Effects of Turmeric and Salt on Proximate Composition, Microbial Load and Organoleptic Quality of Treated Sun Dried Loitta (*Harpadon nehereus*)

A Thesis

By

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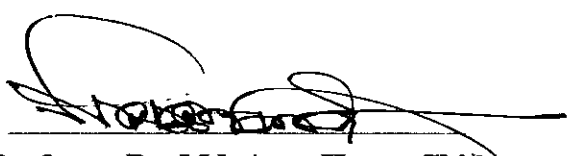
Approved as to the style and content by



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Declaration

Effects of Turmeric and Salt on Proximate Composition, Microbial Load and Organoleptic Quality of Treated Sun Dried Loitta (*Harpadon nehereus*)

The results presented in the thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.

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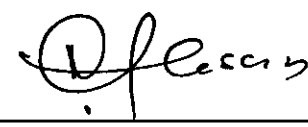

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To

Our Beloved Friend

Nayan Sarker.....

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Abstract

Studies were conducted to produce good quality of dried loitta fish (*Harpadon nehereus*) by combining the effect of salt (by weight) salt and 3% salt and different levels of turmeric powder (2, 3 and 4% of fish body weight) prior to drying in solar-tent dryer were entitled as T-1, T-2, T-3 and T-4 respectively. Quality changes in dried products under different treatments were assessed at every 10 days intervals of 60 days storage periods through proximate composition (protein, lipid, ash and moisture), microbial load (CFU/g) and organoleptic aspects. The highest and lowest level of protein, lipid, moisture and ash were found 62.82±0.29 to 56.64±.03, 11.12±0.02 to 7.039±0.05, 17.09±0.08 to 13.33±0.12 and 14.52±0.07 to 10.12±0.09 respectively with 60 days of storage. Statistics showed highest level of protein content on T-2 significantly varies (P <0.05) from other treatments at 20th, 30th, 40th and 50th day of preservation. However, at 60th day of preservation the highest value of protein percentage found 62.24±0.10 on T-2 and 60.94±0.30 on T-3 showed no significant difference (P >0.05) to between the treatments. The lipid content was highest 10.16±0.02 and 10.11±0.12 at T-3 and T-4 varies significantly (P<0.05) from other treatments at 60 days of preservation. Statistically (P <0.05) lowest moisture content (13.96±0.08) was also observed in T-2. At 60th day of preservation the highest value of ash content found 14.13±0.04 in T-4 varies significantly (P <0.05) with other treatments.

Effect of salt and turmeric was investigated on the bacteriological properties of dried fish. Control showed highest (P < 0.05) bacterial load in both 30th and 60th day of preservation (6.740±0.07×10^4 and 7.33±0.07×10^4 CFU/g respectively) than the others and that of the lowest (P < 0.05) was observed in T-4 (1.96±0.08×10^3 and 2.22±0.08×10^3 CFU/g) followed by T-3 (2.43±0.05×10^3 and 2.56±0.04×10^3 CFU/g) and T-2 (3.26±0.04×10^3 and 2.79±0.05×10^3 CFU/g) respectively. Total bacterial load gradually decreased in drying process and observed to decrease significantly (P <0.05) with the increase in turmeric concentration together with salt prior to drying. Among the all other treatments salt and turmeric treated fish, T-2 showed top most scores for skin appearance, color, texture and odor. Considering the nutritional value, bacterial load and organoleptic assessment it reveals that treated Loitta (*Harpadon nehereus*) with 3% salt and 2% turmeric prior to drying can maintain it quality better for storage.

Keywords: Loitta, *Harpadon nehereus,* salt and turmeric, proximate composition, microbial load, organoleptic assessment.

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List of Abbreviations and non-English Words

Abbreviation	Elaboration
°C	Degree Centigrade
ACI	Advanced Chemical Industries
AOAC	Association of Official Analytical Chemists
CFU/g	Colony Forming Unit per Gram
et al.	And Others
FAO	Food and Agricultural Organization
Fig.	Figure
FMRT	Fisheries and marine Resource Technology Discipline
FPQC	Fish Processing and Quality Control
g	Gram
KU	Khulna University
M. Sc.	Master of Science
mL	Microliter
ml	Mililiter
N	Normality
SPC	Standard Plate Count
T	Treatment
TMAO	Tri Methyl Amine Oxide
TPC	Total Plate Count
USFDA	United States Food and Drug Administration
viz.	Namely/That is to Say/As Follows

1.Introduction

1.1 Background of the study

Fish and fisheries are the intrinsic part of life of Bangladeshi people from the time long past and play a vital role in generating employment, nutrition, earning foreign currency and other aspects of the economy (Alam, 2002). Fisheries sector contributed 4.43% to national GDP and 22.21% to the agricultural GDP and 2.73% to foreign exchange earnings by exporting fish products in 2010-11. Fish provides 60% of national animal protein consumption (DoF, 2012). The demand of fish consumption (20.44 kg / people / year) is higher than the current fish consumption (17.52 kg / people / year) (*Kabir et al.*, 2012). At present, 275 freshwater and 475 marine water fish species, 24 prawns and 36 species of shrimp is available in our country which show the richness of fish and other aquatic resources in our country (Oluborode *et al.*, 2010). There are large areas of open water bodies in the form of rivers, canals, haors, baors criss-crossing the land and about 3,71,309 ha pond areas (DoF, 2012). Besides these freshwater bodies, the country possesses a vast marine water area in the south and south eastern region with 2,640 sq. nautical miles coastline, 41,040 sq. nautical miles of exclusive economic zone and 24,800 sq. nautical miles of continental shelf (DoF, 2012).

In Bangladesh, plenty of fish is harvested during the fishing season. But in this peak season the fishermen can't afford to sell all catches at a same time. Thus the fishermen have to sell either their catch at a cheaper rate or they have to let their catch go waste due to lack of proper processing and good facilities. If the fish could be processed or preserved for short term or long term period and stored successfully the requirement of the off season would have been met up to a significant extent. Proper preservation starts the moment it is harvested until reaches the consumer's table (Oluborode *et al.*, 2010). As fish is highly perishable material, so it is very important to provide it to the consumer with a good quality. Good quality is the degree of excellence. Proper treatment or processing of premium quality fresh fish can minimize the post harvest loss and thus reduced the amount of fish spoilage.

Efforts should therefore, be geared towards increased fish production through improved resource management matched with effective post-harvest handling, preservation and processing to prevent spoilage. Consequently, research is needed to improve their shelf life and nutritional values in traditional preservation techniques, so in the peak harvesting periods, these fish could preserve properly to serve in off season as a cheap and immediate source of animal protein to all classes peoples. To prolong the shelf life of fish, some preservation methods used in our country include chilling, freezing, drying, salting and smoking.

Among all the preservation drying is the simplest and traditional fish preservation system since ancient time. Dry fish is a low cost dietary protein source and used as a substitute of fish at the scarcity of fresh fish round the year. It is estimated that about 20% of the local artisanal fish catch are sun dried and consumed in the domestic market in Bangladesh (Mazid and Kamal, 2005). Dried fish is a very popular and delicious food item in Bangladesh especially, in the coastal, central and north-eastern districts (Nowsad, 2007). Moreover, some marine fish species people do not like to consume as fresh fish but they like to eat dry fish of these species. Moreover, dry fish has a storage life of several years and is a great source of protein, essential fatty acids, vitamins and many minerals. So it is consumed all over the world for its nutritional value, taste, and flavor.

But in our country process of drying fish is very traditional and unhygienic. This process is mainly performed by household of the artisanal fishermen. They are mostly illiterate and unconscious about food hygiene and quality. For family consumption or business purposes a huge amount of fish is dried in the sun at peak season of harvesting. In our country a large quantity of dried fish are spoiled each year due to lack of proper drying, preservation and storage facilities particularly during the glut season (Neuschler, 1988). Major factors for poor quality of dry fishes are unhygienic handling and storage, lack of proper drying, physical damage, contamination with dirt and microorganism (Sugumar *et al.,* 2004). The quantitative losses through spoilage and insect attack on dried fish have been estimated to 10-35% in the marine areas (Doe *et al.*, 1977; Ahmed *et al.*, 1978). The quality of sun dried fishes is adversely affected

by microorganisms (Prakash *et al.,* 2011). Fish usually takes 5 to 7 days to dry during which it gets heavily contaminated (Doe *et al.,* 1977). Now the people of our country have become more conscious than before. They don't buy poor quality of dry fish. The physical and organoleptic qualities of most of the traditional sun dried products available in the market are not satisfactory for human consumption (Kamruzzaman, 1992; Reza *et al.* 2008). Although, few scientific articles on drying methodologies, household socio-economics, resource use of dried fish processors (Ahmed et al., 1993; DFID, 2001). Therefore it is very crucial to keep the nutritional value mostly unchanged with the different storage period.

Now days it has been observed that fish treated with several natural preservations like turmeric, lemon juice, lemon leaves extraction, ginger etc or other cooking ingredients showed better performance than our traditional processing method. It has many advantages such as it's a long time preservation method, availability of ingredients and for the retention of good beneficial property as well (Hossain *et al.*, 2012).

Salt has been used as a preservative since ancient times, to protect food against bacteria, mold, and spoilage. Basically, salt works by drying food. It absorbs water from foods, making the environment too dry to survive harmful micro-organisms. Table salt or sodium chloride is a common preservative because it is non-toxic, inexpensive, and tastes good. We also use this ingredient on a daily basis to our different food items.

Whereas turmeric is one of the oldest known anti-bacterial ingredients used by the ancient civilizations. Turmeric (*Curcuma longa*) has long been used as a coloring and flavoring agent for foods. Curcuminoids are the main component of turmeric and have a range of pharmacological activities (Santosh *et al.,* 2011) In Bangladesh, turmeric is a available species and is considered as one of the crucial ingredient for cooking any kind of dish. Even in our country some of farmer use turmeric for preservation of fish by drying it under the sunlight. But, there is very little scientific information about the use of turmeric in fish preservation. Due to the consumer awareness of chemical preservatives, extensive studies are been made on natural preservatives for preservation

of meat and fish products. The objectives for this study is to extend the shelf life of fish treated with salt and turmeric powder which would not alter the taste and flavor of the food product or add a new undesirable taste.

The present study was carried out to evaluate the potentiality of turmeric along with salt on the dried fish product as to observe the biochemical composition (proximate composition) at different storage period and microbial load(TPC) determination for Loitta fish (*Harpadon nehereus*).

This marine fish is of commercial significance (Rahman, 1989 and 2005). Used as food fish in Bangladesh and both fresh and sun-dried fish are used in this purpose. (Rupsankar, 2010) reported that traditionally the demand of fresh fish is limited and major portion of landings are converted to rope dried product. According to (Rahman 1989 and 2005) it is highly esteemed as food particularly in Chittagong (Bangladesh) where these are found in abundance. He also mentioned that dried Loitta fish has commercial importance in south and Southeast Asia. So the study might be help the future scientist, fish processors and the local people as a means of preservation process using such type of natural preservation.

1.2 Expected outcome

1. Access the proximate composition of Loitta *(Harpadon nehereus)* before and after treatment.
2. Measurement of microbial load (TPC) before and after treatment
3. Measurement of organoleptic and flavor taste of Loitta *(Harpadon nehereus)*.

2. Review of Literature

Effect of sundried fish treated by biopreservation as well as turmeric has a very few works worldwide. There are many researches on sundried fish available but no mentionable works yet to show on turmeric treated sundried fish. Turmeric treated loitta fish and determination of proximate composition with microbial activities in different stored period is unknown and no such work has been conducted worldwide. In this part, works of different researchers has been overviewed that are relevant to objectives of this study.

Lithhi *et al.*, (2012) studied suitability of herbal pesticides, turmeric and neem, in repelling dry fish insect *Necrobia sp.* Adult. They investigated repellency effect of turmeric and neem against the *mite Necrobia sp.* And determined field on the basis of their repellency, keeping quality, insect occurrence and sensory evaluation of turmeric and neem treated dry fish and their cooked products. They observed that turmeric extract and powder were more repellent than neem extract and powder. Their study suggested that turmeric at the rate of 3% extract or 1.5% powder or neem at the rate 5% extract or 1.5% powder could be suitable field doses for application of such herbs in dry fish directly to repel insects while storing the products.

Aliet A., (2007) observed that organoleptic and microbiological assessment of ten commercially important dried and fresh fishes. They showed Standard Plate count of seven dried fish samples like Loytta, Gang tengra and Phasa ranged from 4.23 to 7.8×10^3 CFU/g, five contained 3.2 to 6.07×10^4 CFU/g, while the remaining two samples (Shaplapata and Churi) SPC of 2.26 and 2.77 cfu/g respectively.

Huque *et al.*, (2013) conducted a study to determine the effects of radiation on biochemical (moisture, protein, fat, ash, carbohydrate, calcium and phosphorus) and microbiological qualities (TVBC, TCC and TFC) of three different dried fishes (Chepa, Loitta and Chingri) collected from retails markets. They found the highest moisture content (40.85 ± 0.42) in Chepa compare to Loitta (19.48 ±0.40) and Chingri (17.09 ±0.77). They found highest rate of total protein content in non-irradiated Chingri (60.39

±0.75) and Loitta (55.85 ± 0.40) compare to Chepa (32.67 ± 0.06). They revealed a result that radiation (3 and 5 kGy) has no significant effect on biochemical composition of three dried fishes and microbiology showed that total viable bacterial count (TVBC) was estimated in non-irradiated Chepa (5.58 ± 0.14 log cfu/g), Loitta (3.72 ± 0.09 log cfu/g) and Chingri (5.34 ± 0.15 log cfu/g) respectively which was significantly reduced by 1 to 3 logs at 3 kGy and 3 to 5 logs at 5 kGy gamma radiation. They also found maximum Total coliform count (TCC) in non-irradiated Chepa (5.28 ± 0.02 log cfu/g) compare to Loitta (3.23± 0.09) and Chingri (4.56 ± 0.06). They recorded Total fungal count (TFC) as 3.60 ± 0.09 and 3.78 ± 0.05 log cfu/g in non-irradiated Chepa and Chingri respectively but there was no TFC in non-irradiated Loitta. At 3 and 5 kGy , no TCC and TFC were found in all dried fishes.

Moisture, protein, lipid and ash contents of the solar tunnel dried product of silver jewfish (*Johnius argentatus*), ribbon fish (*Trichiurus haumela*), bombay duck (*Harpodon nehereus*) varied in the range of 11.48 to 16.83%, 58.51 to 68.49%, 6.08 to 8.62% and 13.05 to 14.88%, respectively (Mehbub, 2004).

