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PV Taral
Doctor of Philosophy Scholar College of Fisheries, Karnataka Veterinary Animal and Fisheries Science University, Mangalore, Karnataka, India

DV Bhola
Assistant Professor, College of Fisheries Science, Junagadh Agricultural University, Veraval, Gujarat, India

NA Pargi
Master of Fisheries Science College of Fisheries Science, Junagadh Agricultural University, Veraval, Gujarat, India

Tandel Rutvik P
Master of Fisheries Science College of Fisheries Science, Junagadh Agricultural University, Veraval, Gujarat, India

Bhutti JK
Master of Fisheries Science Scholar Post Graduate Institute of Fisheries Education and Research, at Rajpur (Nava), Himmatnagar, Gujarat, India

Modi KP
Master of Fisheries Science Scholar Institute of Fisheries Post Graduate Studies, Tamil Nadu Dr. Jayalalitha Fisheries University, Vaniyanchavdi, Chennai, Tamil Nadu, India

Corresponding Author:
PV Taral
Doctor of Philosophy Scholar College of Fisheries, Karnataka Veterinary Animal and Fisheries Science University, Mangalore, Karnataka, India

Mat drying and packaging effect of dry salted lizard fish during storage

PV Taral, DV Bhola, NA Pargi, Tandel Rutvik P, Bhutti JK and Modi KP

Abstract
Mat drying is age old and natural sun drying preservation method. During storage study so many different in dry fish. Changes in biochemical, microbiological and sensory attributes of dried salted lizard fish during storage in gunny bag, air packaging (AP) and vacuum packaging (VP) 200 gauge LDPE were invested. For this study total volatile basic nitrogen (TVB-N), Tri methyl amine nitrogen (TMA-N), Thiobarbituric acid value (TBA), free fatty acid value (FFA) and peroxide value (PV). Sensory attributes and microbiological analyses were carried monthly during storage. Vacuum packaging material has long shelf life among three. Gunny bag has shorter shelf life among three. Air packaging has intermediate half-life. The spoilage in dry fish during storage due to the oxygen trapping, water activity and interaction of fat contain, yeast, mold and bacterial contamination. Packaging material is essential for prevention for dry fish. Batter the Packaging quality batters the dry fish product if raw material and all processing and good handling practice during prepare dry fish. Dried and dehydrated foods are more concentrated than any other forms of food. Dry fish is a good source of protein for people in the rural areas.

Keywords: Mat drying, lizard fish, different packaging material, storage period, shelf life of dried fish

1. Introduction

Drying is considered as the least expensive method of fish preservation [1]. Fish represents valuable source of proteins and nutrients in the diet of many people and its importance in contributing to food security is rising significantly [2]. The major methods of preservation are chilling, freezing, canning, salting, drying and other methods of less importance are smoking, marinating and fermenting [3].

Global total fish production in 2016 was 171 million tonnes, of which 79.3 million tonnes was from marine water and 11.6 million tonnes from inland waters. The share of world fish production utilized for direct human consumption has increased significantly in recent decades, from 67% in the 1960s to 87% or more than 146 million tonnes. In 2016, 46% (67 million tonnes) of the fish for direct human consumption was in the form of live, chilled or fresh fish. The rest of the production for edible purpose was in different processed forms, with about 12% (17 million tonnes) in dried, salted, smoked or other cured forms, 15% (20 million tonnes) in prepared form and 31% (45 million tonnes) in frozen form [4].

Sun drying is still widely used in many tropical and subtropical countries. Sun drying is the cheapest method, but the quality of the dried products is far below the international standards [5]. These dried fishes are supplied to different markets like Ahmedabad, Rajkot, Valsad and Surat in Gujarat state. Shelf life of dry product is 1 to 6 months. It is also supplied to various other states like Tamil Nadu, Madhya Pradesh, Andhra Pradesh, Maharashtra, Kerala etc. High quality dried fish supplied to foreign dry fish markets like Sri Lanka, Malaysia, Singapore, United Arab Emirates etc [6]. Dry salted fish is a very popular food item in the Caribbean, Europe, Canada and other parts of the world.

