PREPARATION OF FISH SOUP POWDER FROM TILAPIA FISH (*Oreochromis* spp.) AND IT'S STORAGE STUDY

WARTHA GITESH CHHOTU

B.Sc. (Agri.)

Department of Post Harvest Management of Meat, Poultry and Fish

Post Graduate Institute of Post Harvest Management

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

(Maharashtra State, India)

July, 2012

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A THESIS

submitted to the

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

In partial fulfillment of requirements for degree of

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IN

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Approved by the Advisory Committee

Chairman and Research Guide

Shri. S. T. Sharangdhar
Assistant Professor (F.PTM)
College of Fisheries, Ratnagiri

Members

Dr. J. M. Koli
Assistant Professor (F.PTM)
College of Fisheries Ratnagiri

Dr. V. A. Thorat
Assistant Professor (Agril. Econ.)
College of Agriculture, Dapoli

Dr. K. H. Pujari
Project Officer (Associate dean)
PGI-PHM

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ABSTRACT

The present studies indicated that a tasty and nutritionally rich soup can be prepared using Tilapia fish. The standardization of ingredients for soup powder indicated that the starch namely corn flour @ 25%, pepper powder @ 2.5% and tomato powder @ 12% of the fish meat are the standard proportions of the ingredients for the fish soup powder. The other ingredients used were salt, butter, onion, carrot, monosodium glutamate, ascorbic acid, ginger, garlic and cinnamon powder. At every stage, organoleptic evaluation of fish soup powder was carried out.

The use of four different types of packages namely Metalized film, Trend pouch, HDPE pouch and LDPE pouch for storing the soup powder revealed that Metalized film pouch was the best packaging material for storing the fish soup powder, since the biochemical, microbiological and organoleptic changes were least in the soup powder stored in the metalized film pouches. LDPE pouch was not suitable packaging material for storing fish soup powder.

1. INTRODUCTION

The Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other elements for the maintenance of healthy body (Andrew, 2001). On an average the protein content of fish ranges from 15 to 24 % (Balachandran, 2001). The fish protein shows high digestibility, high biological value and growth promoting capacity (Devadas, 1994). Apart from protein, fishes contain 1.5 % to 30 % lipid and the balance is largely water (Devadas, 1994). The moisture and oil content are inversely proportional and the sum of these two becomes upto 80 %. The carbohydrate is absent except for a very small amount of glycogen and its metabolic products (Devadas, 1994). Fish meat is also rich in polyunsaturated fatty acids (PUFA) (Fierens and Corthout, 2007). The dietary fat from fish is a good source of essential fatty acids. Fish also contains considerable amount of omega-3 fatty acids (Chandrasekhar and Deosthale, 1993). Most fishes accumulate vitamin A and D in their liver. They also contain certain amount of vitamin E. The liver oils of certain fishes like cod, halibut, shark and sawfish are some of the richest known natural sources of vitamin A and D. Some fishes are also rich in carotene. Crab muscles has 780 micro grams of carotene per 100 g. Cod liver oil is especially rich in vitamin D, containing 250 micrograms per 100 g. (Devadas, 1994). Fish flesh is a good source of vitamin B i.e. niacin, pyridoxine and biotin. Horse mackerel, mullet and sardine are rich in niacin. Fatty fishes like sardine and herring are rich in riboflavin, pantothenic acid and vitamin B_{12}. Mrigal meat contain 1.4 microgram per 100 g. of vitamin B_{12} (Devadas, 1994). The edible parts of fish are good source of minerals and trace elements. Fish and other sea foods are rich in calcium, phosphorous, sodium, iron and zinc. The flesh of fatty fishes likes salmon, tuna and herring have more amount of calcium. Fish, when dried with bones, contain nearly 3000 mg. per 100 g of calcium. Therefore, the habit of eating the head and bones of fish in developing countries is beneficial and contributing to the calcium and phosphorous supplies (Devadas, 1994).

Therefore, fish supplies an appropriate balance of proteins, vitamins and minerals and relatively low calories (Sikorski *et al*., 1990). Fish provides about 15.6 % of the world's need for animal proteins and 5.6 % of the total protein requirements. It is estimated that 60 % of people in developing countries obtain 40 to 100 % of animal protein in their diets from fish (Lowe *et al.*, 1998). The wide prevalence of malnutrition among infants and children in several tropical and subtropical countries has been well recognized during recent years (Rao *et al*., 1964). The diets consumed by infants and preschool children belonging to the low income groups of population in India and other developing countries are lacking in protein rich and protective foods and hence are deficient in proteins, certain vitamins and minerals. Protein malnutrition, anemia and vitamin deficiency diseases are widely prevalent among them (Desai *et al*., 1967). According to Devadas (1994) malnutrition is the largest public health problem faced by India and is prevalent among majority of 110 million pre-schoolers. Medical researchers carried out detailed investigations and showed the

men who ate fish once or twice per week were protected against coronary heart disease (Erkkila *et al*., 2004). An increase in fish oils in the diet results in a marked reduction in blood cholesterol and triglyceride levels (Bjerregaard *et al*., 2004). Fish is a good source of fluorine and iodine, which are needed for the development of strong teeth and the prevention of goiter in man (Andrew, 2001).

The FAO (Anonymous, 2010) report indicates that the total capture production of the world during 2009 was 145.1 Mt and it is projected at 164 Mt in 2020, a growth of about 15 % above the average level for 2008-2010. Major increases in the quantity of fish produced will originate from aquaculture. However, for the projection period, the annual growth rate of aquaculture is estimated at 2.8 %; a reduction compared to the rate of 5.6 % of the previous decade. India produced total 4.1 million tonnes from marine and inland capture fisheries and 3479 thousand tonnes from aquaculture in 2008 (FAO 2008).

The total fish production presently has nearly 55 % contribution from the inland sector and is mainly from culture fisheries. Major share of the inland sector is contributed by fresh water fisheries. The inland sector has a growth rate of 6 %. In 2008, the inland fish production of India was 953106 tonnes. Freshwater aquaculture resources in the country comprise 2.25 million ha of ponds and tanks, 1.3 million ha of beels and derelict waters, 2.09 million ha of lakes and reservoirs, 0.12 million km of irrigation canals and channels and 2.3 million ha of paddy fields (Meenakumari, 2009). Indian major carps (catla, rohu, mrigal), common carp and tilapia are the major fresh water food fishes of India. 70 % of the active fishermen in India are employed in inland fisheries, thus it is one of the largest livelihood providers in fisheries (Gopal, 2009).

In India, large quantity of low valued fish, which goes for conversion into fish meal or fish manure and fetch a very low price to the fishermen (Reddy *et al*., 1990). An appreciable portion of marine catches does not find ready consumer acceptance for table purposes in fresh condition, in view of small size, low meat yield, bony nature and poor taste.

This signifies that there are two contradictory situations i.e. on one hand majority of population, especially children are suffering from malnutrition (Devadas, 1994) and on the other hand considerable amount of fish is being wasted or goes for reduction into fishmeal and fish manure (Reddy *et al*., 1990) that is for non food use. So as to ameliorate this condition, it is necessary to develop certain protein rich product which could fulfil the nutritional needs of the population. Again, underutilization of trash fish leads to neglect upon landing, which poses problems of environmental pollution (Venugopal, 1995). It is therefore important that the total available catch may be put to maximum use as food for human consumption. It is possible if surplus catches of certain cheap varieties of fish could be utilized for manufacture of protein rich products such as fish soup powder, fish protein concentrate etc.