The proximate composition of six marine fish dried was analyzed by Bhuiyan, 2012.The investigation reported 55.8% - 75.9% protein and 9.21% - 6.84% lipid and 6.9% - 14.2% moisture in dried marine fishes in dried fish sample. Where, Rahman *et al.*, (1982) observed 55.75% - 64.49% protein level in dried marine fishes. Hussain *et al.*, (1992) stated that the ash content varied over a large range 1.4-21.6% in 23 different dried species. On the other hand, Azam *et al.*, (2003) found 5.08 to 12.14% of ash content in fourteen dried fishes.

Cutting, (1962) reported that the chief alternation caused by drying is the reduction of moisture which resulted in an increase in protein and therefore, changes in food value in terms of unit amount of fish. But the changes in food value during curing varied greatly depending on the type of fish and the method of processing employed.

Kamaruzzaman (1992) obtained total bacterial count ranging from 1.84 to 5.3×10^5 CFU/g of commercially sun dried fresh water fish products samples.

Latifa *et al.*, (2014) evaluated shelf-life quality of salt and turmeric treated smoke-dried three different Bangladeshi lean fishes, Chapila (*Gudusia chapra*, Hamilton; 1822), Kaika (*Xenentodon cancila*; Hamilton; 1822) and Guchi Baim (*Mastacembelus pancalus*, Hamilton-Buchanan; 1822) by analyzed their biochemical (proximate and chemical)l composition and sensory evaluation during storage at refrigeration temperature(4°C). They found general decline in sensory characteristics i.e. color, texture, odor, general appearance and mean of acceptability of fish- product during storage. Among these three fish species smoke-dried kaika fish product became spoiled at the end of 9 month whereas smoke-dried Chapila and Guchi Baim fish product still remain in good condition. They estimated the shelf-life of smoke-dried Chapila and Guchi Baim fish product as 18 month and 27 month. Because of using salt and turmeric as natural preservative, they detected no yeast or mould in this three smoke-dried fish samples. Therefore, they inferred that salt and turmeric treated smoke-dried Guchi Baim fish product has longer shelf life than another two fish products.

Roy *et al.*, (2014) investigated on effects of salt, chili and turmeric powder on the production of high quality dried fish products from Bombay duck (*Harpodon nehereus*) under open sun drying. They studied five different types of dried products (T1-T5). Moisture content in T3 (fish sample treated with 4% salt)decreased more rapidly to below 16% within 28 hours of drying compared to those treated with other treatments (temperature varies from 24.6 °C to 34 °C and relative humidity varies between 60% and 48%) . Drying process was very slow in control samples where it took 32 hrs for reaching the moisture level to 18.75%. They evaluated that both turmeric and chili powders had strong repellency effect against insect infestation. They also found that Bombay duck treated with salt and herbal products were less infested by the blowfly whereas samples dried under control treatment were severely infested by blowfly.

Geetha *et al.*, (2014) carried out a study on some aspects of biochemical and microbial analysis of sun dry fish *Trichiurus lepturus linnaeus*, 1758 from the east coast off visakhapatnam. They observed that sundry fish Trichiurids are unhygienically sun dried by keeping on the seashore, on mats or road sides. They assessed biochemical and microbial qualities of fresh and sun dried fish. They estimated the bacterial counts ranged from 1.1X104 to 2.5 X 105cfu/g while the fungal counts ranged from 2.0X105 to 5.0 X 106cfu/g. It showed that of bacterial isolated from the dried fish, Staphylococcus was the most predominant organism. Their finding of this study showed that microbial load in the samples from villages was high due to clean and safe practices were not strictly followed.

A study was carried out by Mari *et al.*, (2012) to assess anti-microbial activity of turmeric natural dye against different bacterial strains. In the study in vitro, test confirmed the antimicrobial activity of turmeric extract against ten different bacterial strains. The antibacterial activity was measured by agar well diffusion method. The natural dye showed antibacterial activity against all the test bacterial isolates.

3. Materials and Methods

3.1 Sample Collection

To conduct the research experiment Loitta (*Harpadon neherius*) was collected from Sondhabazar fish Market, Khulna at fresh condition. After collection the sample was immediately taken to the Nutrition and Microbiology Laboratory of Fisheries and marine Resource Technology discipline (FMRT), Khulna University, Khulna, to analyze the sample. The average weight and length of the *loitta* was 55.43±5g and 18.20±3cm respectively. At first the fishes were carefully washed with tap water. Number of sample was 20 pieces for each treatment.

3.2 Sample Preparation

3.2.1 Dressing/Gutting

Prior to the experiment the fishes were gutted and gills, viscera were removed.

3.2.2 Washing

After gutting, the raw materials were washed again with tap water to remove blood, slime and other undesirable substances.

3.3 Treatment preparation

3.3.1 Salt and turmeric

To conduct the experiment salt (ACI salt, ACI Limited) and commercial turmeric powder (Radhuni, A product of Square Food and Beverage Ltd.) were collected from local market. Salt and turmeric powder was mixed with sufficient amount of water and rubbed outer the fish body.

There were three replications under four treatments for the experiment. The treatments were termed as follows:

Table-1: Treatments of the current study

SL.	Treatments	Description
1	Control	Dried fish without salt and turmeric powder
2	T-1	3% salt of fish body weight
3	T-2	3% salt with 2% turmeric powder of fish body weight
4	T-3	3% salt with 3% turmeric powder of fish body weight
5	T-4	3% salt with 4% turmeric powder of fish body weight

3.4 Drying

For drying purposes, a solar tent dryer was made using locally available materials. The dryer was made with wooden frame and covered with transparent polythene sheet which was attached with the frame of the dryer to avoid outside contamination and to protect the samples from the attack of bird, rodent and fly infestation. The dimension of the dryer was 5.5 feet long, 3 feet width and 4 feet high, covered with polythene sheet. Small pores were made to facilitate the air flow. Fishes were kept in sun regularly during day time from 8.30am to 5.30pm for 10 days (22 to 31 may 2015). Prior to treatment the dried fish were kept into airtight polythene bags. The samples for the present study were prepared at fish Nutrition and Microbiology lab of Khulna University. The proximate composition of the treated samples was analyzed with every ten days intervals. The microbial load was counted for three times, one, at the beginning of the experiment second one was at 30 days and last one was counted at 60 days.

3.5 Proximate Composition Analysis

Proximate composition analysis of moisture, ash, lipid and protein were carried out according to the methods of AOAC (1980) with certain modifications as described below.

3.5.1 Moisture determination (%)

Moisture was determined by complete drying of the sample at 105^0C. The loss in weight of the sample is the measurement of moisture content. For determining moisture a porcelain crucible was cleaned, dried and then the constant weight of the crucible was taken. Sample was placed in the crucible and weight was taken. Difference between the weights gave the weight of the sample. The crucible with sample was put in a controlled oven (N40C, Japan) and was dried at 105^0C for 24 hours and was weighed in electric balance (B303S, Japan) several times till the constant weight was achieved.

Calculation

The percentage of moisture content was calculated by the following formula:

$$\text{Moisture (\%)} = \frac{\text{Weight of the sample (g) - Weight of the dried sample (g)}}{\text{Weight of the sample}} \times 100$$

(Pearson, 1976)

3.5.2 Ash Determination (%)

Ash content was determined by igniting the sample in a Digital Muffle Furnace (DMF-05, Korea) at a temperature of 550°C for 6 hr. The sample was then cooled in a desiccator. The average weight in percentage of each sample of the remaining material was taken as that of ash. For determination of ash content the following formula was used-

$$\text{Ash content (\%)} = \frac{\text{Weight (gm) of Ash}}{\text{Weight (gm) of the sample}} \times 100$$

(Pearson, 1976)

3.5.3 Protein determination (%)

All the ingredients were homogenized separately by grindings. The protein level of each ingredient was determined according to the AOAC, 1980.

The procedure involves in two steps: (a) digestion of the sample to convert the N to ammonium sulphate and (b) determination of nitrogen in the digested sample through distillation and titration. About 0.2-0.5g sample was taken in a Kjeldahl flask and about 2g resolvent was added into the flask. About 5ml of concentrated sulfuric acid was added in to the flask slowly. Then the flask was kept on to a Kjeldahl nitrogen digesting apparatus (model No. OSK 8408A, OGAWA SEIKI CO. Ltd.) and heated until a clear digestion mixture appeared. After digestion, the flask was removed from the digestion unit and kept at room temperature until cooling. After cooling the digestion mixture, 70ml distilled water was poured slowly along the flask's inner wall and 0.5g of sandy zinc was also added to the mixture. About 25ml of 33-40% sodium hydroxide (NaOH) solution (containing 1% potassium sulfide) was poured slowly along the flask's inner wall and washed down the remaining solution on the mouth with a small amount of water. The flask was then placed to the Kjeldahl nitrogen distillation apparatus (Model No. OSK 8416A, OGAWA SEIKI CO. Ltd.) and turned the switch on. Before connecting the sample flask with the distillation plant, 10-20ml of 2% boric acid was taken in another Erlenmeyer flask (conical flask) and 2-4 drops of Tashiro's indicator (80mg methyl red and 20mg methylene blue in 95% ethanol and make up to 100ml with 95% ethanol) was added into it. Then the distillation tube was poured into the Erlenmeyer flask so that the end of the glass tube was immersed in the boric acid solution.

Distillation procedure was continued for about 30 minutes to obtain about 30ml distilled solution. After completion of distillation, the solution was titrated with 0.1N hydrochloric acid (HCl).

$$\% \text{ Total nitrogen (\% N)} = \frac{\text{Titrant (ml)} \times \text{Strength of titrant} \times 0.014}{\text{Weight of sample (g)}} \times 100$$

$$\% \text{ Crude Protein} = \% \text{ N} \times 6.25$$

(AOAC, 1980)

3.5.4 Lipid

For lipid determination 2-5g of sample was taken and mixed with 100ml of chloroform and methanol at a ratio of 2:1. Then the mixture was homogenized by using an electric homogenizer for 2 minutes. The resultant mixture was poured into a separation tube through filter paper. Then 50ml of distilled water was added and shook the tube which turned the solution into milky color. The solution was kept in separation funnel for 8-16 hours. Another beaker was dried in the oven weighted and poured clear extracted solution which contain lipid. Beaker was then kept on the hot plate (Stuart Scientific heater) at 70^0C until the evaporation of chloroform and methanol. The percentage of lipid count was calculated by the following equation:

$$\text{Percentage (\%) of Lipid} = \frac{\text{Weight of the residue}}{\text{Weight of sample}} \times 100$$

(Horowitz, 1984)

3.6 Microbial analysis

3.6.1 Total Plate Count

Microbiological analysis was done according to the Bacteriological Analytical Manual of United States Food and Drug Administration (USFDA). Total Plate Count (TPC) or Standard Plate Count (SPC) was included in current study.

3.6.3.1 Sterilization of equipments

Test tubes, Petri dishes, conical flask, plastic tips and other glassware were sterilized by autoclaving at a temperature of 121°C and a pressure of 15 pound per square inch for about 1 to 2 hours.

3.6.3.2 Media preparation

Media was being prepared by compounding require individual ingredients or, more conveniently, by adding water to a dehydrated product which contained all the ingredients. Practically, all media were available commercially in powdered form.

- Definite amounts of Plate Counting Agar (2.5g) were being accurately weighted
- These would take in separate volumetric flask (500ml) containing distilled water (half of the required volume)
- Then the final volume (500ml) being adjusted by pouring additional distilled water.
- Then the volumetric flasks kept in autoclave for sterilization. Autoclave has to be done at a temperature of 121°C for about 1 to 2 hours.
- After autoclave, the agar media was kept in the bio-safety cabinet for 20-30 minutes for cooling and then transferred in required number of petri dishes by 25ml volume for preparing plates.

3.6.3.3 Sample Preparation & Dilution (Water Samples)

1 ml of sample water was taken especially from the each sample and was transferred to cotton plugged bottle containing 9 ml distilled water. The sample was mixed properly by shaking the bottle carefully. Then the total amount became 10 ml. This made 1st decimal dilution (0.1). In this way five dilution tubes with the dilution strength, 10^{-1} through 10^{-5} were made **(fig-1).**

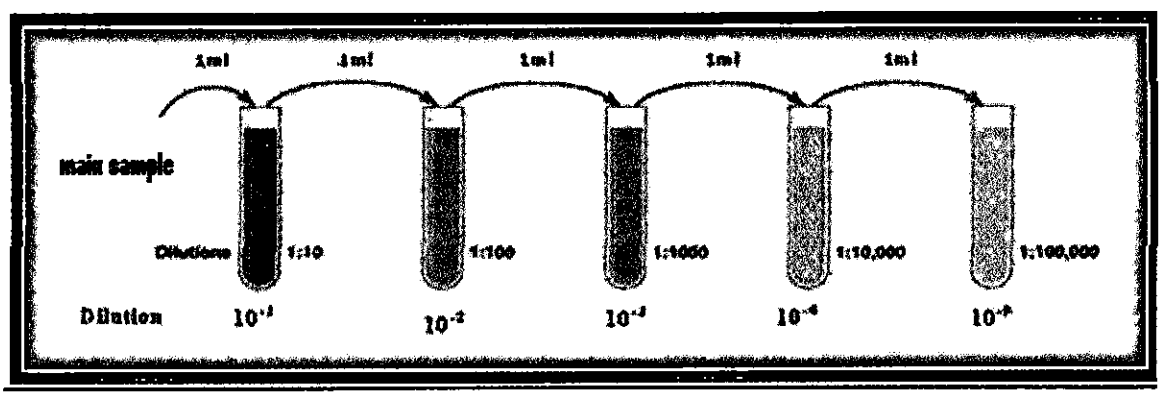

Figure: 1: Serial dilution of sample

The pour plate method requires use of 1 mL, 0.1 mL, and 0.01 mL or 0.001 mL of sample. The difficulty measuring and working with the two smaller volumes, 0.01 and 0.001 mL, require the use of sample dilutions.