2. Materials and Methods

2.1 Raw material

Fresh lizard fishes were collected from Veraval fish landing center and then transported in clean and sterile insulated box to fish processing laboratory of College of Fisheries, Veraval. Samples were thoroughly washed with cool tap water to remove all adhering material and damaged fishes.

2.2 Preparation of fish

The average length and weight of the fishes were measured and organoleptic parameters were observed. After that, dressing was done using clean knife in order to remove head, fins, scales, gill and gut. Dressed sample was washed again for removal of blood pigments and viscera and made into butter fly style along with sprinkling of dry crystal salt.

2.3 Drying

Each group of Salted fishes were dried through different methods of open sun drying until required moisture level is attained. Drying rate, moisture and temperature was measured during drying process. Weight and moisture of the sample was determined at every level of drying procedure. At the end of drying, dried fish sample was collected and weighed**.**

2.4 Packing

Dried sample was divided into three groups for storage and shelf-life study at room temperature. One group of final product was air packed in gunny bag second group in LDPE plastic and the third one was vacuum packed in LDPE plastic material for studying the changes in biochemical and microbiological quality parameters at regular intervals up to six month period.

2.5 Treatment Details

1. M1D1: Mat drying under sun + Air packing in gunny bag.
2. M1D2: Mat drying under sun + Air packing in 200 gauge LDPE Plastic bag.
3. M1D3: Mat drying under sun + Vacuum packing in 200 gauge LDPE plastic bag.

3. Results

3.1 Moisture

Fresh fish proximate composition (Figure 1) and Table 1 show other all parameters. The moisture content increased in all the treatments during the end of the first month storage period and later showed (Figure 2) progressive increasing trend with increasing the storage period. Slight increase in the moisture content due to pinch of hole was observed in sealing side wall after long days M1D2 treatments. Negligible change in the moisture content was recorded in M1D3 treatments from first to last month of storage period indicating the beneficial effects of vacuum packing on quality of dried fishes during long term storage.

3.2 Crude Protein

The interaction effect of treatments with storage period was reported significant. There was gradual and significant decrease in protein content noted in M1D1 treatments packed in gunny bag, compared to M1D2 and M1D3. (Figure 3)

3.3 Ash

The interaction effect of all treatments with storage period was reported significant. The ash content decreased in all the treatments at the end of the first month of storage period and continued decreasing trend with increasing the storage period. (Figure 4.)

3.4 Fat

The fat content decreased slightly in all the treatments in the first month storage period and showed progressive decreasing trend with increasing the storage period. The decrease in fat content was proportional to increase in moisture content of the dried fish during storage. (Figure 5.)

3.5 TMA-N

Difference in TMA-N was significant in all the samples. Slowest change in the TMA-N values was recorded in R1D3 and M1D3 as compared to other treatments. R1D2 and M1D2 treatments had comparatively similar trend in the change of TMA-N value. The samples R1D1 and M1D1, which were packed in gunny bags showed faster spoilage than other treatments. (Figure 6.)

3.6 TVB-N

The change was very much similar to the pattern of change of TMA-N. Difference in the TVB-N values was significant in all the samples. (Figure 7.)

3.7 Free Fatty Acid (FFA)

The changes in the free fatty acid value (% of total lipid) in all samples showed increasing trend with the increase in the storage period. (Figure 8.)

3.8 Peroxide Value (PV)

The changes in peroxide value (m.eq of O_2/kg) in all samples showed increasing trend during storage period as shown in Tables. Significant differences were observed in all treatments in PV during storage. (Figure 9.)

3.9 Thiobarbituric acid (TBA) Value

The changes in the thiobarbituric acid value (% of total lipid) in all samples showed increasing trend with the increasing storage period. Statistically, there were significant differences observed in the TBA values in all the treatments. (Figure 10.)

3.10 Total Plate Count (TPC)

The changes in TPC (log cfu/g) of dry salted lizard fish samples are shown in Figure 11. A marked increase in the TPC value was noted in all the samples with increase in the period of storage. All treatments showed statistically significant difference in the TPC values.