The tilapia is one of the low cost fish and therefore, is an ideal fish for converting into value added products. The fish is available in abundance in local

market and fetches meager price in fresh condition. It is rich in protein and other nutrients. It contains 19.04 % protein, 3.73 % fat and 1.04 % ash (Foh *et al.*, 2011).

In the present work, an attempt was made to prepare fish soup powder from Tilapia fish. Initially the method for preparation of fish soup powder which contained standardization of the quantity of various ingredients of the fish soup powder was determined. During standardization of fish soup powder, organoleptic evaluation was the only criteria considered. The standardized fish soup powder was then packaged in different types of packages and then the storage studies of the same for a period of 90 days were carried out. The storage studies included changes in the biochemical and microbiological characteristics of the stored fish soup powder.

The objectives of present study were summerized as follows:

1. To prepare soup powder from the minced meat of Tilapia fish.
2. Organoleptic evaluation of soup powder.
3. Microbiological and Biochemical analysis of fish soup powder.
4. To study the shelf life of the fish soup powder in different packages.

2. REVIEW OF LITERATURE

2.1 Importance of fish:

Fish is a food product that is nutritionally important as it is rich in protein as compared to other animal foods. With increasing awareness about the nutritional benefits that fish can offer as well as increasing population and income levels, the domestic demand for fish is increasing and it is set to be 8.46 million tonnes by 2020, 66 % of it for fresh fish (NCAP, 2008).

In India, in spite of Green Revolution as much as 20 to 30 % of population do not get adequate nutrition. Malnutrition continues to be a problem of staggering proportions especially in developing countries. A conservative estimate is that about one billion people in developing countries do not get adequate nutrition and of that 36 % of children under six years of age are moderately or severely undernourished (Devadas, 1994). In several developing countries including India where the population is depend mainly on cereal-based diets, a small quantities of fish may provide a critical nutritional improvement for them (Whittle, 1984). The fish is rich in proteins, required fats and other micronutrients (Chandrasekhar and Deosthale, 1993). The nutritive value of the fish is of the same order as that of milk protein and higher than that of those of proteins of oilseeds and legumes (Rao *et al*., 1964). Therefore, fish in general is considered as an important item from nutrition point of view (Sikorski *et al*., 1990).

2.2 Importance of low cost fish:

The miscellaneous fishes get low price in the market hence also termed as low priced fishes or trash fishes. However, these fresh, cheap, miscellaneous fishes form a rich source of protein of high nutritional value. These miscellaneous fishes are being wasted as the quantity is increasing due to deep sea fishing operations, introduction of mechanized trawlers, poor handling, improper preservation practices and discarding practices (Reddy *et al*., 1990). Since the nutritional status of these trash fishes is as the popular table varieties, it is felt desirable to convert these fishes into acceptable protein rich products for human consumption, so that fishermen could get high price for the product and at the same time consumer can get same degree of nutritional support as that from other protein rich products. The need to use these fishes for human consumption, through diversified products has long been pointed out by several scientists all over the world and considerable progress has been made in India in this direction (Reddy *et al*., 1990). In India, with rapid industrialization and urbanization, there is growing group of population which demands ready to eat or ready to cook products (Devadasan, 2003).

2.3 Research work in utilization of low cost fish:

2.3.1 Abroad:

Cobb and Hyder (1972) worked on the development of a process of preparing fish protein concentrate (FPC) with the rehydration and emulsifying capacities. Ackman and Odense (1967) determined the isopropyl alcohol in fish protein concentrate by solvent extraction and gas-liquid chromatography methods. Isopropyl

alcohol is a basic solvent for removing water and associated solubles and lipids from fish in certain processes (Power, 1964) like production of fish protein concentrate. The production of stable and nutritious dietary supplement from fish that is FPC requires almost complete removal of all oxidation-susceptible lipids. The extraction of lipid is possible using isopropyl alcohol. Drozdowski and Ackman (1969) reported on isopropyl extraction of oil and lipids in production of fish protein concentrate from herring. Raa (1985) discussed regarding the fishery products and by-products by use of low cost fish or shrimp bycatch. Dreosti (1974) mentioned in his review on the future of powdered fish products such as fish meal, milk replacer solids and fish protein concentrate from low priced fish. Barzana and Geribay (1994) worked on preparation of fish protein concentrate. In that, he discussed regarding three different types of FPC viz., Type A, Type B and Type C. The FPC Type A contains a minimum of 67.5 % crude protein and not more than 0.75 % fat. FPC Type B contains not more than 3 % fat. Hence the term FPC is reserved for these two types and Type C is considered as crude fishmeal.

2.3.2 India:

The socio-economic status of the urban population in India is increasing and with this there is a growing tendency among the population to opt for ready-to-eat products. Moreover the rapid industrialization and the consequent urbanization of rural India provides ample scope for development of export markets for value added products (Devadasan, 2003).

As discussed earlier, the problem of malnutrition is still prevalent in India. The children of parents belonging to low income group are suffering from malnutrition (Devadas, 1994) and on the other side in India, there is a group of population, which demands ready-to-eat or ready-to-cook products (Devadasan, 2003). So as to fulfil the need of both these groups various edible products were developed and are being developed.

Moorjani and Lahiri (1962) studied the aspect of technology of fish flour. He discussed the nutritive value of fish flour and reported that fish flour is an excellent source of high quality protein and is of particular value in supplementing diets deficient in lysin. It is when added to inferior vegetable protein, maintains nitrogen balance in growing children and the results are comparable to those obtained with the milk. The extensive studies for overall nutritive value revealed that the fish flour is superior to casein. Moorjani and Lahiri (1962) prepared the fish protein enriched corn starch containing 40 % protein. Doraswami *et al.* (1963) took a review of effect of supplementary protein food containing fish flour with regard to nutritional status of children. Rao *et al.* (1964) attempted studying the digestibility coefficient, biological value and net protein utilization of fish flour from oil sardine in children. Desai *et al*. (1967) studied the protein efficiency ratio of fish flour from Bombay duck and a protein food prepared with fish, groundnut and Bengal gram flours and their supplementary value to low protein diets. The protein content ranged from 75.80 % to 94.26 % in the powders prepared using six different methods. Moorjani and Vasantha (1973) took a review on recent advances in fish protein concentrate and studied preservation of fish prior to processing; processing techniques; nutritional aspects and

toxicity studies. Soman *et al.* (1974) reported about acceptability and nutritional qualities of fish powder and concluded that the fish powder is hygienic and quite safe for human consumption. Setty *et al.* (1977) worked on the development of partially hydrolyzed and deodorized fish flour. The four different flours were prepared using four different species of fishes viz. Lactarius, croaker, threadfin bream and ribbonfish. Solanki *et al.* (1977) attempted preparing edible powder from dhoma fish by six different methods and determined the analytical characteristics. A simple method for isolation of protein from squilla without any chemical treatment has been reported by Garg *et al*. (1977). Garg *et al*. (1977) also prepared protein powder from jawla prawn. Anon (1979) prepared edible protein concentrate tablets. Young *et al*. (1979) prepared different value added products like dehydrated salt mince from lizard fish, other salt mince from miscellaneous fish. Mulbagal *et al.* (1980) attempted preparing edible powder from jawla prawn. Warner and Ninjoor (1981) isolated fish protein concentrate from Bombay duck by radiation-heat combination procedure. Also Sudhakaran and Sudhakara (1985) reported preparation of salted dry mince from threadfin bream and sardine. Basu (1990) prepared dried fish cereal mixture from trash fish. The studies revealed that the dried fish cereal mixture can be used for the preparation of soups, stews and other wet foods. Reddy *et al.* (1990) attempted utilization of low cost fish and prepared fish fingers from croaker and perches. Venugopal and Shahidi (1995) were studied about value added products from underutilized fish species and discussed various possibilities for product development using mince from low-cost fishery resources which includes surimi and surimi-based products, sausages, fermented products, protein concentrates and hydrolysates, extruded products, and biotechnological possibilities. The dual advantages of this approach, namely, finding ways for better utilization of low-value fish species and providing protein- rich convenience foods.