3.6.3.4 Pour Plating

- 1 ml of the sample homogenates from the dilution tube from each samples were transferred by pipette into each of the appropriately marked and sterile duplicate Petri dishes (size 100 ml)
- Approximately 20 ml of the plate count agar (kept at 45^0C in a water bath) was poured into each Petri dish within shortage possible time of original dilution
- The sample dilutions and agar media were mixed thoroughly and uniformly by rotating the Petri dishes clockwise and anticlockwise
- Then the agar media were allowed to solidify
- Finally the solid agar media were allowed to freeze for 30 min

3.6.3.5 Incubation

The Petri dishes with solidified agar were incubated at 37^0C for 24 hours in the incubator.

3.6.3.6 Plate Counting

After incubation, the plates were analyzed. Analysis, in this case, means simply counting the entire colony forming units (CFU). To get reliable results with the spread plate method, only those plates were counted that produced between 30 - 300 CFUs. For ease of counting, the plates were marked into quadrants and count each quadrant separately.

1) Dividing the number of CFUs counted by the dilution factor and adjusts for the amount of sample actually plated. Reporting the number of colonies as CFU/g = Number of colonies on plate × reciprocal of dilution of sample.

2) Samples were reported on weight basis.

3) Estimating the number of microorganisms in total sample.

3.7 Organoleptic Quality Assessment

The organoleptic quality evaluation method used in this study was based on the procedure of Shewan and Ehrenberg, (1977), with some modification. To assess the organoleptic quality a panel of three members was formed. The average age of the panel members was 29. Samples from all the treatment were taken for organoleptic test. The assessment was done at 10, 30 and 60 days of the experiment. Prepared Score sheet, for the assessment was supplied to each panel members. Six quality factors were considered to assess the organoleptic quality.

Table-2: Organoleptic assessment indicators

Skin Appearance	Texture	Color	Odor	Score
Very good	Firm and Flexible	Very good	Very good	10
Good	Good	Good	Good	8
Moderately good	Moderately good	Moderately good	Moderately good	6
Moderately Bad	Moderately fragile	Moderately Bad	Moderately Rancid	4
Bad	Fragile	Bad	Rancid	2
Very Bad	Very fragile	Very Bad	Very Rancid	0

3.8. Data Analysis

Microsoft Excel and SPSS-17 were used to analyze and interpret the data. At first the date were input in Microsoft Excel. The data was exported to SPSS-17 for ANOVA Test, Homogenity Test and Descriptive Test. The Tables and graphs were generated from Microsoft Excel using SPSS-17.

The total procedures were as follows:

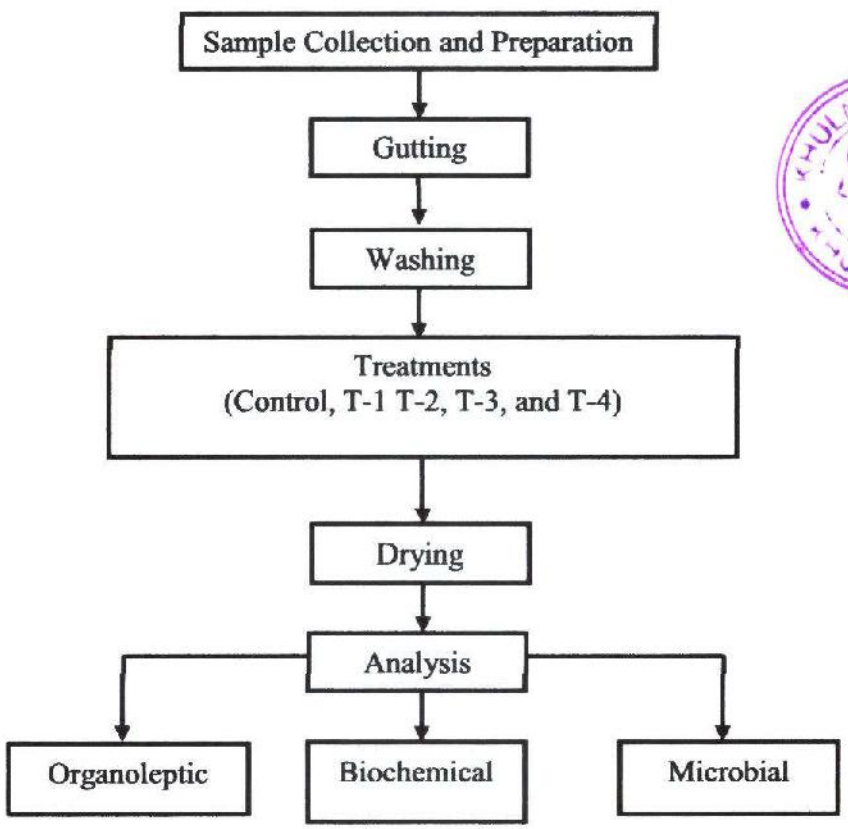

Figure 2: Flow chart of Materials and Methods

4. Result

Quality of food depends upon some key factors like physical observation, organoleptic evaluation, microbiological load, biochemical composition. These parameters serve as important base to evaluate the food quality of fishery products under investigation. To observe the effect of drying method on fish, it is also necessary to analyze the chemical composition and microbial load of final products. This chapter reports the organoleptic characteristics and biochemical aspects and microbiology of sun dried Loitta fish treated with salt with turmeric.

4.1 Proximate composition

Proximate composition of raw Loitta fish (Bombay Duck, *Harpodon nehereus*) is illustrated at Fig-1. The percentage of protein, lipid, moisture and ash contents were 12.2, 16.25, 73.27 and 3.64.

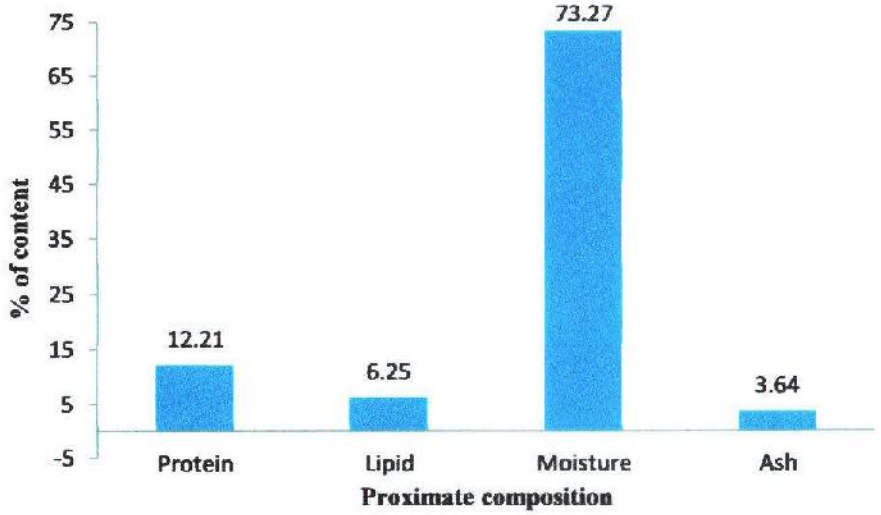

Fig-3: Proximate composition of freshly loitta fish.

Nutrient content viz. protein, lipid, moisture and ash contents of sun dried Loitta fish has been presented in Table-1 and Table-2, Table-3 and Table-4 respectively.

4.1.1 Protein

At 10th day of preservation the highest value of protein percentage found 62.82±0.29 on T-2 and lowest 59.13±0.16 on T-1. Current result showed that there were no significant difference (P>0.05) among T-2, T-3 and Control at 10th day. Statistics showed highest level of protein content on T-2 significantly varies (P<0.05) from other treatments at 20th, 30th, 40th and 50th day of preservation.

Table-3: Protein content of treated sun dried loitta fish*

Storage day	Control	T-1	T-2	T-3	T-4
Day 10	61.71±1.012^{ab}	59.13±0.16^{c}	62.82±0.29^{a}	61.68±0.06^{ab}	60.58±0.09^{bc}
Day 20	60.42±0.04^{bc}	58.61±0.06^{d}	62.71±0.14^{a}	61.47±0.06^{b}	60.04±0.55^{c}
Day 30	60.21±.03^{c}	57.88±.04^{d}	62.63±0.07^{a}	61.33±0.10^{b}	59.93±0.15^{c}
Day 40	59.32±.0.40^{c}	57.42±0.01^{d}	62.48±0.09^{a}	61.16±0.09^{b}	59.81±0.07^{c}
Day 50	58.76±0.05^{d}	56.97±0.05^{e}	62.36±0.13^{a}	61.02±0.02^{b}	59.78±0.07^{c}
Day 60	58.07±0.75^{cd}	56.64±.03^{d}	62.24±0.10^{a}	60.94±0.30^{ab}	59.25±0.08^{bc}

*Values are means of triplicate determination+ SE (n=3). Means on the same row with different letters as superscript are significantly different (P<0.05)

However at 60th day of preservation the highest value of protein percentage found 62.24±0.10 on T-2 and 60.94±0.30 on T-3 showed no significant difference (P>0.05) to each treatments. The lowest protein content observed at T-1 in different storage period. T-1 shows significant difference at 10th, 20th, 30th, 40th and 50th day of preservation among the other treatments.

4.1.2 Lipid

At 10th day of preservation the highest value of lipid percentage found 11.12±0.02 on T-4 and lowest 7.4±0.08 on Control (Table-4). T-4 shows significant difference with other treatments ($p<0.05$). T-2, T-3 and T-4 has highest value 10.12±0.05, 11.25±0.50 and 11.02±0.15 respectively which significantly varies ($P<0.05$) with other treatments at 20th day of preservation. In 30th and 40th day T-4 had highest lipid content10.89±0.06 and 10.78±0.05 respectively that significantly differ ($P<0.05$) with other treatments.

Table-4: Lipid content of treated sun dried loitta fish*

Storage day	*Control*	T-1	T-2	T-3	T-4
Day 10	7.4 ± 0.08^{e}	8.88 ± 0.05^{d}	10.14 ± 0.06^{c}	10.43 ± 0.08^{b}	11.12 ± 0.02^{a}
Day 20	7.32 ± 0.29^{c}	9.11 ± 0.31^{b}	10.12 ± 0.05^{ab}	11.25 ± 0.50^{a}	11.02 ± 0.15^{a}
Day 30	7.13 ± 0.12^{d}	8.62 ± 0.03^{c}	10.04 ± 0.12^{b}	10.33 ± 0.05^{b}	10.89 ± 0.06^{a}
Day 40	7.24 ± 0.11^{d}	8.59 ± 0.02^{c}	9.99 ± 0.04^{b}	10.24 ± 0.05^{b}	10.78 ± 0.05^{a}
Day 50	7.05 ± 0.12^{c}	7.43 ± 0.14^{bc}	8.99 ± 0.89^{ab}	10.21 ± 0.05^{a}	10.62 ± 0.12^{a}
Day 60	7.039 ± 0.05^{c}	7.30 ± 0.03^{c}	9.78 ± 0.04^{b}	10.16 ± 0.02^{a}	10.11 ± 0.12^{a}

*Values are means of triplicate determination+ SE (n=3). Means on the same row with different letters as superscript are significantly different ($P<0.05$)

T-3 and T-4 showed highest lipid content10.21±0.05 and 10.62±0.12 in 50th day of preservation had statistical difference ($P<0.05$) with other treatments. However, at 60 days of preservation the highest value of lipid percentage found 10.16±0.02 in T-3 and lowest 7.039±0.05 at Control.

It is clear from the present results that lipid content was highest 10.16±0.02 and 10.11±0.12 at T-3and T-4 varies significantly ($P<0.05$) from other treatments at 60 days of preservation.

4.1.3 Moisture

At 10th day of preservation the highest value of moisture percentage found 16.21±0.07 on Control and lowest 13.33±0.12 at T-2. It was observed that Control showed highest moisture level at 20th, 30th, 40th and 50th day of storage period which were significantly varies (P<0.05) with any other treatments. Same trend at 60 days of preservation the highest value of moisture percentage found 17.09±0.08 on Control and lowest 13.96±0.08 on T-2 and both varies significantly (P<0.05) from other treatments at 60 days of preservation.

Table-5: Moisture content of treated sun dried loitta fish*

Storage day	Control	T-1	T-2	T-3	T-4
Day 10	16.21 ± 0.07^{a}	15.38 ± 0.32^{b}	13.33 ± 0.12^{c}	15.02 ± 0.12^{b}	15.29 ± 0.04^{b}
Day 20	16.37 ± 0.03^{a}	15.39 ± 0.09^{b}	13.60 ± 0.05^{d}	15.14 ± 0.06^{c}	15.35 ± 0.02^{bc}
Day 30	16.56 ± 0.05^{a}	15.47 ± 0.04^{b}	13.49 ± 0.20^{c}	15.29 ± 0.02^{b}	15.44 ± 0.04^{b}
Day 40	16.65 ± 0.04^{a}	15.59 ± 0.09^{b}	13.67 ± 0.06^{d}	15.31 ± 0.03^{c}	15.45 ± 0.01^{bc}
Day 50	16.77 ± 0.09^{a}	15.80 ± 0.02^{b}	13.77 ± 0.05^{d}	15.33 ± 0.04^{c}	15.48 ± 0.06^{c}
Day 60	17.09 ± 0.08^{a}	15.96 ± 0.12^{b}	13.96 ± 0.08^{d}	15.38 ± 0.05^{c}	15.71 ± 0.13^{bc}

*Values are means of triplicate determination+ SE (n=3). Means on the same row with different letters as superscript are significantly different (P<0.05)

4.1.4 Ash

At 10th day of preservation the highest value of ash content found 14.52±0.07 on T-4 and lowest 11.22±0.55 on T-1 respectively. T-3 and T-4 showed significant variance (P<0.05) with other treatments at 10th day. It was observed that T-4 varies significantly at day 20th and 40th day of preservation possessed highest value to other treatments. At 10th day of preservation the highest value of ash content found 14.52±0.07 on T-4 and lowest 11.22±0.55 on T-1 respectively. T-3 and T-4 showed significant variance (P<0.05) with other treatments at 10th day. It was observed that T-4 varies significantly at day 20th and 40th day of preservation possessed highest value to other treatments.