3.11 Total Halophilic Count (THC)

The changes in THC (log cfu/g) values of dry salted lizard fish samples are shown in Figure 12. A marked increase in the THC value was noted in all the samples with increase in the period of storage. All treatments had shown values, which are statistically significant.

3.12 Total Fungal Count (TFC)

The variation in TFC (log cfu/g) of dry salted lizard fish samples are shown in Figure 13. All treatment had shown statistically significant different values of TFC. Initially, there was no TFC value noted both in the mat and rack dried fishes.

3.13 Overall Quality

The overall quality of dried fish samples varied between treatments and score decreased as time of storage period increased as shown in figure 14. Statistically, there were significant differences observed in all the treatments.

Table 1: Fresh fish raw data

Physical Characteristics	Mean ± S.D.
Weight of Fish (g)	99.00 ± 0.26
Weight of dressed fish (g) (from whole fish)	79.20 ± 5.32
Yield of dressed fish from whole fish	80.00%
Proximate Composition	
Moisture (%)	79.45 ± 0.41
Crude Protein (%)	16.85 ± 0.35
Fat (%)	1.03 ± 0.20
Ash (%)	1.06 ± 0.32
Chemical Characteristics	
TMA-N (mg/100gm)	3.16 ± 0.14
TVB-N (mg/100gm)	5.12 ± 0.09
PV (milli equivalent of O_2/kg of fat)	1.19 ± 0.13
FFA value (% of oleic acid)	1.20 ± 0.08
TBA (mg malonaldehyde/kg)	1.20 ± 0.45
Microbiological Characteristic	
TPC (cfu/g) of sample	2.85 ± 0.01
THC (cfu/g) of sample	2.47 ± 0.02
TFC (cfu/g) of sample	0
Sensory Characteristics	
Appearance	8.70
Colour	8.77
Taste	8.82
Odour	8.85
Texture	8.40
Over All Acceptability	8.71

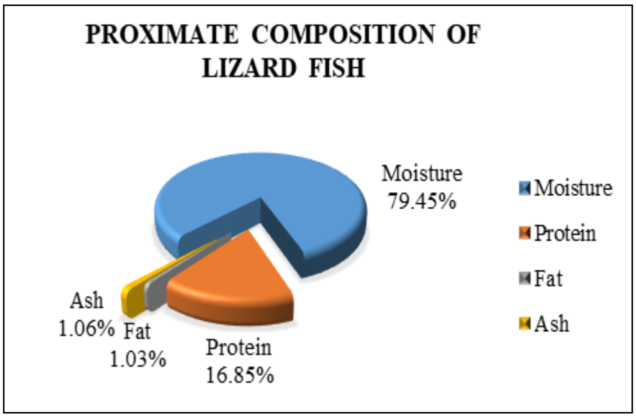

Fig 1: Fresh lizard fish composition

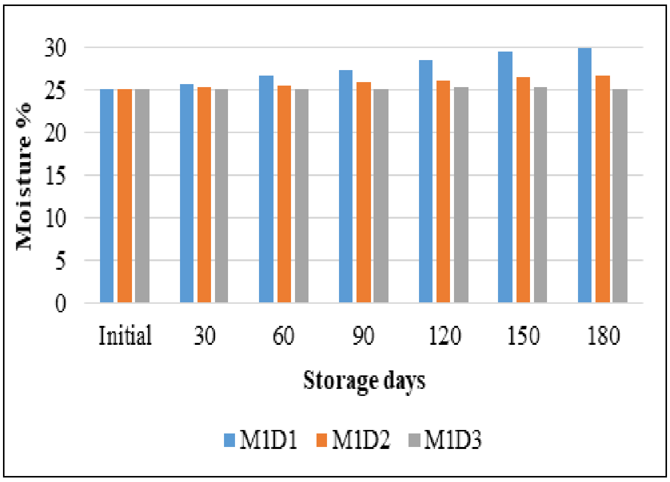

Fig 2: Changes in moisture (%)

