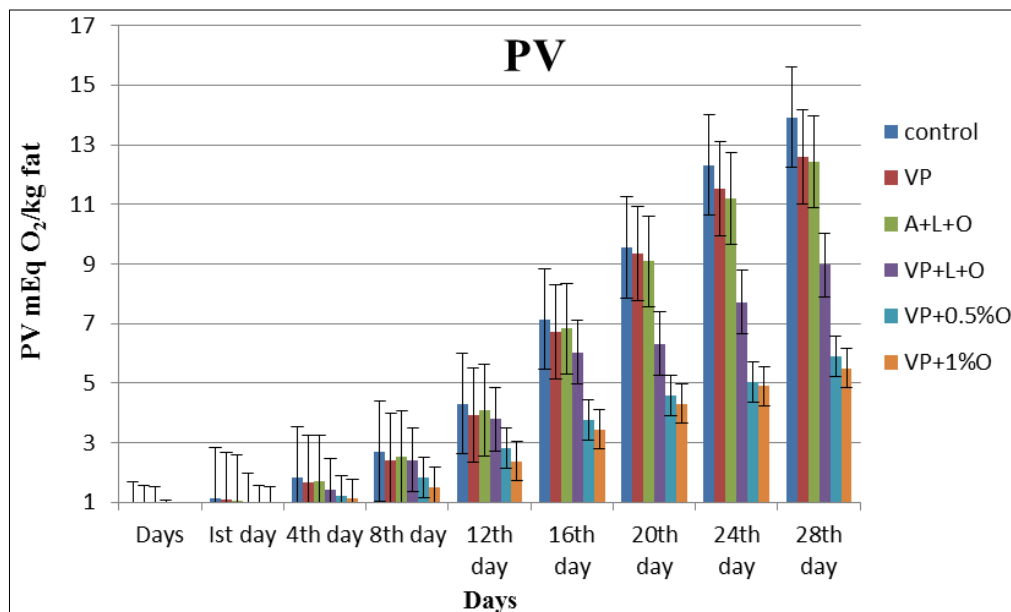


**Fig 1:** Free Fatty Acid (FFA) content of crab meat treated with oregano oil and vacuum packaging and their combination and control during 28days of storage at 4 °C. Bars represent the standard error (n=3).

**Determination of Peroxide Value (PV)**

PV is used to determine primary lipid oxidation and in this study, it was seen to increase with storage days. PV increased from an initial value of  $0.84 \pm 0.001 \text{ mEqO}_2/\text{kg fat}$  to  $12.87 \pm 0.004 \text{ mEqO}_2/\text{kg fat}$  in the control sample. The sample with a combination of oregano oil and vacuum packaging showed the value well below the acceptability limit. The trend followed by all samples is shown in the Figure 02. The FFA

released and PV obtained were the lowest ( $p < 0.01$ ) in the sample with 1% oregano oil and vacuum packaging. The second best results were obtained by the sample with 0.5% oregano oil and vacuum packaging whereas control and VP had higher values as VP alone is not sufficient enough to prevent the hydrolytic rancidity and auto oxidation of the product.