Table-6: Ash content of treated sun dried loitta fish*

Treatment	Control	T-1	T-2	T-3	T-4
Day 10	11.76±0.74^{bc}	11.22±0.55^{c}	12.48±0.10^{bc}	13.57±0.12^{ab}	14.52±0.07^{a}
Day 20	10.76±0.10^{d}	11.53±.0.13^{cd}	11.82±0.47^{c}	13.32±0.04^{b}	14.43±0.05^{a}
Day 30	10.55±0.05^{d}	11.32±.0.06^{cd}	12.23±0.08b^{c}	13.28±0.57^{ab}	14.31±.0.05^{a}
Day 40	10.31±.0.08^{d}	11.24±0.07^{cd}	11.66±0.50^{c}	13.15±0.06^{b}	14.23±0.02^{a}
Day 50	10.18±.0.12^{c}	11.17±.0.03^{bc}	12.13±0.03^{ab}	13.15±.0.03^{a}	12.81±0.70^{a}
Day 60	10.12±0.09^{e}	11.04±0..04^{d}	12.01±0.04^{c}	13.06±0.02^{b}	14.13±0.04^{a}

*Values are means of triplicate determination+ SE (n=3). Means on the same row with different letters as superscript are significantly different (P<0.05)

However, at 50th day there were no significant difference (P>0.05) among T-2, T-3 and T-4. At 60th day of preservation the highest value of ash content found 14.13±0.04 in T-4and lowest 10.12±0.09 at Control.

It is found from the present results that ash content was highest at T-4 varies significantly (P<0.05) from other treatments at 60th day of preservation.

4.2 Microbiological assessment

The total plate count expressed as colony forming unit in one gram of sample (CFU/g) of the representative samples of Loitta fish was determined by standard plate count method on plate count agar media (Table-5). Bacterial loads of fresh loitta fish was 6.6± 0.55×10^{5} CFU/g.

Whereas bacterial loads of treated sun dried Loitta were 6.740±0.07×10^{4}, 3.620±0.06×10^{4}, 3.26±0.04×10^{3}, 2.43±0.05×10^{3} and 1.96±0.08×10^{3} CFU/g in 30th day of storage period in Control, T-1, T-2, T-3 and T-4 respectively. In 60th day of storage bacterial loads were 7.33±0.07×10^{4}, 5.48±0.12×10^{4}, 2.79±0.05×10^{3}, 2.56±0.04×10^{3} and 2.22±0.08×10^{3} Control, T-1, T-2, T-3 and T-4 respectively CFU/g (Table-5).

The highest bacterial load at day 30th were 6.740±0.07×10^{4} CFU/g on Control which is significantly varies (P<0.05) among other treatments and lowest were T-4 which is not significantly vary (P>0.05) with other two treatments T-2 and T-3.

The highest bacterial load at day 60th were 73.30±0.70 CFU/g on Control that vary significantly ($P<0.05$) with any other treatments and lowest were 2.22±0.08 CFU/g on T-4 which shows no statistical difference ($P>0.05$) with treatments T-2 and T-3.

Table-7: Bacterial load of sun dried loitta fish (values in 10^3)*

Storage time	Control	T-1	T-2	T-3	T-4
Day 30	67.40 ± 0.77^a	36.20 ± 0.59^b	3.26 ± 0.04^c	2.43 ± 0.05^c	1.96 ± 0.08^c
Day 60	73.30 ± 0.70^a	54.80 ± 1.15^b	2.79 ± 0.05^c	2.56 ± 0.04^c	2.22 ± 0.08^c

*Values are means of triplicate determination+ SE (n=3). Means on the same row with different letters as superscript are significantly different ($P<0.05$)

4.3 Organoleptic test

It is very important to evaluate organoleptic test to determine the consumer's acceptability. *Organoleptic test was performed at 60th day of storing period. Averages of all score are show in* Table-7. The score were assessed base on skin appearance, texture, color and odour. Best score of Skin Appearance, Texture, Color and odour is found 8.00, 7.17, 7.89 and 6.67 on T-2 (3% salt and 2% turmeric) respectively. Lowest score of was found 4.78 4.67, 4.11 and 3.89 on Control for skin appearance, texture, color and odour respectively.

Table-6: Organoleptic score sheet of Paryam and Pilgrim (1977)

Skin Appearance	Texture	Color	Odor	Score
Very good	Firm and Flexible	Very good	Very good	10
Good	Good	Good	Good	8
Moderately good	Moderately good	Moderately good	Moderately good	6
Moderately Bad	Moderately fragile	Moderately Bad	Moderately Rancid	4
Bad	Fragile	Bad	Rancid	2
Very Bad	Very fragile	Very Bad	Very Rancid	0

Table-8: Average organoleptic score of sun dried treated fish.

	Control	Salt only (T-1)	2% Turmeric (T-2)	3% Turmeric (T-3)	4% Turmeric (T-4)
Skin Appearance	4.78	5.89	8.00	7.33	6.67
Texture	4.67	5.78	7.17	6.50	5.83
Color	4.11	5.44	7.89	7.11	6.56
Odour	3.89	4.78	6.67	6.11	6.11

5. Discussion

5.1.1 Protein

The study was found that nutritional value of Loitta (*Harpadon nehereus*) species is decreased due to longer storage period. In the current investigation it was observed that the protein percentage decreased with the increased of day of preservation. The above figure shows that T-4 and T-3 decrease less than others. At Control, T-1, T-2, T-3 and T-4 protein content decreased 61.71±1.012, 59.13±0.16, 62.88±.03, 61.68±0.06 and 60.59±0.09 to 58.07±0.75, 56.64±.03, 62.01±0.05, 60.94±0.30 and 59.25±0.08 respectively. It was also observed that, about 60 days of preservation period protein percentage of Control, T-1, T-3, and T-4 showed significant difference ($P<0.05$) while T-2 showed no significant difference while T-3 not significantly differ ($P>0.05$) with 10th day and 60th day period (Appendix II). Which indicates there was no variation of protein level in different storage period of T-2 (3% salt and 2% turmeric).

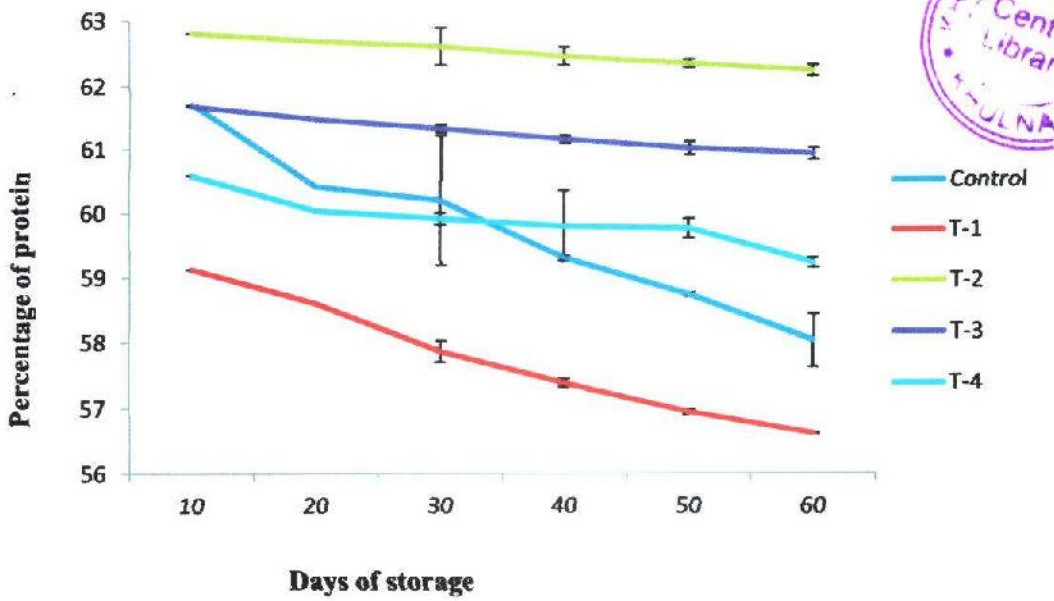

Fig-4: Protein contentment with different time

The protein level was found higher 62.88±.03 on T-2 (3% salt and 2% turmeric) in 10 days of storage period and 62.01±0.05 at 60 days of interval. At the end of experiment (after 60 days) T-2 (3% salt and 2% turmeric) showed highest level of protein content

which is significantly differs from any other treatments. This could be occurred because, turmeric powder contains slight amount of protein (8.5/100g) (Lal, 2012) which contribute to increase level of protein on T-2. But with the gradual increment of turmeric it reduces the content of protein by possessed the space of fish body in case of T-3 (3% salt and 3% turmeric), T-4 (3% salt and 4% turmeric). Protein level was found lower 59.13±0.16 at T-1 (salt only) in 10 days of storage period and 56.64±.03 in 60 days of interval (Table 1). Bhuiyan, (1992) observed 55.8% - 75.9% protein in dried fish sample (*Harpadon nehereus*) and Rahman *et al.*, (1982) observed 55.75% - 64.49% protein level in dried marine fishes which are similar to the current study.

5.1.2 Lipid

The lipid contents decreased with the increase of preservation time and vice versa for treatments. The value of lipid contents decreased more in treatment Control, T-1 than other treatments with storage time. At Control, T-1, T-2, T-3 and T-4 lipid content decreased 7.4±0.08-7.039±0.05, 8.88±0.05-7.30±0.03, 10.14±0.06-9.78±0.04-10.16±0.02, 10.43±0.08-10.16±0.02 and 11.12±0.02-10.11±0.12 respectively. This might be due to oxidative deterioration, thereby affecting lipid extraction. There were no significant difference ($P>0.05$) on Control and T-2 at day 10^{th} to 60^{th} day's lipid content. But the lipid content of T-1, T-3 and T-4 had significant difference ($P<0.05$) at day 10^{th} and 60^{th} (Appendix II).

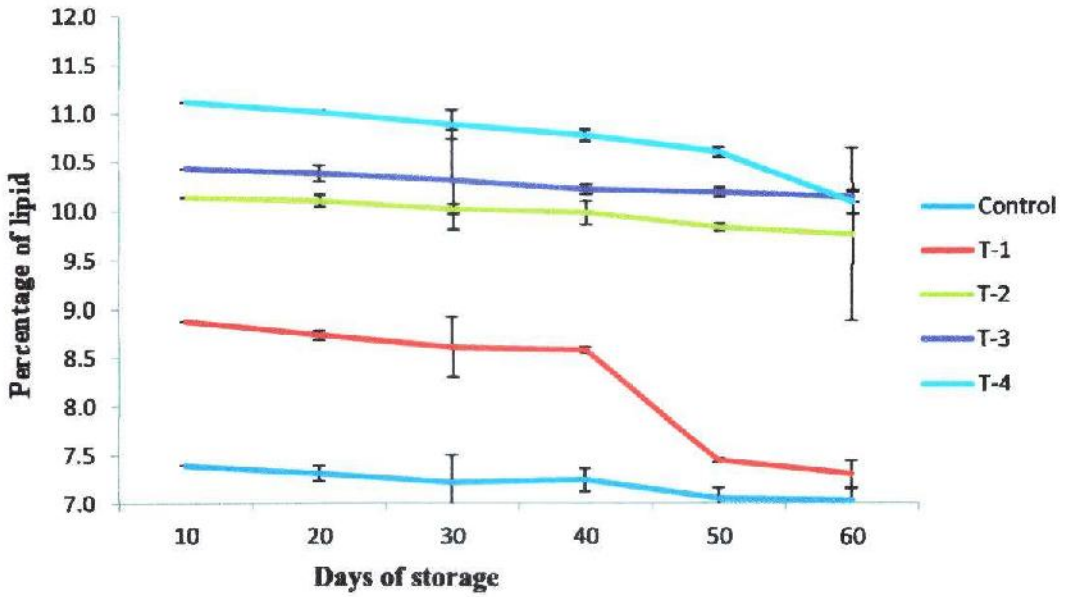

Fig-5: Lipid contentment with time

The mean percentages of lipid were found higher 11.12±0.02 in T-4 (3% salt and 4% turmeric) and lower 7.4±0.08 in Control at 10 days of storage period. Whether, T-4(3% salt and 4% turmeric) showed higher level of lipid content 10.16±0.02 and lowest at T-Control 7.039±0.05 at day 60th. On the contrary T-3 and T-4 has no significant difference at same day of experiment (Appendix II). Bhuiyan, (1992) observed 9.21% - 6.84% lipid in dried marine fishes. The lipid content ranging from 0.45% - 15.51% was reported by Rubbi *et al.*, (1987) in marine fishes which is very close with the present investigation. Lovern, (1950) reported that lipid content may be varied by influenced of the variation of species, diet, temperature, salinity, selective mobilization and distribution.

5.1.3 Moisture

The moisture level increases with the time of preservation. On the contrary, At Control, T-1, T-2, T-3 and T-4 moisture level increased 16.21±0.07-17.09±0.08, 15.38±0.32-15.96±0.12, 13.33±0.12-13.96±0.08, 15.02±0.12-15.38±0.05 and 15.29±0.04-15.71±0.13 respectively. The moisture level of day 10th and 60th varies significantly

(P<0.05) on Control, T-2, T-3 and T-4 while T-1 showed no significant (P>0.05) difference at 10th and 60th day's moisture level (Appendix II).

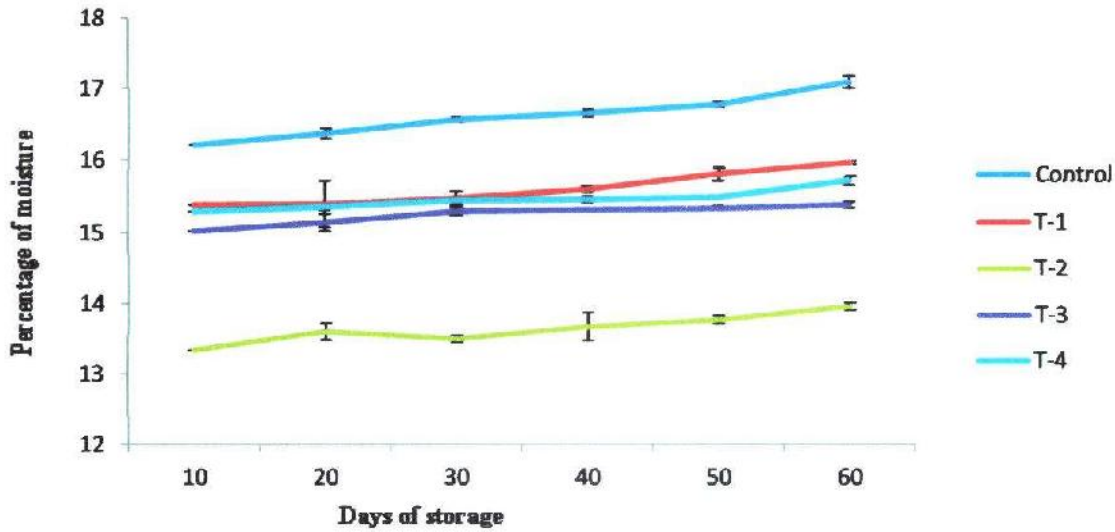

Fig-6: Moisture contentment with time

Moisture level found lowest 13.96±0.08 at T-2(3% salt and 2% turmeric) which significantly varies (P<0.05) and highest 17.09±0.08 at Control in 60 days of storage period. Bhuiyan, (1992) observed 6.9% - 14.2% moisture in dried marine fishes. The present study has some dissimilarities of above author, because present experiment studied different storage time of dry fishes with different treatments whereas other author only studied fresh dry fishes.