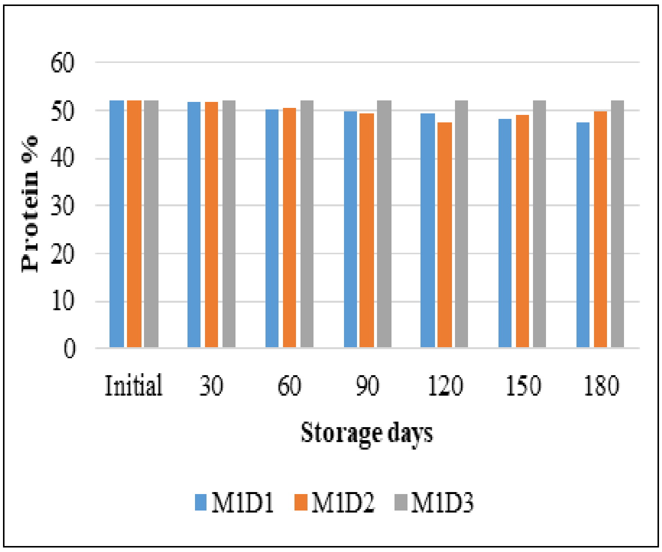

Fig 3: Changes in the crude protein (%)

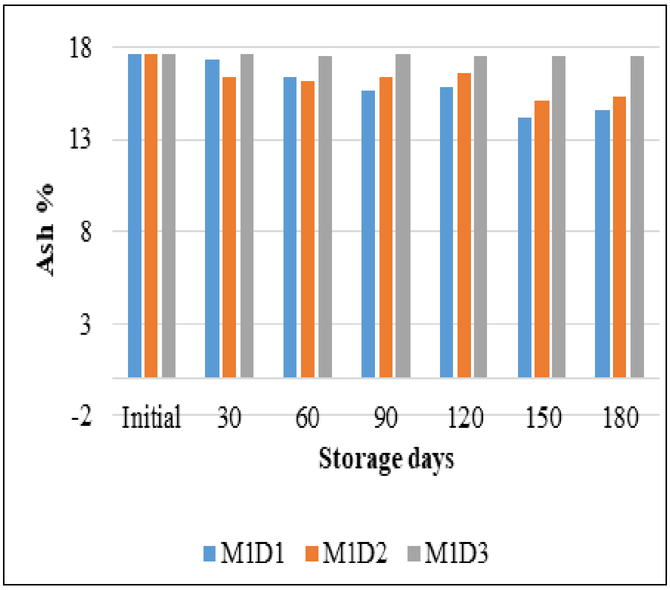

Fig 4: Changes in the ash (%)

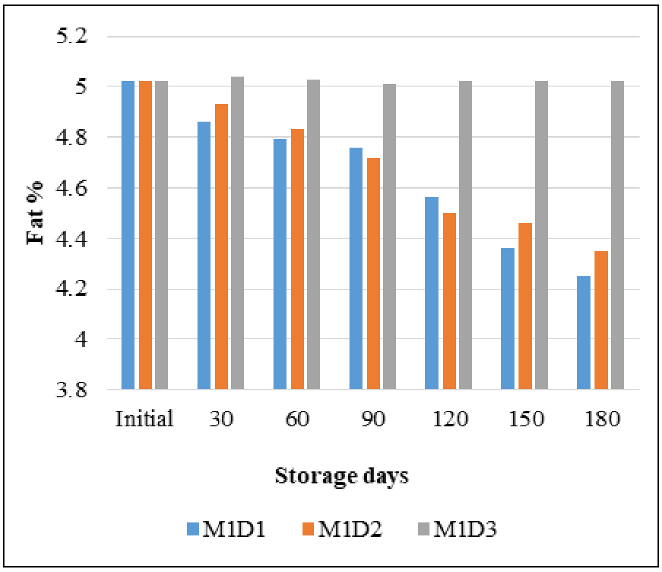

Fig 5: Changes in the crude fat (%)