2.4 Research work on fish soup powder:

Soup is a delicacy enjoyed by people of all classes in East and the West. Fish soup powder and soup tablets have become an accepted instant food item (Gopakumar, 1973). Fish soup powder has become a commercial success and there are several agencies in India currently manufacturing and marketing it (Gopakumar, 1973). Miscellaneous underutilized fish is an ideal raw material for the preparation of fish soup powder.

Venugopalan and James (1969) worked on preparation of fish soup mix. Mixed trash fish comprising mostly kilimin (*Synagris* spp.), jew fish (*Otolithes* spp.) and silver bellies (*Leognathes* spp.) were used for the preparation of fish soup mix.

Gopakumar *et al*. (1974) prepared fish soup powder and soup powder tablets. The variety of fish used was pink perch, croaker, eel etc. The attempts have been made under the I.C.A.R. Co-ordinated Research Project on utilization of trash fish to prepare variety of products, from trash fish. Shenoy *et al.* (1987) published a feasibility report on the production of fish soup powder. In that he discussed the required raw materials and entire processing of fish soup powder and soup tablets. Also necessary facilities and equipments were discussed and at last the production cost of the fish soup powder was determined.

Warang *et al.* (2005) prepared fish soup powder from croaker fish. Yadav (2008) utilized brown seaweed (*Sargassum tenerrimum)* for the preparation of edible soup.

Studies on packaging materials of fish soup powder have also been carried out. Gopal *et al.* (1988) worked on development of flexible packaging for fish soup powder. The packaging material used were low density polythene (LDPE), high molecular weight high density polythene (HM-HDPE), polypropylene (PP), polyester (PEST) laminated with low density polythene, PVDC coated on cellophane on both sides laminated with LDPF and low density high density co-extruded polythene film (LDPE-HDPE). The sealed pouches were kept for storage studies at ambient conditions and relative humidity 80 to 90%. Gopakumar (1996) also worked out the suitable packaging material for fish soup powder and other fishery products. The different packaging materials used were low density polythene (LDPE), high molecular weight high density polythene (HM-HDPE), 12 micron plain polyester laminated with LDPE-HDPE co- extruded film, polypropylene (PP), polyester (PEST) laminated with low density polythene, PVDC coated on cellophane on both sides laminated with LDPE and low density high density co-extruded polythene film (LDPE-HDPE) and LD/BA/Nylon/BA/Primacore multilayer film. Warang *et al.*, (2005) published about the effect of different packages on storage characteristics of fish soup powder. The packaging materials used were trend pouch, high density polythene (HDPE), low density polythene (LDPE). Yadav (2008) used trend pouch for the storage study of edible soup powder prepared from brown seaweed (*Sargassum tenerrimum*).

2.5 Research work on tilapia fish:

Oyedapo Fagbenro and Kim Jauncey (1993) worked on chemical and nutritional quality of stored fermented tilapia fish silage. Ou *et al.* (2002) studied about gelatin based antimicrobial edible coating to prolong shelf life of tilapia fillets. Tokur *et al.* (2004) investigated the changes in the chemical and sensory qualities of fishburger produced from Tilapia (*Oreochromis niloticus*) during frozen storage (-18^0 C) over 8 months. Oliveira Cavalheiro *et al.* (2007) utilized shrimp industry waste in the formulation of tilapia (*Oreochromis niloticus*) feed. K. Chowdhury and Dominique P. Bureau (2009) predicted body composition of Nile tilapia (*Oreochromis niloticus*). Rawdkuen *et al.* (2009) studied the biochemical and gelling properties of tilapia Surimi and protein recovered using an acid-alkaline process. Dhanapal *et al.* (2010) studied the quality of ready to serve tilapia fish curry with PUFA in retortable pouches. Jamilah *et al.* (2010) extracted gelatin from the skin of red tilapia (*Oreochromis nilotica*), walking catfish (*Clarias batrachus*) and striped catfish (*Pangasius sutchi fowler*). The highest gelatin yield (dry basis) was obtained from red tilapia (39.97 %). S. A. Emire and M. M. Gebremariam (2010) investigated the influence of frozen period on the proximate composition microbiological quality of Nile tilapia fish (*Oreochromis niloticus*). The proximate composition and microbiological analysis were carried out at 15 days interval on tilapia fish fillets during frozen storage.

2.6 Necessity of utilization of low cost fish in Maharashtra state:

The fish production of Maharashtra state during the period 2009-10 was 538.35 thousand tonnes (Annual report 2010-11). In 2007-08 the inland fish production of Maharashtra state was 136.63 thousand tonnes (Anonymous, 2008). The miscellaneous freshwater fishes are being wasted as the quantity is increasing due to poor handling, improper preservation practices and discarding practices. Since the nutritional status of these trash fishes is as the popular table varieties, it is felt desirable to convert these fishes into acceptable protein rich products for human consumption, so that fishermen could get high price for the product and at the same time consumer can get same degree of nutritional support as that from other protein rich products.

3. MATERIALS AND METHODS

3.1 Materials:

3.1.1 Fish meat:

Freshly caught tilapia fishes i.e. (*Oreochromis* spp.) (Plate 1) was procured from Sangli, brought under iced condition and immediately processed for further use in product preparation.

3.1.2 Starch:

Commercially available good quality Premium corn flour of 'Golden Harvest' brand was used.

3.1.3 Salt:

Iodized Tata brand salt was used.

3.1.4 Other ingredients:

Fresh coriander, carrots, ginger, onions, garlic, tomatoes, cinnamon powder and pepper powder were procured from local market and added in suitable proportions to impart the tropical taste to the product.

3.1.5 Butter:

Commercially available good quality butter of 'Amul' was used for frying onions.

3.1.6 Water:

Potable water was used whenever required.

3.1.7 MSG:

Additives like monosodium glutamate added to impart meaty flavour.

3.1.8 Ascorbic acid:

It is used as a preservative.

3.1.9 Vinegar and sauce:

The vinegar, monosodium glutamate, soya sauce and chilli sauce was used during preparing soup from the soup powder.

3.1.10 Knife:

Stainless steel knife was used for cutting purposes.

3.1.11 Pan:

A frying pan was used for frying chopped onions.

3.1.12 Trays:

Stainless steel trays were used for mixing ingredients.

3.1.13 Equipments:

3.1.13.1 Electronic balance:

Digital electronic balance of 'Sartorius' make (Citizen Scale Pvt. Ltd. Mumbai, India) having 0.01 g minimum sensitivity was used for weighing purpose.

3.1.13.2 Mixer grinder:

Prestige made mixer grinder was used for mixing and homogenizing the ingredients.

3.1.13.3 Refrigerator:

Domestic refrigerator of 'Blue star' brand (Made in Denmark) having 25 kg/24 h freezing capacity used for storage of raw materials.

3.1.13.4 Hot air oven:

Hot air oven (Nishitronics instruments, Pune) was used for drying tilapia fish soup powder and estimation of moisture content of product.

3.1.13.5 Autoclave:

Autoclave of 'Equitron' brand (Medical Instruments mfg. Co, Mumbai) was used for sterilization of glasswares and media.