5.1.4 Ash

In this investigation ash contents of different treatments decreases with the time of preservation. At Control, T-1, T-2, T-3 and T-4 ash level decreased 11.76±0.74-10.12±0.09, 11.22±0.55-11.04±0.04, 12.48±0.10-12.01±0.04, 13.57±0.12-13.06±0.02 and 14.52±0.07-14.13±0.04 respectively. In case of Control, the ash content varies significantly (P<0.05) between 10th day and 60th day of stored period. But in case of T-1, T-2, T-3 and T-4, ash contents do not varies significantly (P>0.05) between day 10th and 60th (Appendix *II*).

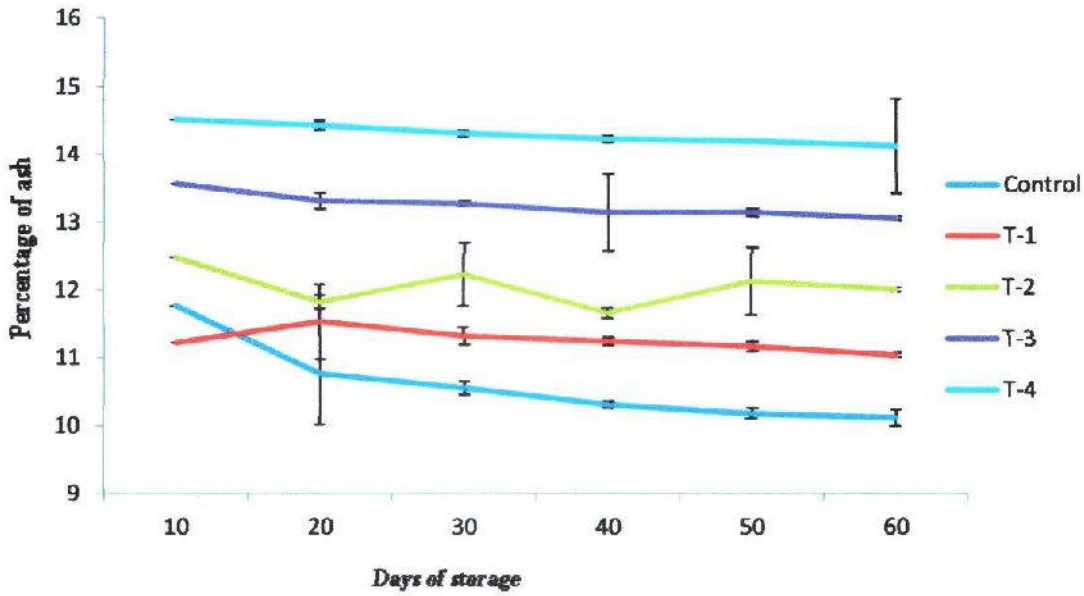

Fig-7: Ash contentment with time

The highest level of ash content was found 14.13±0.04 in T-4 (3% salt and 4% turmeric) and lowest level of ash content was found 10.12±0.09 in (Control). Hussain *et al.* (1992) stated that the ash content varied over a large range 1.4-21.6% in 23 different dried species. Azam *et al.* (2003) found 5.08 to 12.14% of ash content in fourteen dried fishes. Both studies indicate similarity to the current study.

5.2 Microbial aspects

The result of microbial loads revealed that Control had most microbial loads than any other treatments. Control and T-1 showed significant difference to any other turmeric treated sample i.e. T-2, T-3 and T-4 at both day 30th and 60th.

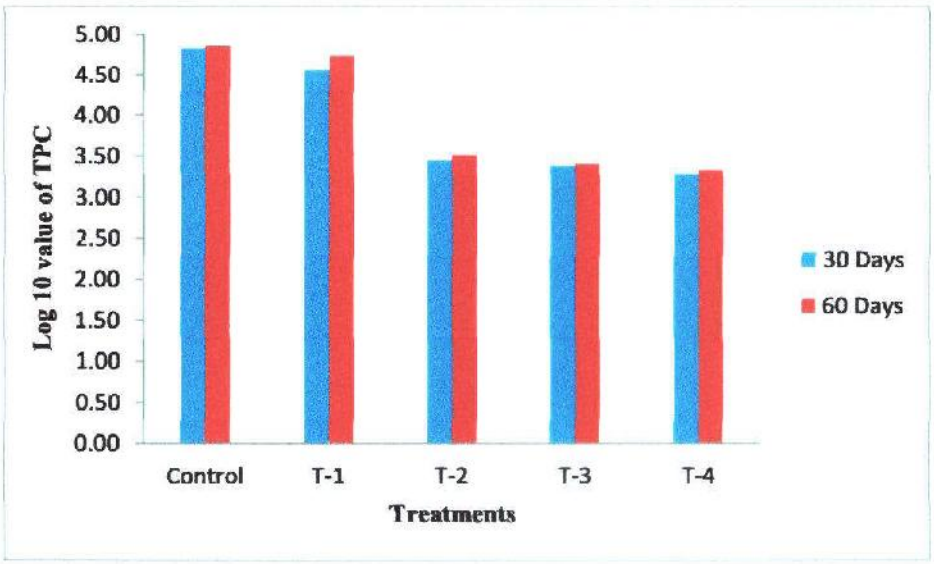

Fig-8: Total plate count of treated sun dried loitta fish

Microbial loads increases with the storage period. The result shows that Control, T-1, T-2, T-3 and T-4 was increased $6.740\pm0.07\times10^4$-$7.33\pm0.07\times10^4$ CFU/g, $3.620\pm0.06\times10^4$-$5.48\pm0.12\times10^4$ CFU/g, $3.26\pm0.04\times10^3$-$2.79\pm0.05\times10^3$ CFU/g, $2.43\pm0.05\times10^3$-$2.56\pm0.04\times10^3$ CFU/g and $1.96\pm0.08\times10^3$-$2.22\pm0.08\times10^3$ CFU/g respectively at day 30th to day 60th.

The result shows that the Total Plate Count of different sample in both 30th and 60th day indicated an acceptable microbial load ($<10^5$ CFU/g) by ICMSF, (1998). The investigation shows that the salt and salt treated dried fish contains less microbes than without treated dried fish. This could happen because salt makes unfavourable condition of microbes. Mari *et al*, (2012) found turmeric has good antimicrobial characteristics.

5.3 Organoleptic Aspects of Quality

The turmeric treated (T-2, T-3 and T-4) sun dried fish showed good quality for skin appearance rather than salt treated and untreated. Among the turmeric treated fish T-2 showed top most scores for skin appearance, color, texture and odour. During organoleptic evaluation, the dried fish had characteristic natural colour (yellowish white, silvery white). Almost all of sample had no rancid smell and insect infestation. No broken pieces or powdery particles were observed during the study except control

and salt treated sample (T-1). Based on the observation on organoleptic qualities of T-2 samples were best. This investigation of organoleptic aspects of Bombay duck (loitta) is similar to the observation of Khan et al, (1997).

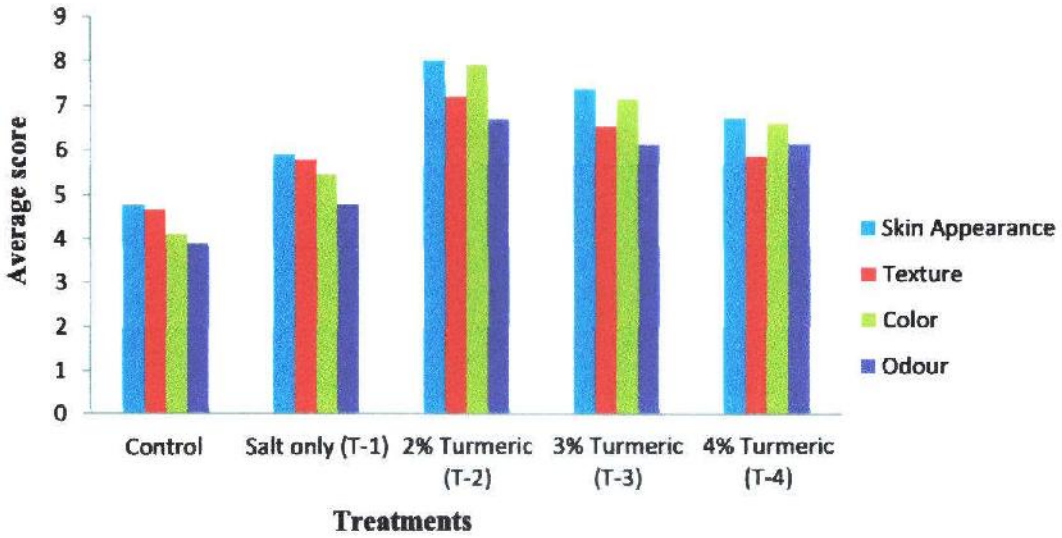

Fig-9: The average score of organoleptic test

From the graph it is clear that the overall score i.e. Skin appearance, Texture, Color and Odour were highest at T-2.

6. Conclusion

This study was conducted to assess the proximate composition, microbial load and organoleptic quality aspects of salt and salt–turmeric treated (with different level of concentration) loitta fish (Bombay duck) was dried at solar tent before 2 months of storage period. The present study reveals that different level of salt and salt-turmeric concentrations have a significant role on the proximate composition of marine loitta fish. It was observed that the hygienically dried samples using salt and salt- turmeric comparatively good nutritional value and quality aspects like color, skin appearance and odor. Salt and turmeric treatment reduces bacterial growth during drying period but it increases with storage period.

Recommendation

Sun dried loitta (Harpodon nehereus) products are very much popular in Bangladesh. Therefore, more studies are required in this sector to produce safer dried products. More studies should be conducted on the shelf life of salt and turmeric powder treated sun dried marine products under various storage conditions for longer period. Good quality and good nutritional values of loitta fish can be obtained by treatments of 3% salt and 2% turmeric concentration under sun drying in solar-tent dryer.

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8. Appendices

Appendix I

Proximate composition

Protein (results are in triplicate):

Days	Control	Salt only (T1)	2% Turmeric & Salt (T2)	3% Turmeric & Salt (T3)	4% Turmeric & Salt (T4)
10	60.58	59.38	62.26	61.77	60.61
10	60.82	59.17	62.99	61.71	60.41
10	63.73	58.84	63.21	61.56	60.74
20	60.5	58.65	62.94	61.36	59.11
20	60.42	58.68	62.74	61.56	61.02
20	60.34	58.5	62.45	61.49	59.99
30	60.16	57.81	62.7	61.52	60.11
30	60.24	57.87	62.49	61.28	60.04
30	60.23	57.96	62.7	61.19	59.64
40	60.11	57.44	62.55	61.21	59.93
40	59.01	57.41	62.31	61.29	59.69
40	58.84	57.42	62.58	60.98	59.81
50	58.66	56.88	62.47	61.06	59.91
50	58.78	56.99	62.22	61.01	59.77
50	58.84	57.04	62.39	60.99	59.66
60	58.61	56.69	62.36	61.41	59.14
60	59.01	56.64	62.05	61.04	59.21
60	56.59	56.59	62.31	60.37	59.4

Lipid (results are in triplicate)

Days	Control	Salt only (T1)	2% Turmeric & Salt (T2)	3% Turmeric & Salt (T3)	4% Turmeric & Salt (T4)
10	7.24	8.97	10.03	10.57	11.16
10	7.47	8.79	10.24	10.41	11.11
10	7.49	8.88	10.15	10.31	11.09
20	7.68	9.73	10.19	10.41	10.81
20	7.53	8.83	10.02	12.13	10.93
20	6.75	8.79	10.15	11.23	11.32
30	7.07	8.68	9.87	10.25	10.78
30	7.35	8.62	9.98	10.42	10.91
30	6.96	8.56	10.27	10.32	10.98
40	7.43	8.55	10.06	10.17	10.82
40	7.23	8.61	9.93	10.29	10.69
40	7.06	8.61	9.99	10.26	10.83
50	6.82	7.67	9.78	10.23	10.45
50	7.11	7.46	7.22	10.11	10.57
50	7.22	7.18	9.97	10.29	10.84
60	7.11	7.24	9.83	10.12	10.29
60	6.93	7.36	9.80	10.18	10.16
60	7.05	7.3	9.71	10.18	9.88

Moisture(results are in triplicate)

Days	Control	Salt only (T1)	2% Turmeric & Salt (T2)	3% Turmeric & Salt (T3)	4% Turmeric & Salt (T4)
10	16.32	15.27	13.14	15.20	15.31
10	16.23	15.98	13.31	15.07	15.24
10	16.08	14.89	13.54	14.79	15.32
20	16.35	15.34	13.69	15.17	15.32
20	16.43	15.27	13.57	15.22	15.38
20	16.33	15.56	13.54	15.03	15.35
30	16.49	15.41	13.63	15.25	15.41
30	16.54	15.54	13.74	15.33	15.51
30	16.65	15.46	13.09	15.29	15.40
40	16.58	15.73	13.73	15.32	15.44
40	16.72	15.62	13.56	15.36	15.47
40	16.65	15.42	13.72	15.25	15.44
50	16.79	15.78	13.82	15.39	15.50
50	16.92	15.83	13.67	15.34	15.58
50	16.6	15.79	13.82	15.26	15.36
60	16.97	15.77	13.84	15.38	15.61
60	17.06	15.94	13.93	15.47	15.56
60	17.24	16.17	14.11	15.29	15.96

Ash(results are in triplicate)