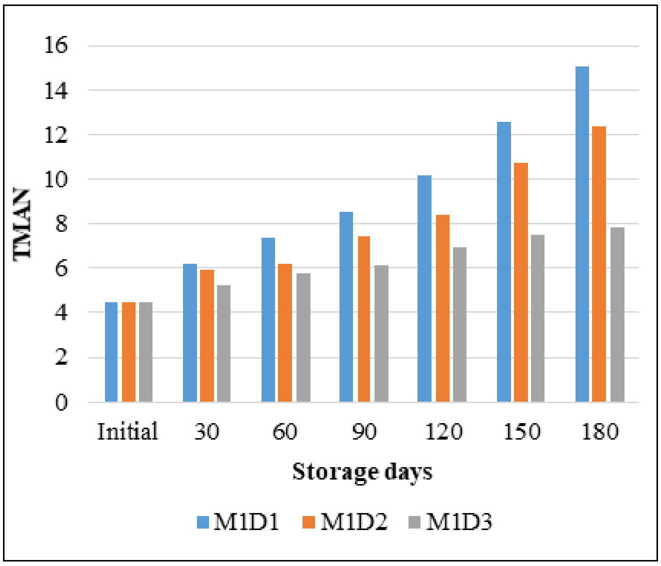

Fig 6: Changes in the TMA-N (mg%)

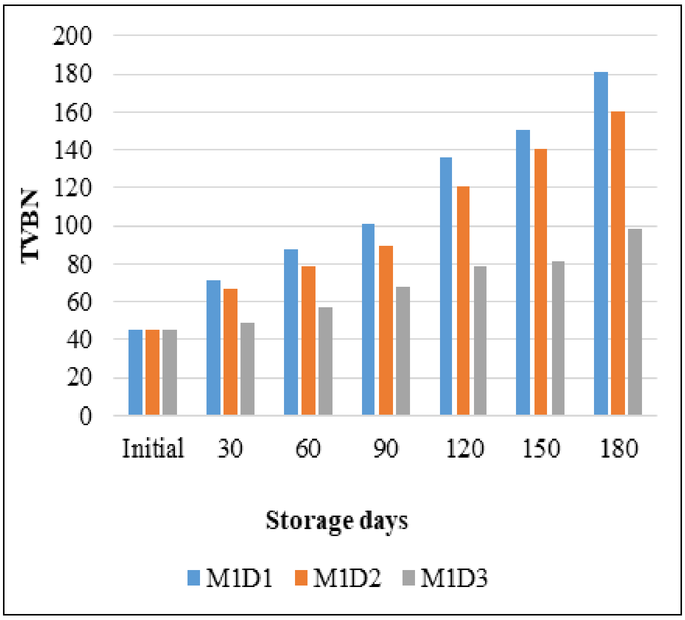

Fig 7: Changes in the TVB-N (mg%)

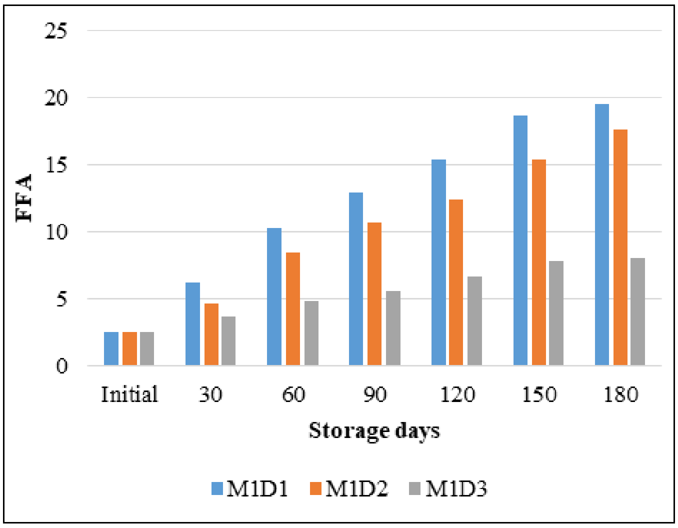

Fig 8: Changes in the FFA (% of oleic acid)