3.1.13.6 Incubator:

Bacteriological 'Yorco' brand incubator was used for incubation of samples in petri dishes with media.

3.1.13.7 Muffle furnace:

Muffle furnace (Classic scientific, Mumbai) was used for estimation of ash.

3.1.13.8 Heating mantle:

Heating mantle was used for heating chemicals and also during estimation of proximate composition.

3.1.13.9 Gas stove:

A liquid petroleum gas stove, manufactured by 'Jyoti Gas Appliances' was used for cooking and frying processes.

3.1.13.10 Desiccator:

Desiccator was used for storing the product moisture free for further estimation of fat content and protein content etc.

3.1.13.11 Sealing machine:

Electronic sealing machine, a quality product of 'MOOSH' India (Mumbai) was used for sealing purpose.

3.1.13.12 pH meter:

pH meter (Sentex, USA) was used for pH estimation (range 0 to 11).

3.1.13.13 Packaging materials used:

The purpose of using four different packages for packing soup powder was to determine the most suitable packaging for storage.

3.1.13.13.1 Metalized film:

Metalized films of 100 g. Capacity and 20 X 14 cm size were used for packaging fish soup powder.

3.1.13.13.2 Trend packs:

Trend packs of 100 g. Capacity and 18.5 X 10.5 X 1.5 cm size were used for packaging fish soup powder.

3.1.13.13.3 HDPE pouches:

High Density Polythene (HDPE) Pouches of 100 g. capacity and 22 X 15.5 cm size were used.

3.1.13.13.4 LDPE pouches:

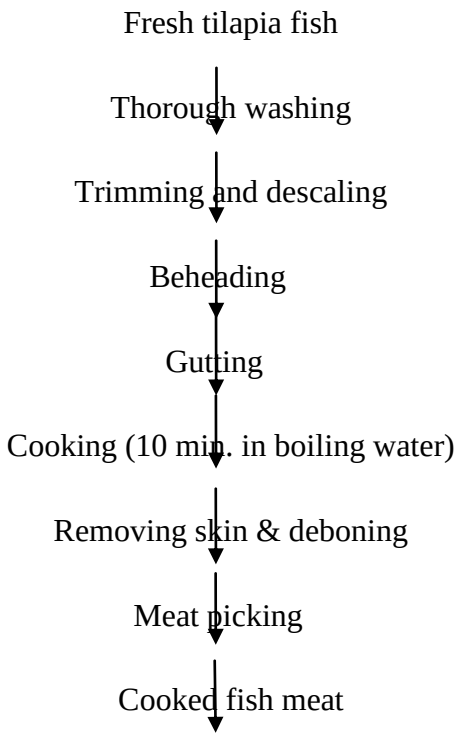
Low Density Polythene (LDPE) pouches of 100 g. Capacity and 22 X 15.5 cm size were used as packaging materials for soup powder.

3.2 Methods:

General preparation of raw material:

Freshly caught tilapia fishes were brought to the laboratory under iced condition and washing, trimming, beheading, gutting and finally cooking was done to get cooked fish meat (Plate 2).

Flow Chart 1: General method for preparation of cooked fish meat



3.2.1 Standardization:

For the preparation of fish soup powder, the composition and method of Warang *et al.* (2002) was followed.

3.2.1.1 Standardization for type of starch to be used while preparing fish soup powder:

Three different type of fish soup powder was prepared by incorporating three different types of starches namely corn flour, tapioca and maida (Table 2).

3.2.1.2 Standardization for concentration of corn flour to be used while preparing fish soup powder:

Three different types of fish soup powder was prepared by incorporating three different concentrations of corn flour viz. 15%, 20% and 25% of total cooked fish meat. Rest all ingredients were kept constant (Table 3).

3.2.1.3 Standardization for concentration of tomato powder to be used while preparing fish soup powder:

Three different types of fish soup powder was prepared by incorporating three different concentrations of tomato powder viz. 10%, 12% and 15% of total cooked fish meat. Rest all ingredients were kept constant (Table 4).

3.2.1.4 Standardization for concentration of pepper powder to be used while preparing fish soup powder:

Three different types of fish soup powder was prepared by incorporating three different concentrations of pepper powder viz. 1.5%, 2.5% and 3.5% of total cooked fish meat. Rest all ingredients were kept constant (Table 5).

3.2.2 Storage Studies:

The storage study of fish soup powder was undertaken. The fish soup powder was packed in metalized films, trend pouches, HDPE pouches and LDPE pouches; sealed and kept at room temperature for shelf life studies. The studies included organoleptic, biochemical and microbiological evaluation of fish soup powder.

3.2.2.1 Organoleptic evaluation:

Various sensory characteristics such as appearance, colour, taste, consistency, odour and overall acceptability were evaluated during the standardization by a group of ten trained panelists using a ten point hedonic scale.

3.2.2.2 Biochemical analysis:

3.2.2.2.1 Total volatile base-Nitrogen (TVB-N):

The TVB-N values were estimated by convey micro diffusion method (Beatty and Gibbons, 1936) and expressed as mg % N/100 g fish meat.

3.2.2.2.2 Peroxide value (PV):

Peroxide value of fish soup powder was estimated by titrimetric method of AOAC (2005).

3.2.2.2.3 Estimation of proximate composition:

Proximate composition of fresh tilapia fish and fish soup powder were estimated as per AOAC (2005). Moisture was estimated by the method of AOAC (2005), Fat by soxhlet extraction, crude protein by kjeldhal's method and the ash was determined as per AOAC (2005). The Carbohydrate was estimated by Anthrone method.

3.2.2.2.4 pH:

5 g. of sample was homogenized in 45 ml. Distilled water and pH of homogenate recorded by using the pH meter (Sentex, USA) (AOAC, 2005).

3.2.2.3 Microbiological analysis:

3.2.2.3.1 Sterilization:

The bacteriological media were steam sterilized at 15 psi. for 30 min. in an autoclave. Glassware's used for this work were also sterilized in the same manner.

3.2.2.3.2 Preparation of homogenate:

For bacteriological analysis 25 g. of sample was aseptically weighed and transferred to 225 ml. of physiological saline in a homogenizing cup. Homogenization was done with the help of mortar and pestle.

3.2.2.3.3 Total Plate counts (TPC):

Appropriate dilutions were prepared from the homogenate using sterile physiological saline and plated by pour plate technique. The media used was plate count agar. The petri plates containing sample were incubated at room temperature for 48 hours.

3.2.2.3.4 Mould counts (MC):

Appropriate dilutions were prepared from the homogenate and plated on mycological agar plates in duplicate by pour plate technique (AOAC, 2005) and incubated at room temperature for 5 days.

3.2.2.3.5 Staphylococcus counts:

Appropriate dilutions were prepared from the homogenate and plated by pour plate technique on egg-yolk free Baired-parker agar plates medium (Lachica, 1984) and incubated at 37°C for 48 hours.

3.2.2.3.6 Salmonella counts:

Pre-enrichment in lactose broth at 37^{o} C for 24 hours and selective enrichment in selenite cystine broth at 37^{o} C for 24 hours were done according to APHA (1976). Selective plating was done on Bismuth sulphite agar and incubated at 37^{o} C for 48 hrs.

3.2.2.3.7 *E. coli* counts:

As per Collins and Lyne (1984) appropriate dilutions were prepared from the homogenate and plated by pour plate technique on Tergitol-7 agar plate medium and incubated at 37° C for 18 to 24 hours.