Days	Control	Salt only (T1)	2% Turmeric & Salt (T2)	3% Turmeric & Salt (T3)	4% Turmeric & Salt (T4)
10	13.25	11.85	12.35	13.36	14.45
10	11.03	11.68	12.41	13.59	14.66
10	11.01	10.12	12.68	13.76	14.45
20	10.62	11.36	12.28	13.39	14.44
20	10.71	11.44	10.89	13.26	14.51
20	10.95	11.79	12.30	13.31	14.34
30	10.6	11.38	12.12	13.27	14.42
30	10.46	11.2	12.18	12.29	14.25
30	10.59	11.38	12.39	14.28	14.26
40	10.42	11.19	10.65	13.24	14.26
40	10.35	11.16	12.14	13.16	14.2
40	10.16	11.37	12.18	13.05	14.23
50	10.04	11.11	12.13	13.14	14.21
50	10.09	11.17	12.08	13.1	12.25
50	10.41	11.23	12.18	13.21	11.98
60	9.97	11.12	12.07	13.08	14.19
60	10.27	11.02	12.02	13.03	14.14
60	10.13	10.98	11.94	13.07	14.06

TPC (results are in triplicate)

Days	Control	Salt only (T1)	2% Turmeric & Salt (T2)	3% Turmeric & Salt (T3)	4% Turmeric & Salt (T4)
30	67100	35400	2696	2412	1812
30	68860	37340	2840	2360	1980
30	66240	35860	2834	2518	2088
60	72300	52500	3320	2500	2360
60	74660	55800	3180	2640	2210
60	72940	56100	3280	2540	2084

Proximate composition and microbial load of fresh fish

Protein%	Lipid%	Moisture%	Ash%	TPC(CFU/g)
12.18	6.33	73.46	12.01	664300
12.28	6.26	73.1	12.32	662000
12.17	6.16	73.25	12.3	653700

Appendix II

Protein

Treatment	Day 10	Day 20	Day 30	Day 40	Day 50	Day 60
Control	61.71±1.01^{a}	60.42±0.04^{ab}	60.21±0.09^{ab}	59.32±0.40^{b}	58.76±0.05^{b}	58.07±0.75^{b}
T-1	59.13±0.16^{a}	58.61±0.06^{b}	57.88±0.04^{c}	57.42±0.01^{d}	56.97±0.05^{b}	56.64±0.03^{b}
T-2	62.82±0.29^{a}	62.71±0.14^{a}	62.63±0.07^{a}	62.48±0.09^{a}	62.36±0.13^{a}	62.24±0.10^{a}
T-3	61.68±0.06^{a}	61.47±0.06^{ab}	61.33±0.10^{ab}	61.16±0.09^{ab}	61.02±0.02a^{b}	60.94±0.30^{b}
T-4	60.68±0.09^{a}	60.04±0.55^{ab}	59.98±0.15^{ab}	59.81±0.07^{ab}	59.78±0.07^{ab}	59.25±0.08^{b}

Table-1: Protein content of sun dried loitta with different treatment

Lipid

Treatment	Day 10	Day 20	Day 30	Day 40	Day 50	Day 60
Control	7.4±0.08^{a}	7.32±0.29^{a}	7.13±0.12^{a}	7.24±0.11^{a}	7.05±0.12^{a}	7.039±0.05^{b}
T-1	8.88±0.05^{a}	9.11±0.31^{a}	8.62±0.03^{a}	8.59±0.02^{a}	7.43±0.14^{b}	7.30±0.03^{b}
T-2	10.14±0.06^{a}	10.12±0.05^{a}	10.04±0.12^{a}	9.99±0.04^{a}	8.99±0.89^{a}	9.78±0.04^{a}
T-3	10.43±0.08^{ab}	11.25±0.50^{a}	10.33±0.05^{ab}	10.24±0.05^{b}	10.21±0.05^{b}	10.16±0.02^{b}
T-4	11.12±0.02^{a}	11.02±0.15^{ab}	10.89±0.06^{ab}	10.78±0.05^{ab}	10.62±0.12^{b}	10.11±0.12^{c}

Table-2: Lipid content of sun dried loitta with different treatment

Moisture

Treatment	Day_10	Day_20	Day_30	Day_40	Day_50	Day_60
Control	16.21±0.07^{d}	16.37±0.03^{cd}	16.56±0.05^{bc}	16.65±0.04^{bc}	16.77±0.09^{c}	17.09±0.08^{a}
T-1	15.38±0.32^{a}	15.39±0.09^{a}	15.47±0.04^{a}	15.59±0.09^{a}	15.80±0.02^{a}	15.96±0.12^{a}
T-2	13.33±0.12^{b}	13.60±0.05^{ab}	13.49±0.20^{ab}	13.67±0.06^{ab}	13.77±0.05^{ab}	13.96±0.08^{a}
T-3	15.02±0.12^{b}	15.14±0.06^{ab}	15.29±0.02^{ab}	15.31±0.03^{ab}	15.33±0.04^{a}	15.38±0.05^{a}
T-4	15.29±0.04^{b}	15.35±0.02^{ab}	15.44±0.04^{ab}	15.45±0.01^{ab}	15.48±0.06^{ab}	15.71±0.13^{a}

Table-3: Moisture content of sun dried loitta with different treatment

Ash

Treatment	Day 10	Day 20	Day30	Day40	Day50	Day60
Control	11.76±0.74^{a}	10.76±0.10^{ab}	10.55±0.05^{ab}	10.31±0.08^{ab}	10.18±0.12^{b}	10.12±0.09^{b}
T-1	11.22±0.55^{a}	11.53±.0.13^{a}	11.32±.0.06^{a}	11.24±0.07^{a}	11.17±.0.03^{a}	11.04±0.04^{a}
T-2	12.48±0.10^{a}	11.82±0.47^{a}	12.23±0.08^{a}	11.86±0.50^{a}	12.13±0.03^{a}	12.01±0.04^{a}
T-3	13.57±0.12^{a}	13.32±0.04^{a}	13.28±0.57^{a}	13.15±0.06^{a}	13.15±.0.03^{a}	13.06±0.02^{a}
T-4	14.52±0.07^{a}	14.43±0.05^{a}	14.31±0.05^{a}	14.23±0.02^{a}	12.81±0.70^{b}	14.13±0.04^{ab}

Table-4: Ash content of sun dried loitta with different treatment

Appendix-III
Descriptive

Protein

Storage day	Treatments	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Day_I0	Control	3	61.7100	1.75348	1.01237	60.58	63.73
	3% Salt Only	3	59.1300	.27221	.15716	58.84	59.38
	3% Salt + 2% Turmeric	3	62.8200	.49729	.28711	62.26	63.21
	3% Salt + 3% Turmeric	3	61.6800	.10817	.06245	61.56	61.77
	3% Salt + 4% Turmeric	3	60.5867	.16623	.09597	60.41	60.74
Day_20	Control	3	60.4200	.08000	.04619	60.34	60.50
	3% Salt Only	3	58.6100	.09644	.05568	58.50	58.68
	3% Salt + 2% Turmeric	3	62.7100	.24637	.14224	62.45	62.94
	3% Salt + 3% Turmeric	3	61.4700	.10149	.05859	61.36	61.56
	3% Salt + 4% Turmeric	3	60.0400	.95598	.55194	59.11	61.02
Day_30	Control	3	60.2100	.04359	.02517	60.16	60.24
	3% Salt Only	3	57.8800	.07550	.04359	57.81	57.96
	3% Salt + 2% Turmeric	3	62.6300	.12124	.07000	62.49	62.70
	3% Salt + 3% Turmeric	3	61.3300	.17059	.09849	61.19	61.52
	3% Salt + 4% Turmeric	3	59.9300	.25357	.14640	59.64	60.11
Day_40	Control	3	59.3200	.68942	.39804	58.84	60.11
	3% Salt Only	3	57.4233	.01528	.00882	57.41	57.44
	3% Salt + 2% Turmeric	3	62.4800	.14799	.08544	62.31	62.58
	3% Salt + 3% Turmeric	3	61.1600	.16093	.09292	60.98	61.29
	3% Salt + 4% Turmeric	3	59.8100	.12000	.06928	59.69	59.93
Day_50	Control	3	58.7600	.09165	.05292	58.66	58.84
	3% Salt Only	3	56.9700	.08185	.04726	56.88	57.04
	3% Salt + 2% Turmeric	3	62.3600	.12767	.07371	62.22	62.47
	3% Salt + 3% Turmeric	3	61.0200	.03606	.02082	60.99	61.06
	3% Salt + 4% Turmeric	3	59.7800	.12530	.07234	59.66	59.91
Day_60	Control	3	58.0700	1.29723	.74895	56.59	59.01
	3% Salt Only	3	56.6400	.05000	.02887	56.59	56.69
	3% Salt + 2% Turmeric	3	62.2400	.16643	.09609	62.05	62.36
	3% Salt + 3% Turmeric	3	60.9400	.52716	.30436	60.37	61.41
	3% Salt + 4% Turmeric	3	59.2500	.13454	.07767	59.14	59.40

Lipid

Storage day	Treatments	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Day_10	Control	3	7.4000	.13892	.08021	7.24	7.49
	3% Salt Only	3	8.8800	.09000	.05196	8.79	8.97
	3% Salt + 2% Turmeric	3	10.1400	.10536	.06083	10.03	10.24
	3% Salt + 3% Turmeric	3	10.4300	.13115	.07572	10.31	10.57
	3% Salt + 4% Turmeric	3	11.1200	.03606	.02082	11.09	11.16
Day_20	Control	3	7.3200	.49930	.28827	6.75	7.68
	3% Salt Only	3	9.1167	.53154	.30688	8.79	9.73
	3% Salt + 2% Turmeric	3	10.1200	.08888	.05132	10.02	10.19
	3% Salt + 3% Turmeric	3	11.2567	.86031	.49670	10.41	12.13
	3% Salt + 4% Turmeric	3	11.0200	.26665	.15395	10.81	11.32
Day_30	Control	3	7.1267	.20108	.11609	6.96	7.35
	3% Salt Only	3	8.6200	.06000	.03464	8.56	8.68
	3% Salt + 2% Turmeric	3	10.0400	.20664	.11930	9.87	10.27
	3% Salt + 3% Turmeric	3	10.3300	.08544	.04933	10.25	10.42
	3% Salt + 4% Turmeric	3	10.8900	.10149	.05859	10.78	10.98
Day_40	Control	3	7.2400	.18520	.10693	7.06	7.43
	3% Salt Only	3	8.5900	.03464	.02000	8.55	8.61
	3% Salt + 2% Turmeric	3	9.9933	.06506	.03756	9.93	10.06
	3% Salt + 3% Turmeric	3	10.2400	.06245	.03606	10.17	10.29
	3% Salt + 4% Turmeric	3	10.7800	.07810	.04509	10.69	10.83
Day_50	Control	3	7.0500	.20664	.11930	6.82	7.22
	3% Salt Only	3	7.4367	.24583	.14193	7.18	7.67
	3% Salt + 2% Turmeric	3	8.9900	1.53581	.88670	7.22	9.97
	3% Salt + 3% Turmeric	3	10.2100	.09165	.05292	10.11	10.29
	3% Salt + 4% Turmeric	3	10.6200	.19975	.11533	10.45	10.84
Day_60	Control	3	7.0300	.09165	.05292	6.93	7.11
	3% Salt Only	3	7.3000	.06000	.03464	7.24	7.36
	3% Salt + 2% Turmeric	3	9.7800	.06245	.03606	9.71	9.83
	3% Salt + 3% Turmeric	3	10.1600	.03464	.02000	10.12	10.18
	3% Salt + 4% Turmeric	3	10.1100	.20952	.12097	9.88	10.29

Moisture

Storage day	Treatments	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Day_10	Control	3	16.2100	.12124	.07000	16.08	16.32
	3% Salt Only	3	15.3800	.55326	.31943	14.89	15.98
	3% Salt + 2% Turmeric	3	13.3300	.20075	.11590	13.14	13.54
	3% Salt + 3% Turmeric	3	15.0200	.20952	.12097	14.79	15.20
	3% Salt + 4% Turmeric	3	15.2900	.04359	.02517	15.24	15.32
Day_20	Control	3	16.3700	.05292	.03055	16.33	16.43
	3% Salt Only	3	15.3900	.15133	.08737	15.27	15.56
	3% Salt + 2% Turmeric	3	13.6000	.07937	.04583	13.54	13.69
	3% Salt + 3% Turmeric	3	15.1400	.09849	.05686	15.03	15.22
	3% Salt + 4% Turmeric	3	15.3500	.03000	.01732	15.32	15.38
Day_30	Control	3	16.5600	.08185	.04726	16.49	16.65
	3% Salt Only	3	15.4700	.06557	.03786	15.41	15.54
	3% Salt + 2% Turmeric	3	13.4867	.34790	.20086	13.09	13.74
	3% Salt + 3% Turmeric	3	15.2900	.04000	.02309	15.25	15.33
	3% Salt + 4% Turmeric	3	15.4400	.06083	.03512	15.40	15.51
Day_40	Control	3	16.6500	.07000	.04041	16.58	16.72
	3% Salt Only	3	15.5900	.15716	.09074	15.42	15.73
	3% Salt + 2% Turmeric	3	13.6700	.09539	.05508	13.56	13.73
	3% Salt + 3% Turmeric	3	15.3100	.05568	.03215	15.25	15.36
	3% Salt + 4% Turmeric	3	15.4500	.01732	.01000	15.44	15.47
Day_50	Control	3	16.7700	.16093	.09292	16.60	16.92
	3% Salt Only	3	15.8000	.02646	.01528	15.78	15.83
	3% Salt + 2% Turmeric	3	13.7700	.08660	.05000	13.67	13.82
	3% Salt + 3% Turmeric	3	15.3300	.06557	.03786	15.26	15.39
	3% Salt + 4% Turmeric	3	15.4800	.11136	.06429	15.36	15.58
Day_60	Control	3	17.0900	.13748	.07937	16.97	17.24
	3% Salt Only	3	15.9600	.20075	.11590	15.77	16.17
	3% Salt + 2% Turmeric	3	13.9600	.13748	.07937	13.84	14.11
	3% Salt + 3% Turmeric	3	15.3800	.09000	.05196	15.29	15.47
	3% Salt + 4% Turmeric	3	15.7100	.21794	.12583	15.56	15.96