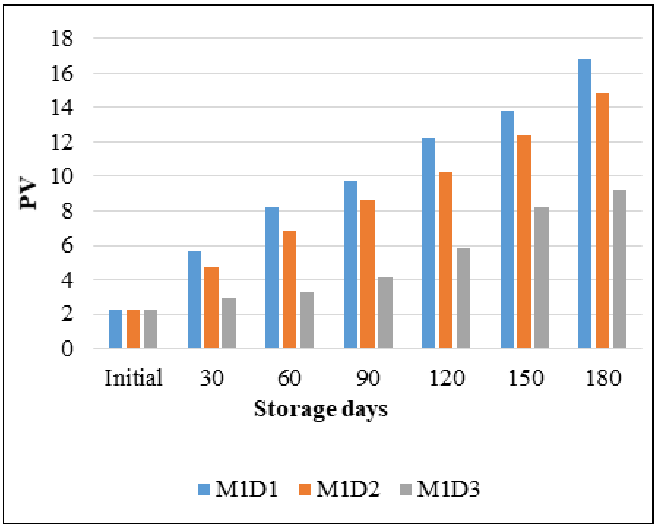

Fig 9: Changes in the PV (milli equivalent of O_2/kg)

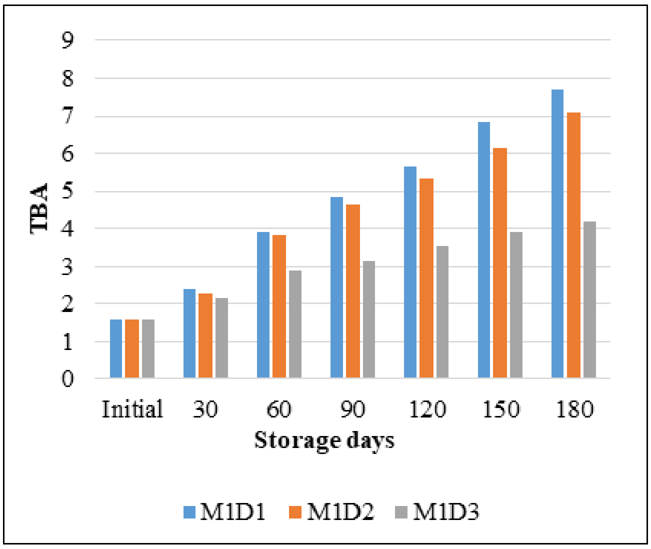

Fig 10: Changes in the TBA (mg malonaldehyde/kg)

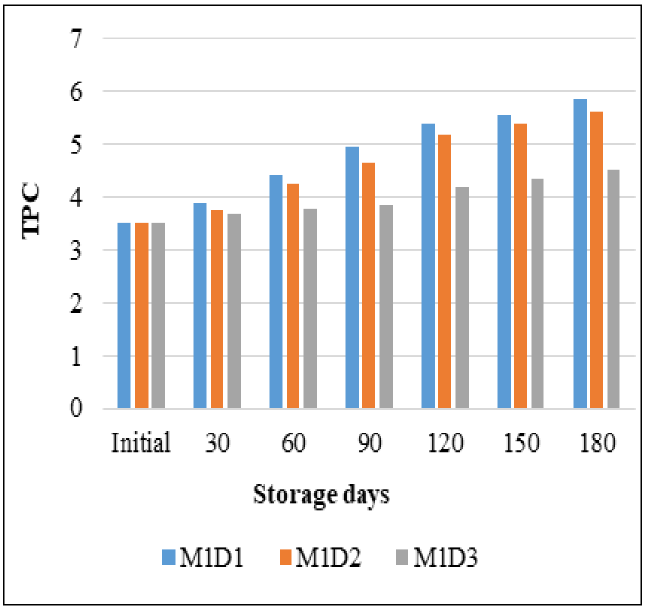

Fig 11: Changes in the total plate count (log cfu/g)