3.2.3 Statistical analysis:

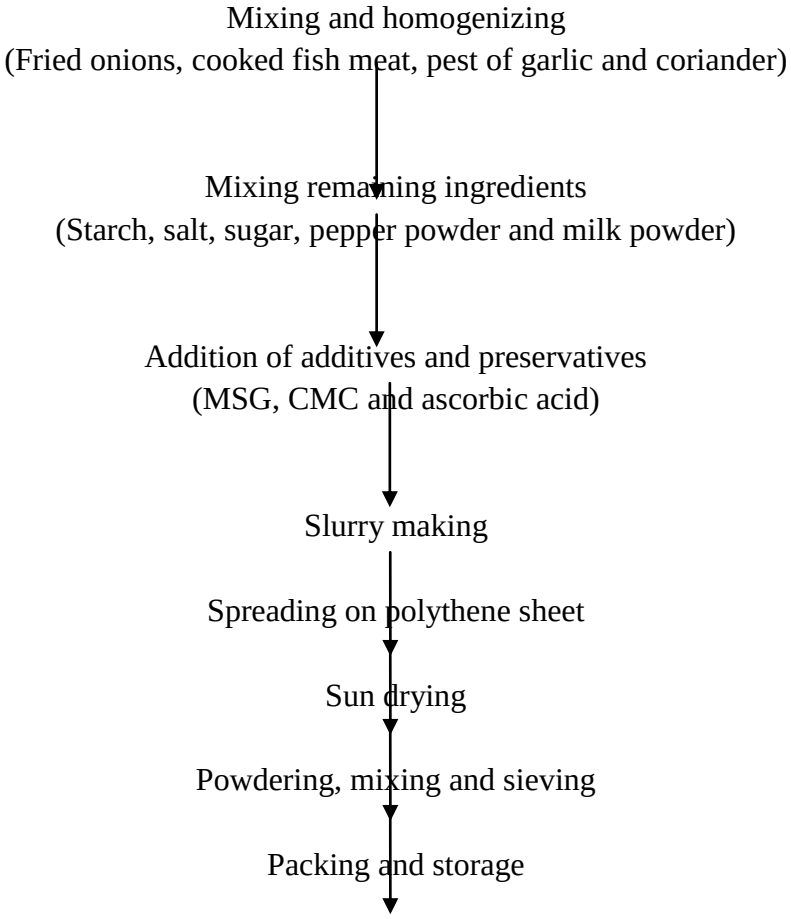
The scores of overall acceptability in the organoleptic evaluation were subjected to the statistical analysis. One way analysis of variance (Snedecor and Cochran, 1968) was done for the standardization of product as well as during storage study. Least significant difference based on t-test was used when necessary

Table 1: Recipe for the preparation of fish soup powder (Warang *et al.*, 2005)

Sr. No.	Ingredients	Quantity (g.)
1	Fish meat	1000
2	Salt	225
3	Tapioca starch	125
4	Corn flour	125
5	Coriander	25
6	Chopped onion	750
7	Garlic	15
8	Ascorbic acid	2
9	Pepper powder	35

10	Milk powder	125
11	Sugar	30
12	Vanaspati	125
13	Carboxy methyl cellulose	4
14	Mono sodium glutamate	13

Flow Chart 2: Method fallowed for the preparation of fish soup powder (Warang *et al.*, 2005)



4. RESULTS

4.1 Proximate composition of fresh fish:

The proximate composition of fresh fish was found to be moisture 76.26%, crude protein 18.69%, crude fat 3.86% and ash 1.19% (Table 6 and figure 1).

4.2 Standardization of different ingredients in fish soup powder:

The standardization of different ingredients in fish soup powder was carried out step by step (Flow chart 3).

Flow Chart 3: Standardization of different ingredients used in the soup powder preparation:

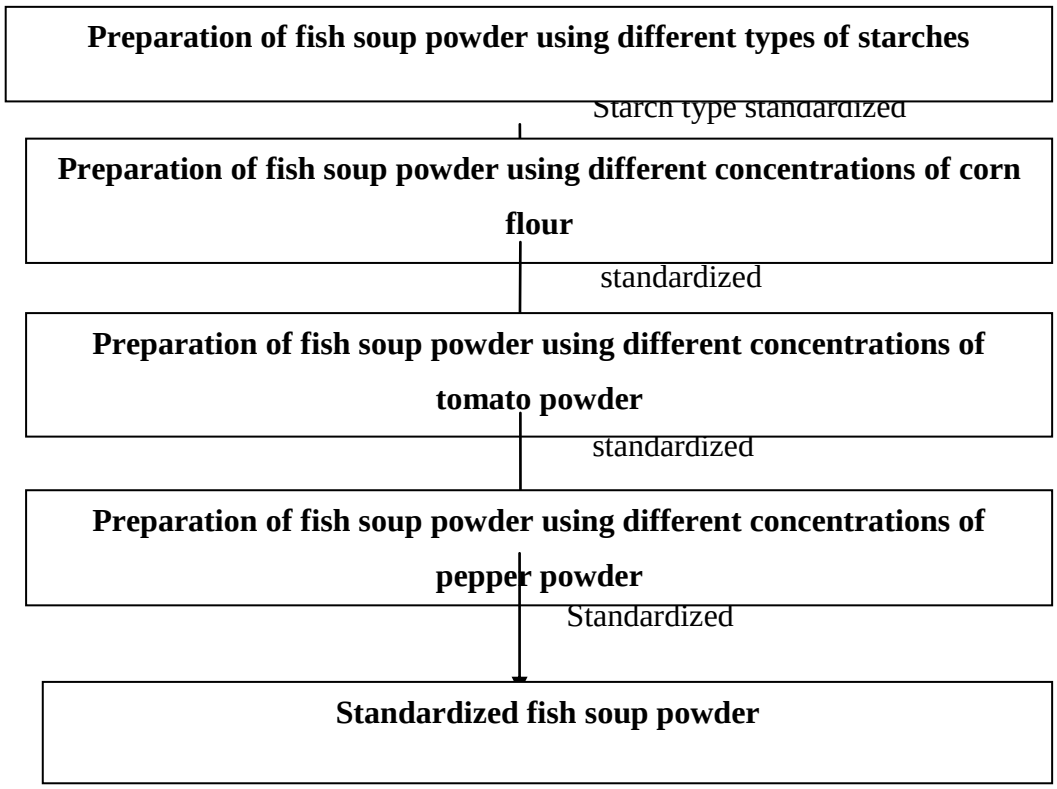


Table 2: Different types of starch used during the standardization of type of starch

Sr. No.	Ingredients	Quantity (g.)	Quantity (g.)	Quantity (g.)
1	Fish meat	1000	1000	1000
2	Salt	170	170	170
3	Cinnamon powder	75	75	75
4	**Starch**	**200 (A)**	**200 (B)**	**200 (C)**
5	Coriander	55	55	55

6	Chopped onion	850	850	850
7	Garlic	25	25	25
8	Ginger	35	35	35
9	Pepper powder	25	25	25
10	Tomato powder	120	120	120
11	Carrot	100	100	100
12	Butter	250	250	250
13	MSG	18	18	18
14	Ascorbic acid	2	2	2

A = Corn flour, B = Tapioca starch, C = Maida

Table 3: Different concentrations of corn flour used during the standardization of concentration of corn flour