Ash

Storage period	Treatments	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Day_10	Control	3	11.7633	1.28753	.74336	11.01	13.25
	3% Salt Only	3	11.2167	.95354	.55053	10.12	11.85
	3% Salt + 2% Turmeric	3	12.4800	.17578	.10149	12.35	12.68
	3% Salt + 3% Turmeric	3	13.5700	.20075	.11590	13.36	13.76
	3% Salt + 4% Turmeric	3	14.5200	.12124	.07000	14.45	14.66
Day_20	Control	3	10.7600	.17059	.09849	10.62	10.95
	3% Salt Only	3	11.5300	.22869	.13204	11.36	11.79
	3% Salt + 2% Turmeric	3	11.8233	.80835	.46670	10.89	12.30
	3% Salt + 3% Turmeric	3	13.3200	.06557	.03786	13.26	13.39
	3% Salt + 4% Turmeric	3	14.4300	.08544	.04933	14.34	14.51
Day_30	Control	3	10.5500	.07810	.04509	10.46	10.60
	3% Salt Only	3	11.3200	.10392	.06000	11.20	11.38
	3% Salt + 2% Turmeric	3	12.2300	.14177	.08185	12.12	12.39
	3% Salt + 3% Turmeric	3	13.2800	.99504	.57449	12.29	14.28
	3% Salt + 4% Turmeric	3	14.3100	.09539	.05508	14.25	14.42
Day_40	Control	3	10.3100	.13454	.07767	10.16	10.42
	3% Salt Only	3	11.2400	.11358	.06557	11.16	11.37
	3% Salt + 2% Turmeric	3	11.6567	.87203	.50347	10.65	12.18
	3% Salt + 3% Turmeric	3	13.1500	.09539	.05508	13.05	13.24
	3% Salt + 4% Turmeric	3	14.2300	.03000	.01732	14.20	14.26
Day_50	Control	3	10.1800	.20075	.11590	10.04	10.41
	3% Salt Only	3	11.1700	.06000	.03464	11.11	11.23
	3% Salt + 2% Turmeric	3	12.1300	.05000	.02887	12.08	12.18
	3% Salt + 3% Turmeric	3	13.1500	.05568	.03215	13.10	13.21
	3% Salt + 4% Turmeric	3	12.8133	1.21706	.70267	11.98	14.21
Day_60	Control	3	10.1233	.15011	.08667	9.97	10.27
	3% Salt Only	3	11.0400	.07211	.04163	10.98	11.12
	3% Salt + 2% Turmeric	3	12.0100	.06557	.03786	11.94	12.07
	3% Salt + 3% Turmeric	3	13.0600	.02646	.01528	13.03	13.08
	3% Salt + 4% Turmeric	3	14.1300	.06557	.03786	14.06	14.19

Homogenity Test (Tukey HSD)

Uses Harmonic Mean Sample Size = 3.000.

Day_10

Treatment	N	Subset for alpha = 0.05		
		1	2	3
3% Salt Only	3	59.1300		
3% Salt + 4% Turmeric	3	60.5867	60.5867	
3% Salt + 3% Turmeric	3		61.6800	61.6800
Control	3		61.7100	61.7100
3% Salt + 2% Turmeric	3			62.8200
Sig.		.271	.496	.483

Day_20

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt Only	3	58.6100			
3% Salt + 4% Turmeric	3		60.0400		
Control	3		60.4200	60.4200	
3% Salt + 3% Turmeric	3			61.4700	
3% Salt + 2% Turmeric	3				62.7100
Sig.		1.000	.831	.095	1.000

Day_30

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt Only	3	57.8800			
3% Salt + 4% Turmeric	3		59.9300		
Control	3		60.2100		
3% Salt + 3% Turmeric	3			61.3300	
3% Salt + 2% Turmeric	3				62.6300
Sig.		1.000	.236	1.000	1.000

Day_40

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt Only	3	57.4233			
Control	3		59.3200		
3% Salt + 4% Turmeric	3		59.8100		
3% Salt + 3% Turmeric	3			61.1600	
3% Salt + 2% Turmeric	3				62.4800
Sig.		1.000	.409	1.000	1.000

Day_50

Treatment	N	Subset for alpha = 0.05				
		1	2	3	4	5
3% Salt Only	3	56.9700				
Control	3		58.7600			
3% Salt + 4% Turmeric	3			59.7800		
3% Salt + 3% Turmeric	3				61.0200	
3% Salt + 2% Turmeric	3					62.3600
Sig.		1.000	1.000	1.000	1.000	1.000

Day_60

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt Only	3	56.6400			
Control	3	58.0700	58.0700		
3% Salt + 4% Turmeric	3		59.2500	59.2500	
3% Salt + 3% Turmeric	3			60.9400	60.9400
3% Salt + 2% Turmeric	3				62.2400
Sig.		.113	.228	.052	.164

Lipid

Day_10

Treatment	N	Subset for alpha = 0.05				
		1	2	3	4	5
Control	3	7.4000				
3% Salt Only	3		8.8800			
3% Salt + 2% Turmeric	3			10.1400		
3% Salt + 3% Turmeric	3				10.4300	
3% Salt + 4% Turmeric	3					11.1200
Sig.		1.000	1.000	1.000	1.000	1.000

Day_20

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Control	3	7.3200		
3% Salt Only	3		9.1167	
3% Salt + 2% Turmeric	3		10.1200	10.1200
3% Salt + 4% Turmeric	3			11.0200
3% Salt + 3% Turmeric	3			11.2567
Sig.		1.000	.202	.128

Day_30

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Control	3	7.1267			
3% Salt Only	3		8.6200		
3% Salt + 2% Turmeric	3			10.0400	
3% Salt + 3% Turmeric	3			10.3300	
3% Salt + 4% Turmeric	3				10.8900
Sig.		1.000	1.000	.177	1.000

Day_40

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Control	3	7.2400			
3% Salt Only	3		8.5900		
3% Salt + 2% Turmeric	3			9.9933	
3% Salt + 3% Turmeric	3			10.2400	
3% Salt + 4% Turmeric	3				10.7800
Sig.		1.000	1.000	.075	1.000

Day_50

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Control	3	7.0500		
3% Salt Only	3	7.4367	7.4367	
3% Salt + 2% Turmeric	3		8.9900	8.9900
3% Salt + 3% Turmeric	3			10.2100
3% Salt + 4% Turmeric	3			10.6200
Sig.		.959	.127	.104

Day_60

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Control	3	7.0300		
3% Salt Only	3	7.3000		
3% Salt + 2% Turmeric	3		9.7800	
3% Salt + 4% Turmeric	3			10.1100
3% Salt + 3% Turmeric	3			10.1600
Sig.		.079	1.000	.979

Moisture

Day_10

Treatment	N	Subset for alpha = 0.05		
		1	2	3
3% Salt + 2% Turmeric	3	13.3300		
3% Salt + 3% Turmeric	3		15.0200	
3% Salt + 4% Turmeric	3		15.2900	
3% Salt Only	3		15.3800	
Control	3			16.2100
Sig.		1.000	.559	1.000

Day_20

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt + 2% Turmeric	3	13.6000			
3% Salt + 3% Turmeric	3		15.1400		
3% Salt + 4% Turmeric	3		15.3500	15.3500	
3% Salt Only	3			15.3900	
Control	3				16.3700
Sig.		1.000	.109	.982	1.000

Day_30

Treatment	N	Subset for alpha = 0.05		
		1	2	3
3% Salt + 2% Turmeric	3	13.4867		
3% Salt + 3% Turmeric	3		15.2900	
3% Salt + 4% Turmeric	3		15.4400	
3% Salt Only	3		15.4700	
Control	3			16.5600
Sig.		1.000	.680	1.000

Day_40

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt + 2% Turmeric	3	13.6700			
3% Salt + 3% Turmeric	3		15.3100		
3% Salt + 4% Turmeric	3		15.4500	15.4500	
3% Salt Only	3			15.5900	
Control	3				16.6500
Sig.		1.000	.391	.391	1.000

Day_50

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt + 2% Turmeric	3	13.7700			
3% Salt + 3% Turmeric	3		15.3300		
3% Salt + 4% Turmeric	3		15.4800		
3% Salt Only	3			15.8000	
Control	3				16.7700
Sig.		1.000	.413	1.000	1.000

Day_60

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
3% Salt + 2% Turmeric	3	13.9600			
3% Salt + 3% Turmeric	3		15.3800		
3% Salt + 4% Turmeric	3		15.7100	15.7100	
3% Salt Only	3			15.9600	
Control	3				17.0900
Sig.		1.000	.173	.389	1.000

Ash

Day_10

Treatment	N	Subset for alpha = 0.05		
		1	2	3
3% Salt Only	3	11.2167		
Control	3	11.7633	11.7633	
3% Salt + 2% Turmeric	3	12.4800	12.4800	
3% Salt + 3% Turmeric	3		13.5700	13.5700
3% Salt + 4% Turmeric	3			14.5200
Sig.		.282	.074	.530

Day_20

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Control	3	10.7600			
3% Salt Only	3	11.5300	11.5300		
3% Salt + 2% Turmeric	3		11.8233		
3% Salt + 3% Turmeric	3			13.3200	
3% Salt + 4% Turmeric	3				14.4300
Sig.		.181	.879	1.000	1.000

Day_30

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Control	3	10.5500			
3% Salt Only	3	11.3200	11.3200		
3% Salt + 2% Turmeric	3		12.2300	12.2300	
3% Salt + 3% Turmeric	3			13.2800	13.2800
3% Salt + 4% Turmeric	3				14.3100
Sig.		.302	.179	.103	.111

Day_40

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Control	3	10.3100			
3% Salt Only	3	11.2400	11.2400		
3% Salt + 2% Turmeric	3		11.6567		
3% Salt + 3% Turmeric	3			13.1500	
3% Salt + 4% Turmeric	3				14.2300
Sig.		.099	.711	1.000	1.000

Day_50

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Control	3	10.1800		
3% Salt Only	3	11.1700	11.1700	
3% Salt + 2% Turmeric	3		12.1300	12.1300
3% Salt + 4% Turmeric	3			12.8133
3% Salt + 3% Turmeric	3			13.1500
Sig.		.257	.282	.235

Day_60

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05				
		1	2	3	4	5
Control	3	10.1233				
3% Salt Only	3		11.0400			
3% Salt + 2% Turmeric	3			12.0100		
3% Salt + 3% Turmeric	3				13.0600	
3% Salt + 4% Turmeric	3					14.1300
Sig.		1.000	1.000	1.000	1.000	1.000

Appendix IV
Descriptive

Protein (discussion)

Treatments	Storage day	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10 Days	3	61.7100	1.75348	1.01237	60.58	63.73
	20 Days	3	60.4200	.08000	.04619	60.34	60.50
	30 Days	3	60.2100	.04359	.02517	60.16	60.24
	40 Days	3	59.3200	.68942	.39804	58.84	60.11
	50 Days	3	58.7600	.09165	.05292	58.66	58.84
	60 Days	3	58.0700	1.29723	.74895	56.59	59.01
3% Salt Only	10 Days	3	59.1300	.27221	.15716	58.84	59.38
	20 Days	3	58.6100	.09644	.05568	58.50	58.68
	30 Days	3	57.8800	.07550	.04359	57.81	57.96
	40 Days	3	57.4233	.01528	.00882	57.41	57.44
	50 Days	3	56.9700	.08185	.04726	56.88	57.04
	60 Days	3	56.6400	.05000	.02887	56.59	56.69
3% Salt + 2% Turmeric	10 Days	3	62.8200	.49729	.28711	62.26	63.21
	20 Days	3	62.7100	.24637	.14224	62.45	62.94
	30 Days	3	62.6300	.12124	.07000	62.49	62.70
	40 Days	3	62.4800	.14799	.08544	62.31	62.58
	50 Days	3	62.3600	.12767	.07371	62.22	62.47
	60 Days	3	62.2400	.16643	.09609	62.05	62.36
3% Salt + 3% Turmeric	10 Days	3	61.6800	.10817	.06245	61.56	61.77
	20 Days	3	61.4700	.10149	.05859	61.36	61.56
	30 Days	3	61.3300	.17059	.09849	61.19	61.52
	40 Days	3	61.1600	.16093	.09292	60.98	61.29
	50 Days	3	61.0200	.03606	.02082	60.99	61.06
	60 Days	3	60.9400	.52716	.30436	60.37	61.41
3% Salt + 4% Turmeric	10 Days	3	60.5867	.16623	.09597	60.41	60.74
	20 Days	3	60.0400	.95598	.55194	59.11	61.02
	30 Days	3	59.9300	.25357	.14640	59.64	60.11
	40 Days	3	59.8100	.12000	.06928	59.69	59.93
	50 Days	3	59.7800	.12530	.07234	59.66	59.91
	60 Days	3	59.2500	.13454	.07767	59.14	59.40

Lipid (discussion)

Treatments	Storage day	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10 Days	3	7.4000	.13892	.08021	7.24	7.49
	20 Days	3	7.3200	.49930	.28827	6.75	7.68
	30 Days	3	7.1267	.20108	.11609	6.96	7.35
	40 Days	3	7.2400	.18520	.10693	7.06	7.43
	50 Days	3	7.0500	.20664	.11930	6.82	7.22
	60 Days	3	7.0300	.09165	.05292	6.93	7.11
3% Salt Only	10 Days	3	8.8800	.09000	.05196	8.79	8.97
	20 Days	3	9.1167	.53154	.30688	8.79	9.73
	30 Days	3	8.6200	.06000	.03464	8.56	8.68
	40 Days	3	8.5900	.03464	.02000	8.55	8.61
	50 Days	3	7.4367	.24583	.14193	7.18	7.67
	60 Days	3	7.3000	.06000	.03464	7.24	7.36
3% Salt + 2% Turmeric	10 Days	3	10.1400	.10536	.06083	10.03	10.24
	20 Days	3	10.1200	.08888	.05132	10.02	10.19
	30 Days	3	10.0400	.20664	.11930	9.87	10.27
	40 Days	3	9.9933	.06506	.03756	9.93	10.06
	50 Days	3	8.9900	1.53581	.88670	7.22	9.97
	60 Days	3	9.7800	.06245	.03606	9.71	9.83
3% Salt + 3% Turmeric	10 Days	3	10.4300	.13115	.07572	10.31	10.57
	20 Days	3	11.2567	.86031	.49670	10.41	12.13
	30 Days	3	10.3300	.08544	.04933	10.25	10.42
	40 Days	3	10.2400	.06245	.03606	10.17	10.29
	50 Days	3	10.2100	.09165	.05292	10.11	10.29
	60 Days	3	10.1600	.03464	.02000	10.12	10.18
3% Salt + 4% Turmeric	10 Days	3	11.1200	.03606	.02082	11.09	11.16
	20 Days	3	11.0200	.26665	.15395	10.81	11.32
	30 Days	3	10.8900	.10149	.05859	10.78	10.98
	40 Days	3	10.7800	.07810	.04509	10.69	10.83
	50 Days	3	10.6200	.19975	.11533	10.45	10.84
	60 Days	3	10.1100	.20952	.12097	9.88	10.29
	Total	18	10.7567	.36901	.08698	9.88	11.32