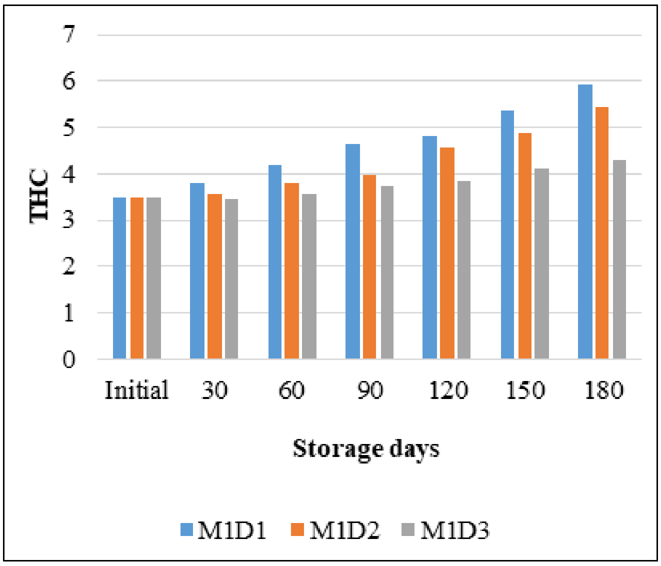

Fig 12: Changes in the total helophytic count (log cfu/g)

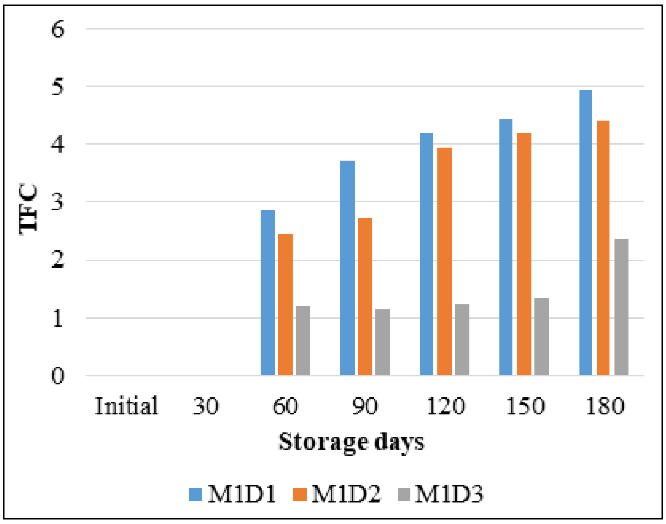

Fig 13: Changes in the total halophilic count (log cfu/g)

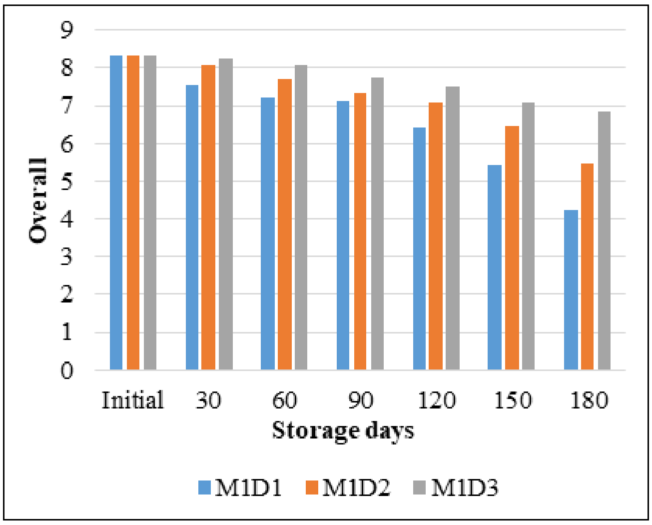

Fig 14: Changes in the sensory score for overall quality

4. Discussion

Nurul *et al.*, (2005) [7] studied effects of various drying methods on the quality of shark's dendeng and reported that different drying methods affect colour, but not the proximate composition. In a previous study by Tinyiro *et al.* (2015) [8] it was reported that water content of dried capelin in HB (Hessian bag) gunny bag increased with time and was significantly different compared to the other packaging. The all proximate parameters were significant. This was very much similar to earlier finding of the Covey and Sargent (1972) [9]. In contrast to this, Sen (2005) [10] reported that the process of salting or drying does not affect the nutritive value of the protein in any significant. Increase of protein was due to dehydration of water molecule present between the proteins causing aggregation of protein and this result in the increase in protein content of dried fishes (Ninawe and Rathnakumar, 2008) [11] Statistically the interaction effect of treatments with storage period was reported significant. These observations are in line with observations of Oparaku (2010). [12]

Similar trend of increasing total volatile base nitrogen (TVB-N) have also been reported by Saisithi (1967) [13] and Prasad and Gunda (2007) [14]. The TVB-N value of 200 mg% was suggested as the threshold value for spoilage of cured fish (Sreenivasan & Joseph, 1966; Prasad & Rao, 1994) [15, 16].