Sr. No.	Ingredients	Quantity (g.)	Quantity (g.)	Quantity (g.)
1	Fish meat	1000	1000	1000
2	Salt	170	170	170
3	Cinnamon powder	75	75	75
4	**Corn flour**	**150**	**200**	**250**
5	Coriander	55	55	55
6	Chopped onion	850	850	850
7	Garlic	25	25	25
8	Ginger	35	35	35
9	Pepper powder	25	25	25
10	Tomato powder	120	120	120
11	Carrot	100	100	100

12	Butter	250	250	250
13	MSG	18	18	18
14	Ascorbic acid	2	2	2

Table 4: Different concentrations of tomato powder used during standardization of concentration of tomato powder

Sr. No.	Ingredients	Quantity (g.)	Quantity (g.)	Quantity (g.)
1	Fish meat	1000	1000	1000
2	Salt	170	170	170
3	Cinnamon powder	75	75	75
4	Corn flour	250	250	250
5	Coriander	55	55	55
6	Chopped onion	850	850	850
7	Garlic	25	25	25
8	Ginger	35	35	35
9	Pepper powder	25	25	25
10	**Tomato powder**	**100**	**120**	**150**
11	Carrot	100	100	100
12	Butter	250	250	250
13	MSG	18	18	18
14	Ascorbic acid	2	2	2

Table 5: Different concentrations of pepper powder used during standardization of concentration of pepper powder

Sr. No.	Ingredients	Quantity (g.)	Quantity (g.)	Quantity (g.)
1	Fish meat	1000	1000	1000
2	Salt	170	170	170

3	Cinnamon powder	75	75	75
4	Corn flour	250	250	250
5	Coriander	55	55	55
6	Chopped onion	850	850	850
7	Garlic	25	25	25
8	Ginger	35	35	35
9	**Pepper powder**	**15**	**25**	**35**
10	Tomato powder	120	120	120
11	Carrot	100	100	100
12	Butter	250	250	250
13	MSG	18	18	18
14	Ascorbic acid	2	2	2

Table 6: Proximate composition of Tilapia fish

Parameters	**Moisture (%)**	**Protein (%)**	**Fat (%)**	**Ash (%)**
Tilapia fish	**76.26**	**18.69**	**3.86**	**1.19**

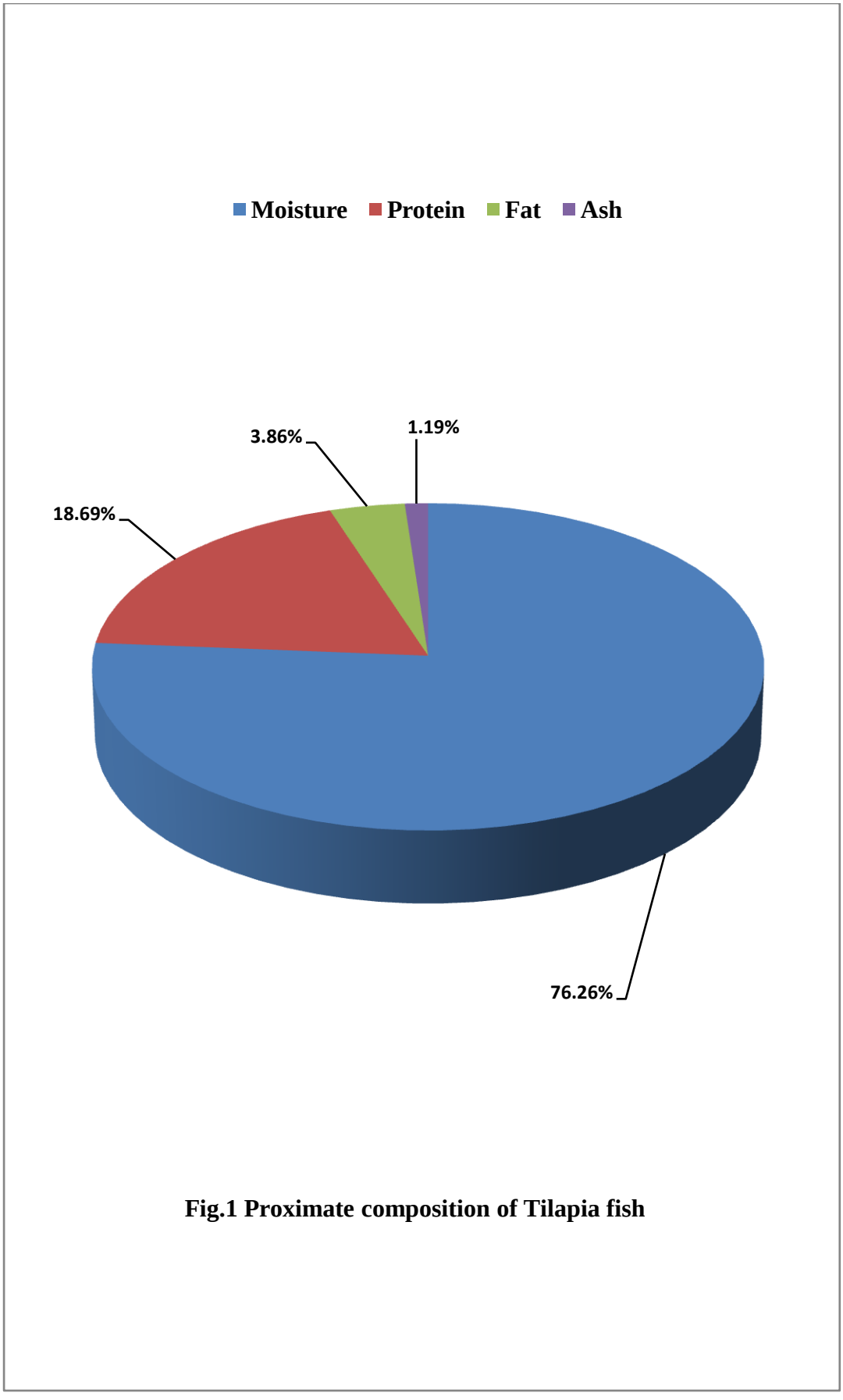


Fig.1 Proximate composition of Tilapia fish

Expt.1: Standardization of fish soup powder using different types of starches:

Three different types of starches namely corn flour, tapioca and maida were used for the preparation of different soup powders. The soups prepared from these soup powders were then organoleptically evaluated. The soup powders prepared using corn flour, tapioca and maida scored 7.7, 6.6 and 5.0 points respectively (Table 7).

The ANOVA test (Table 8) for standardization of three different types of starches namely corn flour, tapioca and maida for preparation of fish soup powder was carried out. The L.S.D. test indicated that among the three different treatments viz. Corn flour incorporated soup powder (T1), tapioca incorporated soup powder (T2) and maida incorporated soup powder (T3); the T3 and T2 was significantly different from T1 (Table 8). Hence Corn flour incorporated soup powder was selected.