Moisture (discussion)

Treatments	Storage day	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10 Days	3	16.2100	.12124	.07000	16.08	16.32
	20 Days	3	16.3700	.05292	.03055	16.33	16.43
	30 Days	3	16.5600	.08185	.04726	16.49	16.65
	40 Days	3	16.6500	.07000	.04041	16.58	16.72
	50 Days	3	16.7700	.16093	.09292	16.60	16.92
	60 Days	3	17.0900	.13748	.07937	16.97	17.24
3% Salt Only	10 Days	3	15.3800	.55326	.31943	14.89	15.98
	20 Days	3	15.3900	.15133	.08737	15.27	15.56
	30 Days	3	15.4700	.06557	.03786	15.41	15.54
	40 Days	3	15.5900	.15716	.09074	15.42	15.73
	50 Days	3	15.8000	.02646	.01528	15.78	15.83
	60 Days	3	15.9600	.20075	.11590	15.77	16.17
3% Salt + 2% Turmeric	10 Days	3	13.3300	.20075	.11590	13.14	13.54
	20 Days	3	13.6000	.07937	.04583	13.54	13.69
	30 Days	3	13.4867	.34790	.20086	13.09	13.74
	40 Days	3	13.6700	.09539	.05508	13.56	13.73
	50 Days	3	13.7700	.08660	.05000	13.67	13.82
	60 Days	3	13.9600	.13748	.07937	13.84	14.11
3% Salt + 3% Turmeric	10 Days	3	15.0200	.20952	.12097	14.79	15.20
	20 Days	3	15.1400	.09849	.05686	15.03	15.22
	30 Days	3	15.2900	.04000	.02309	15.25	15.33
	40 Days	3	15.3100	.05568	.03215	15.25	15.36
	50 Days	3	15.3300	.06557	.03786	15.26	15.39
	60 Days	3	15.3800	.09000	.05196	15.29	15.47
3% Salt + 4% Turmeric	10 Days	3	15.2900	.04359	.02517	15.24	15.32
	20 Days	3	15.3500	.03000	.01732	15.32	15.38
	30 Days	3	15.4400	.06083	.03512	15.40	15.51
	40 Days	3	15.4500	.01732	.01000	15.44	15.47
	50 Days	3	15.4800	.11136	.06429	15.36	15.58
	60 Days	3	15.7100	.21794	.12583	15.56	15.96

Ash (discussion)

Treatments	Storage day	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10 Days	3	11.7633	1.28753	.74336	11.01	13.25
	20 Days	3	10.7600	.17059	.09849	10.62	10.95
	30 Days	3	10.5500	.07810	.04509	10.46	10.60
	40 Days	3	10.3100	.13454	.07767	10.16	10.42
	50 Days	3	10.1800	.20075	.11590	10.04	10.41
	60 Days	3	10.1233	.15011	.08667	9.97	10.27
3% Salt Only	10 Days	3	11.2167	.95354	.55053	10.12	11.85
	20 Days	3	11.5300	.22869	.13204	11.36	11.79
	30 Days	3	11.3200	.10392	.06000	11.20	11.38
	40 Days	3	11.2400	.11358	.06557	11.16	11.37
	50 Days	3	11.1700	.06000	.03464	11.11	11.23
	60 Days	3	11.0400	.07211	.04163	10.98	11.12
3% Salt + 2% Turmeric	10 Days	3	12.4800	.17578	.10149	12.35	12.68
	20 Days	3	11.8233	.80835	.46670	10.89	12.30
	30 Days	3	12.2300	.14177	.08185	12.12	12.39
	40 Days	3	11.6567	.87203	.50347	10.65	12.18
	50 Days	3	12.1300	.05000	.02887	12.08	12.18
	60 Days	3	12.0100	.06557	.03786	11.94	12.07
3% Salt + 3% Turmeric	10 Days	3	13.5700	.20075	.11590	13.36	13.76
	20 Days	3	13.3200	.06557	.03786	13.26	13.39
	30 Days	3	13.2800	.99504	.57449	12.29	14.28
	40 Days	3	13.1500	.09539	.05508	13.05	13.24
	50 Days	3	13.1500	.05568	.03215	13.10	13.21
	60 Days	3	13.0600	.02646	.01528	13.03	13.08
3% Salt + 4% Turmeric	10 Days	3	14.5200	.12124	.07000	14.45	14.66
	20 Days	3	14.4300	.08544	.04933	14.34	14.51
	30 Days	3	14.3100	.09539	.05508	14.25	14.42
	40 Days	3	14.2300	.03000	.01732	14.20	14.26
	50 Days	3	12.8133	1.21706	.70267	11.98	14.21
	60 Days	3	14.1300	.06557	.03786	14.06	14.19

Homogenity Test (Tukey HSD)

Uses Harmonic Mean Sample Size = 3.000.

Protein (discussion)

Control

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	58.0700	
50 Days	3	58.7600	
40 Days	3	59.3200	59.3200
30 Days	3	60.2100	60.2100
20 Days	3	60.4200	60.4200
10 Days	3		61.7100
Sig.		.080	.073

3% Salt Only

Day	N	Subset for alpha = 0.05				
		1	2	3	4	5
60 Days	3	56.6400				
50 Days	3	56.9700				
40 Days	3		57.4233			
30 Days	3			57.8800		
20 Days	3				58.6100	
10 Days	3					59.1300
Sig.		.070	1.000	1.000	1.000	1.000

3% Salt + 2% Turmeric

Day	N	Subset for alpha = 0.05
		1
60 Days	3	62.2400
50 Days	3	62.3600
40 Days	3	62.4800
30 Days	3	62.6300
20 Days	3	62.7100
10 Days	3	62.8200
Sig.		.127

3% Salt + 3% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	60.9400	
50 Days	3	61.0200	61.0200
40 Days	3	61.1600	61.1600
30 Days	3	61.3300	61.3300
20 Days	3	61.4700	61.4700
10 Days	3		61.6800
Sig.		.155	.054

3% Salt + 4% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	59.2500	
50 Days	3	59.7800	59.7800
40 Days	3	59.8100	59.8100
30 Days	3	59.9300	59.9300
20 Days	3	60.0400	60.0400
10 Days	3		60.5867
Sig.		.262	.245

Lipid (discussion)

Control

Day	N	Subset for alpha = 0.05
		1
60 Days	3	7.0300
50 Days	3	7.0500
30 Days	3	7.1267
40 Days	3	7.2400
20 Days	3	7.3200
10 Days	3	7.4000
Sig.		.518

3% Salt Only

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	7.3000	
50 Days	3	7.4367	
40 Days	3		8.5900
30 Days	3		8.6200
10 Days	3		8.8800
20 Days	3		9.1167
Sig.		.980	.162

3% Salt + 2% Turmeric

Day	N	Subset for alpha = 0.05
		1
50 Days	3	8.9900
60 Days	3	9.7800
40 Days	3	9.9933
30 Days	3	10.0400
20 Days	3	10.1200
10 Days	3	10.1400
Sig.		.299

3% Salt + 3% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	10.1600	
50 Days	3	10.2100	
40 Days	3	10.2400	
30 Days	3	10.3300	10.3300
10 Days	3	10.4300	10.4300
20 Days	3		11.2567
Sig.		.934	.071

3% Salt + 4% Turmeric

Day	N	Subset for alpha = 0.05		
		1	2	3
60 Days	3	10.1100		
50 Days	3		10.6200	
40 Days	3		10.7800	10.7800
30 Days	3		10.8900	10.8900
20 Days	3		11.0200	11.0200
10 Days	3			11.1200
Sig.		1.000	.108	.212

Moisture (discussion)

Control

Day	N	Subset for alpha = 0.05			
		1	2	3	4
10 Days	3	16.2100			
20 Days	3	16.3700	16.3700		
30 Days	3		16.5600	16.5600	
40 Days	3		16.6500	16.6500	
50 Days	3			16.7700	
60 Days	3				17.0900
Sig.		.519	.078	.259	1.000

3% Salt Only

Day	N	Subset for alpha = 0.05
		1
10 Days	3	15.3800
20 Days	3	15.3900
30 Days	3	15.4700
40 Days	3	15.5900
50 Days	3	15.8000
60 Days	3	15.9600
Sig.		.134

3% Salt + 2% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
10 Days	3	13.3300	
30 Days	3	13.4867	13.4867
20 Days	3	13.6000	13.6000
40 Days	3	13.6700	13.6700
50 Days	3	13.7700	13.7700
60 Days	3		13.9600
Sig.		.102	.071

3% Salt + 3% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
10 Days	3	15.0200	
20 Days	3	15.1400	15.1400
30 Days	3	15.2900	15.2900
40 Days	3	15.3100	15.3100
50 Days	3		15.3300
60 Days	3		15.3800
Sig.		.058	.144

3% Salt + 4% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
10 Days	3	15.2900	
20 Days	3	15.3500	
30 Days	3	15.4400	15.4400
40 Days	3	15.4500	15.4500
50 Days	3	15.4800	15.4800
60 Days	3		15.7100
Sig.		.302	.072

Ash (discussion)

Control

Day	N	Subset for alpha = 0.05	
		1	2
60 Days	3	10.1233	
50 Days	3	10.1800	
40 Days	3	10.3100	10.3100
30 Days	3	10.5500	10.5500
20 Days	3	10.7600	10.7600
10 Days	3		11.7633
Sig.		.708	.058

3% Salt Only

Day	N	Subset for alpha = 0.05
		1
60 Days	3	11.0400
50 Days	3	11.1700
10 Days	3	11.2167
40 Days	3	11.2400
30 Days	3	11.3200
20 Days	3	11.5300
Sig.		.685

3% Salt + 2% Turmeric

Day	N	Subset for alpha = 0.05
		1
40 Days	3	11.6567
20 Days	3	11.8233
60 Days	3	12.0100
50 Days	3	12.1300
30 Days	3	12.2300
10 Days	3	12.4800
Sig.		.378

3% Salt + 3% Turmeric

Day	N	Subset for alpha = 0.05
		1
60 Days	3	13.0600
40 Days	3	13.1500
50 Days	3	13.1500
30 Days	3	13.2800
20 Days	3	13.3200
10 Days	3	13.5700
Sig.		.674

3% Salt + 4% Turmeric

Day	N	Subset for alpha = 0.05	
		1	2
50 Days	3	12.8133	
60 Days	3	14.1300	14.1300
40 Days	3		14.2300
30 Days	3		14.3100
20 Days	3		14.4300
10 Days	3		14.5200
Sig.		.064	.925

Appendix V

Individual Score of organoleptic test

Sudip Debnath

Skin Appearance					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	6	7	9	8	7
30 Days	5	6	9	8	7
60 Days	5	6	8	7	6
Texture					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	7	7
30 Days	5	6	8	7	6
60 Days	4	6	7	6	6
Color					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	7	7
30 Days	4	5	8	7	6
60 Days	4	5	8	7	6
Odor					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	8	8
30 Days	4	5	8	7	7
60 Days	4	5	7	7	7

Sahin Parvez

Skin Appearance					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	8	7
30 Days	4	6	8	8	7
60 Days	4	5	8	7	7
Texture					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	7	7	6.5
30 Days	5	6	8	6	5.5
60 Days	4	5	7	6	5.5
Color					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	8	8
30 Days	4	6	8	8	7
60 Days	4	6	8	7	7
Odor					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	5	7	6	6
30 Days	4	5	7	6	6
60 Days	3	4	6	5	5

Seikh Tarek Arafat

Skin Appearance					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	8	7	7
30 Days	5	6	8	7	6
60 Days	4	5	7	6	6
Texture					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	5	6	7	7	6
30 Days	5	6	7	6	5
60 Days	4	5	6	6	5
Color					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	4	5	8	7	6
30 Days	4	5	8	7	6
60 Days	3	5	7	6	6
Odor					
Days	**Control (T1)**	**Salt only (T2)**	**2% Turmeric (T3)**	**3% Turmeric (T4)**	**4% Turmeric (T5)**
10 Days	4	5	6	6	6
30 Days	4	4	6	5	5
60 Days	2	4	5	5	5

Appendix VI

Photo Gallery

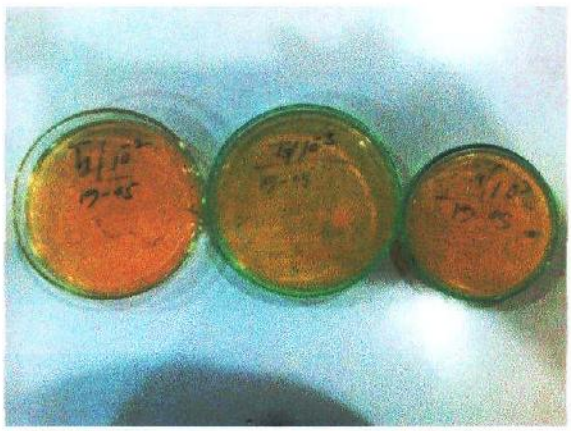

Photo-1: Before counting microbial load

Photo-2: Treated loitta fish in solar

Photo-3: Protein determination

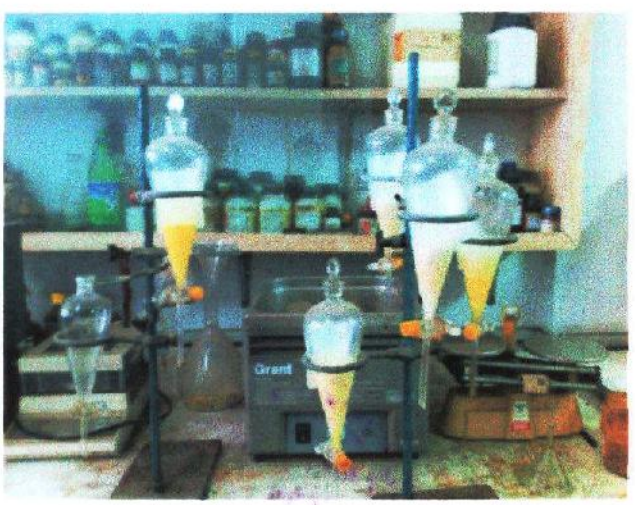

Photo-2: Lipid determination