Pathak (2012) [3] observed that the TMA-N content of the raw fish increased steadily after salting, drying and during subsequent storage period reached a value of around 12.38 mg%. Reddy (1986) [17] has obtained a TMA-N content of 4.60 mg% to 15.96 mg% in salted and sundried fish products. The earlier finding of Beatty and Gibbons (1936) [18] in dried *S. fimbriata* had TMA-N ranged between 7.1-16.34 mg% during the period of storage. This trend was much similar with the present study.

Odoli (2015) [19] reported an increase in PV of air packed cold smoked capelin during storage. Oxygen is a key proponent in the development of lipid hydro peroxide (Fennema, 1996) [20].

The FFA increased gradually during the course of storage and trend was very much similar as PV during the advanced period of storage this agrees with the work of Frazier and West off (1998) [21]. It has been commonly observed that the rate of production of FFA depends on factors such as lipid concentration, pH and temperature (Wills, 1965) [22]. The formation of secondary oxidation products in fats of fish possibly play an important role in higher free fatty acid value [23, 24]. (Udgata, 1989) [23] and (Shetty *et al.*, 1996) [24] have claimed that FFA level has a strong influence on the flavor of salted and maturated fish. Adawiyah *et al.*, (2012) [25] reported an increase in the amount of FFA of lipase-catalyzed lipid hydrolysis in a food model system as a result of increase in moisture content.

Statistically there were significant differences in the TBA values observed in all treatments. According to Fennema (1996) [20] reduction in TBARS content may be due to the reaction of malonaldehyde with proteins in an oxidizing system, usually leading to formation of tertiary products of lipid oxidation.

The proliferation of moulds in dried lizard fish packed in gunny bag was associated with increase in water activity during storage. Sen *et al.* (1961) [26] observed that packed dried mackerel fish developed mold growth in 62 days, when stored at 78° F and 75% R.H. The R.H. and temperature of packages were 92% and 100° F respectively, in 82-100 days, while the initial moisture content was 39.68%. According to them the shelf life of dried and packed fish is limited not by bacterial decomposition but by fungal attack, off odour and bitter taste. Venkataraman & Vasavan (1954-55) [27] was reported that dried mackerel packed in teak wood boxes lined with butter paper turned moldy in 30 to 90 days. As per Indian standards (ISI 4950: 2001) [28], a TPC of 10^5 cfu/g is proposed for dried/cured fish in domestic trade. George Joseph *et al*. (1983) [29] have reported that the white bait samples showed SPC of 12.2477×10^3/g. In AFD meat, total count of less than 400/g has been reported [30]. by Rawal *et al.* (1973) [30]. Subrata basu *et al.* (1989) [31] have noticed high bacterial content ranging from 13×10^3 to 3.3×10^4 /g in market samples of dried white bait in Andhra Pradesh.

Sensory evaluation is the most reliable test for raw materials and processed fishery products (Peryam and Pilgrim 1957) [32]. Being a subjective method, sensory evaluation coupled with other methods form an important quality index (Gill, 1992 [33]; Nunes *et al*., 1992 [34]; Ryder *et al*., 1993) [35].

5. Conclusion

During the analysis of microbiology, lower count of TPC was observed in the case of vacuum is lowest than air packaging LDPE and last one gunny bag drying sample during the storage of 180 days period. Good quality in Vacuum packaging than second one is Air package. Gunny package bad than both packages. Vacuum packaging of mat drying is best quality among the three samples. Air packaging is second one and gunny bag has more spoilage due to direct contaminated by air, dust and water droplets in atmosphere.

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