Table 7: Organoleptic evaluation of fish soup powder prepared by using three types of starches:

Panelists	Appearance			Colour			Taste			Odour			Consistency			Overall Acceptability		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	9	8	5	8	7	6	8	7	3	8	8	5	6	6	5	8	7	5
2	8	6	5	9	8	7	9	7	4	6	7	5	5	5	4	8	7	5
3	9	7	4	7	6	5	8	7	5	7	7	6	7	5	3	8	7	5
4	8	8	6	7	6	5	8	7	5	6	6	4	6	5	5	7	6	5
5	7	6	6	9	8	7	9	8	5	7	7	5	5	4	3	8	7	6
6	8	7	4	8	6	5	7	7	3	6	6	4	6	5	4	7	6	4
7	8	8	5	8	7	6	8	7	4	8	8	5	6	5	5	8	7	5
8	7	7	6	7	7	6	7	6	3	7	8	5	7	6	4	7	7	5
9	8	6	5	8	7	6	8	7	4	8	7	6	6	4	3	8	6	5
10	8	7	4	9	8	7	8	7	4	7	6	5	6	5	4	8	6	5
Average	8	7	5	8	7	6	8	7	4	7	7	5	6	5	4	7.7	6.6	5

T1 : Corn flour

T2 : Tapioca starch

T3 : Maida

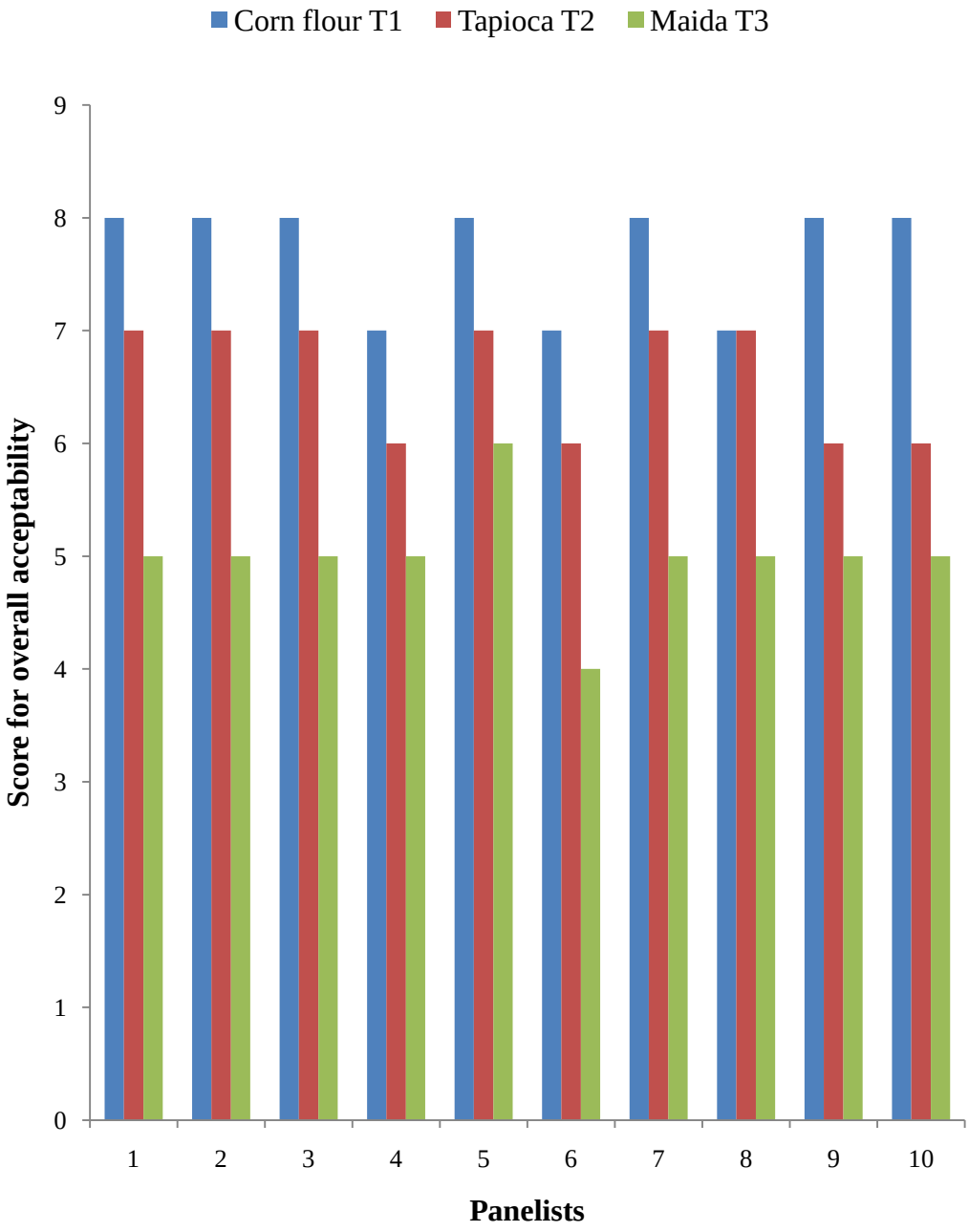


Fig. 2: Organoleptic evaluation of fish soup powder prepared by using three types of starches on overall acceptability criteria

Table 8: ANOVA for organoleptic evaluation of fish soup powder prepared by using three types of starches depending on overall acceptability criteria:

Source of variation	Sum of square	Degree of freedom	Mean square	F	F- Crit.
Between group	36.8667	2	18.4333	76.56923077	3.354130829
Within group	6.5	27	0.2407		
Total	43.3667	29			

Note: F-cal. > F-crit. All treatments given are significantly different at $P < 0.05$

L.S.D. test:

Difference between the mean	More or less L.S.D. value	Significant/Not significant
Xc-Xa = 2.7	>	**Significantly greater**
Xc-Xb = 1.1	>	**Significantly greater**
Xb-Xa =1.6	>	**Significantly greater**

Note: Xa, Xb and Xc = means of overall acceptability score of product prepared from three different types of starches.
Xc = Fish soup powder prepared with corn flour.
Xb = Fish soup powder prepared with tapioca.
Xa = Fish soup powder prepared with maida.

Expt.2: Standardization of fish soup powder using different concentrations of corn flour:

The soup powders prepared with concentrations of corn flour 15%, 20% and 25% of cooked fish meat were made into soup and subjected to organoleptic evaluation. The soup having 25% starch appeared to be thicker and the thickness of it was found to be ideal according to panelists. It had high overall acceptability score i.e.8.2. However soup appeared to be sweeter in taste along with increase in corn flour. The scores for taste were 6.5, 7.5 and 8.3 respectively for 15%, 20% and 25% corn flour of cooked fish meat (Table 9 and Figure 3).

ANOVA indicated that the three treatments i.e. soup powder with 15% corn flour of cooked fish meat (T1), soup powder with 20% corn flour of cooked fish meat (T2) and soup powder with 25% corn flour of cooked fish meat (T3) were significantly different ($P<0.05$). Further L.S.D. test revealed that T3 was significantly different from T1 and T2 (Table 10). Hence T3 was selected. The soup had satisfactory consistency due to appropriate type and concentration of starch.

Table 9: Organoleptic evaluation of fish soup powder prepared by using different concentrations of corn flour:

Panelist	Appearance			Colour			Taste			Odour			Consistency			Overall Acceptability		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	9	9	9	9	9	9	8	9	9	8	9	9	8	9	9	9	9	9
2	6	8	7	6	8	7	5	8	7	6	8	7	5	7	6	6	8	7
3	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8
4	8	7	8	7	8	9	8	8	9	8	7	9	7	8	8	8	8	9
5	7	8	8	7	8	8	6	7	8	8	8	8	6	7	8	6	7	8
6	7	7	7	7	8	9	7	8	9	8	8	9	8	8	8	8	8	8
7	5	7	9	5	7	8	4	8	9	3	8	8	5	7	8	4	7	8
8	8	7	9	8	7	7	7	7	9	7	8	7	6	6	6	7	8	9
9	6	6	7	6	7	8	7	6	6	6	7	6	6	7	8	7	7	8
10	8	7	9	8	7	7	7	7	9	7	8	7	6	7	8	7	7	8
Average	7	7.3	8.1	6.9	7.6	8	6.5	7.5	8.3	6.7	7.8	7.8	6.3	7.3	7.7	6.8	7.6	8.2