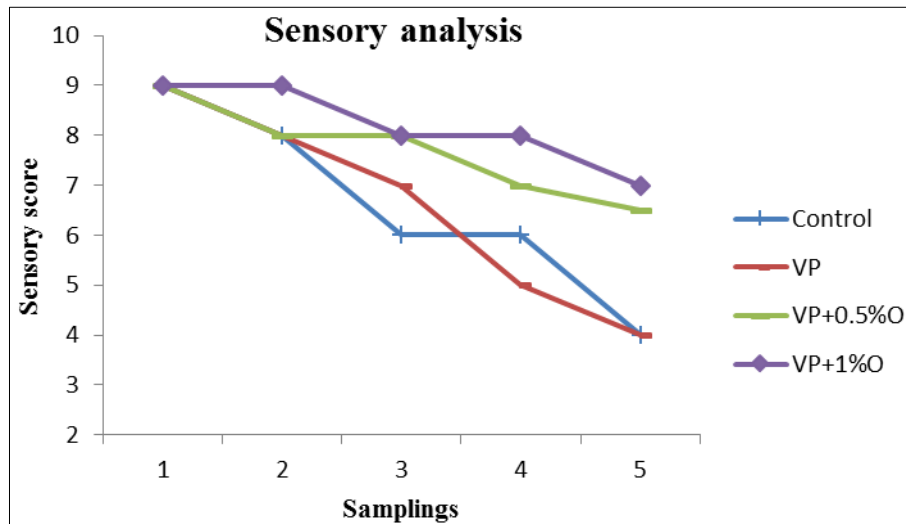


**Fig 2:** Peroxide value (PV) of crab meat treated with oregano oil and vacuum packaging and their combination and control during 28days of storage at 4 °C. Bars represent the standard error (n=3).

**Sensory evaluation**

Sensory evaluation is an organoleptic analysis of seafood important in ensuring the quality of seafood and because of this we can assess the decrease in quality of food during storage. The changes in the sensory quality of the cooked crab meat in 4 samples with or without the addition of oregano oil and combination with vacuum packaging for a period of 28 days at 4 °C is given in Figure 03. No differences in the sensory quality related to acceptability were found between

the different treatments ( $p > 0.01$ ) on the first day as all the samples had the maximum score near about 9 in Hedonic scale. The sensory scores were recorded to go down during the chilled storage period especially for the control sample in which rate of decrease was the most rapid ( $p < 0.01$ ) to each other in terms of lowering of sensory attributes. The end results showed a greater sensory acceptability of the samples treated with oregano oil.



**Fig 3:** Sensory quality score of crab meat treated with oregano oil and vacuum packaging and their combination and control during 28 days of storage at 4 °C. Control is showing decreasing trend as compared to treated sample ( $p < 0.01$ ).

### Discussion

The differences between proximate compositions are likely due to variations in temperature, nutrient availability, migration behaviors, animal physiology, sex and reproductive strategies. Free Fatty Acids are produced by the hydrolysis of oils and fats, particularly of the phospholipids present in the cell membrane. The hydrolysis may be enzymatic or non-enzymatic. FFA is time, moisture and temperature dependent and is more prone to oxidation and turning rancid [19]. Frozen storage of fatty fish species is strongly limited by lipid hydrolysis damage [20] and fish and shellfish species stored at very low temperatures (-12 °C or -14 °C) were also seen to liberate FFA. Lipid or enzymatic hydrolysis is one of the main causes of rancidity in seafood and in present study the range of FFA formation increased significantly ( $p < 0.01$ ). Peroxide value is a measure of the oxidative rancidity taking place in a system. Peroxide Value, as already described is used to determine primary lipid oxidation and in this study, it was seen to increase with storage days [21]. studied the effect of *Zataria multiflora Boiss* EO on quality of catfish (*Silurus glanis Linnaeus, 1758*) burgers stored at 4 °C and found that the PV was significantly ( $P < 0.05$ ) reduced by the addition of this EO (at two different concentrations) compared with untreated samples which is similar to present study. The changes in the sensory attributes of the cooked crab treated with oregano oil at chilled conditions for 28 days. No differences in the sensory quality related to likeness were found between the treatments ( $p > 0.01$ ) on the first day as all the samples had the score near about 9 in Hedonic scale. The reason for such a score is the freshness of the crab which paved a way for panelists to like it. The sensory scores were recorded to go down during the chilled storage period especially for the control sample which rate of decrease was the most rapid ( $p < 0.01$ ) to each other in 88 terms of lowering of sensory attributes and the decrease was progressed very slowly in them over a period of 28 days.

### Conclusion

The present findings were clearly indicative of the fact that the addition of 0.5% and 1% oregano oil in crab meat supposed to be the most efficient for quality of meat and the increasing trend of indices FFA, PV as well as sensory characteristics were significantly lower in treated crab meat that is indicative of the above fact. The storage quality

increased with the treatment of oregano oil and the shelf-life of pasteurized crab meat was prolonged during chilled storage. As per the scores provided by the sensory panel, it was found that the treated samples were organoleptically acceptable in terms of odour throughout the storage and the end results showed a greater sensory acceptability of the samples treated with oregano oil.

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