T1: Corn flour 15%

T2: Corn flour 20%

T3: Corn flour 25%

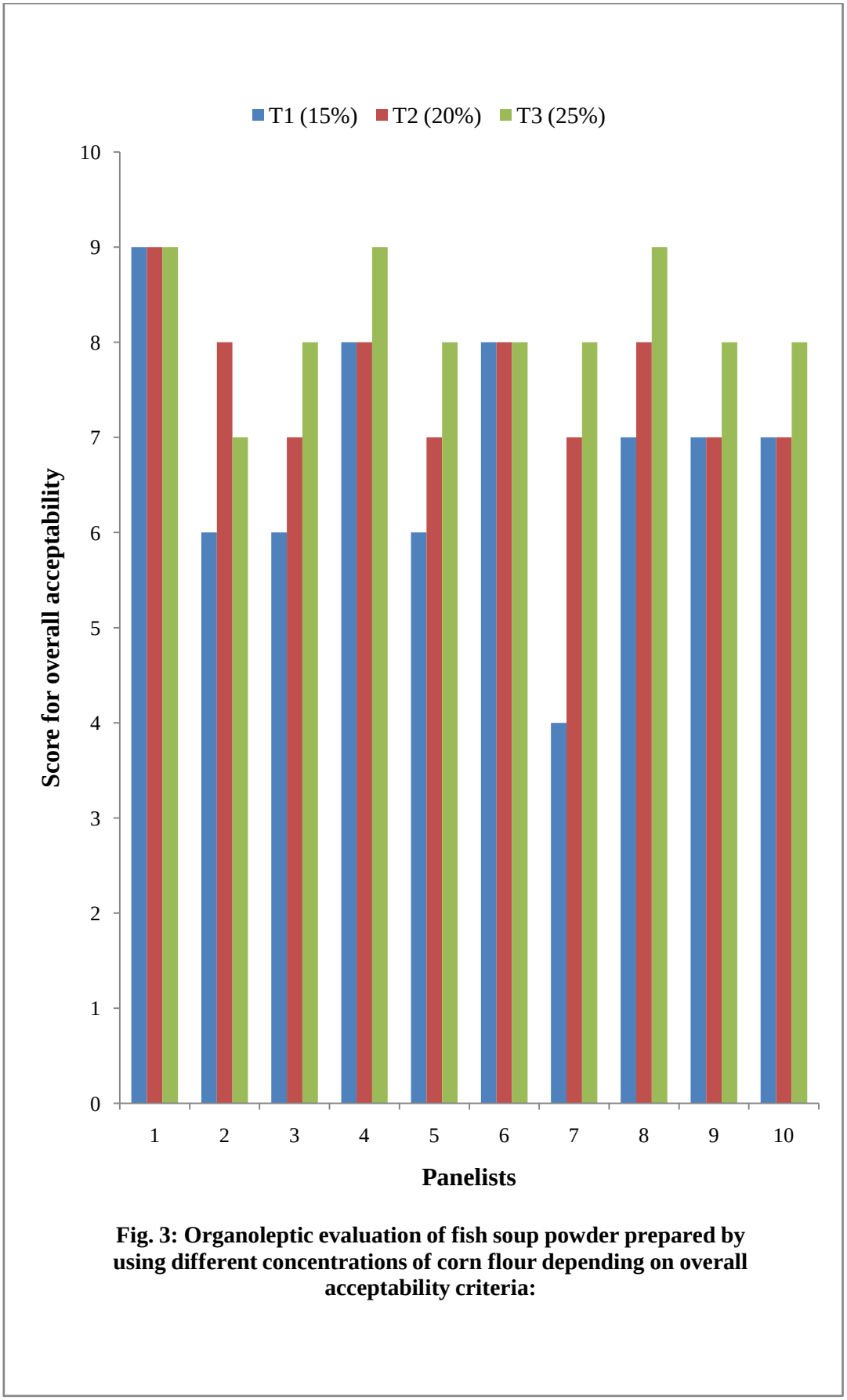


Fig. 3: Organoleptic evaluation of fish soup powder prepared by using different concentrations of corn flour depending on overall acceptability criteria:

Table 10: ANOVA for organoleptic evaluation of fish soup powder prepared by different concentrations of corn flour depending on overall acceptability criteria:

Source of variation	Sum of square	Degree of freedom	Mean square	F	F- Crit.
Between group	9.8667	2	4.9333	5.2031	3.354131
Within group	25.6	27	0.9481		
Total	35.467	29			

Note: F-cal. > F-crit. All treatments given are significantly different at $P < 0.05$.

L.S.D. test:

Difference between the mean	More or less L.S.D. value	Significant/Not significant
Xc - Xa = 1.4	>	**Significantly greater**
Xc - Xb = 0.6	<	**Non significant**
Xb - Xa = 0.8	>	**Significantly greater**

Note: Xa, Xb and Xc = means of overall acceptability score of product prepared from three different concentrations of starches.

Xa = Fish soup powder prepared with 15% corn flour.

Xb = Fish soup powder prepared with 20% corn flour.

Xc = Fish soup powder prepared with 25% corn flour.

Expt.3: Standardization of fish soup powder using different concentrations of tomato powder:

Here the soup powders prepared with three different concentrations of tomato powder were made into soup and subjected to organoleptic evaluation. The concentrations of tomato powder were 10%, 12% and 15% of cooked fish meat. Rest all ingredients kept constant (Table 4). The scores for overall acceptability were 7.2, 8.0 and 7.0 (Table 11 and Figure 4). Hence the concentration of 12% tomato powder noted as an appropriate one.

Tomato powder used was made by using tomatoes. Thin sliced tomatoes were spread on trays and dried in oven. After drying it is then ground in a food processor to obtain tomato powder.

ANOVA indicated that the three treatments i.e. soup powder with tomato powder 10% of cooked fish meat (T1), soup powder with tomato powder 12% of cooked fish meat (T2) and soup powder with tomato powder 15% of cooked fish meat (T3) were significantly different ($P<0.05$). Further L.S.D. test indicated that T2 was found to have high scores for all attributes (Table 12). Hence T2 was selected.

Table 11: Organoleptic evaluation of fish soup powder prepared by using different concentrations of tomato powder:

Panelist	Appearance			Colour			Taste			Odour			Consistency			Overall Acceptability		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	8	8	7	8	8	7	6	6	8	7	7	8	7	7	7	7	7	7
2	7	7	8	7	7	8	7	8	7	8	8	8	7	8	7	7	8	7
3	6	8	5	6	8	5	6	8	5	6	8	5	6	8	5	6	8	5
4	8	9	7	8	9	7	8	9	8	7	9	7	7	9	7	8	9	7
5	8	8	7	8	8	7	6	7	6	7	7	7	8	8	7	8	8	7
6	8	8	8	8	9	8	7	8	7	8	8	8	7	9	7	8	9	8
7	8	8	7	8	8	7	6	6	8	7	7	8	7	7	7	7	7	7
8	7	8	7	7	8	6	8	8	7	7	8	7	7	8	7	7	8	7
9	8	8	7	8	8	7	7	8	7	8	8	8	7	8	7	7	8	7
10	7	8	6	8	9	8	7	8	7	8	8	8	8	8	8	7	8	8
Average	7.5	8	6.9	7.6	8.2	7	6.8	7.6	7	7.3	7.8	7.4	7.1	8	6.9	7.2	8	7

T1 : Tomato powder 10%

T2 : Tomato powder 12%

T3 : Tomato powder 15%

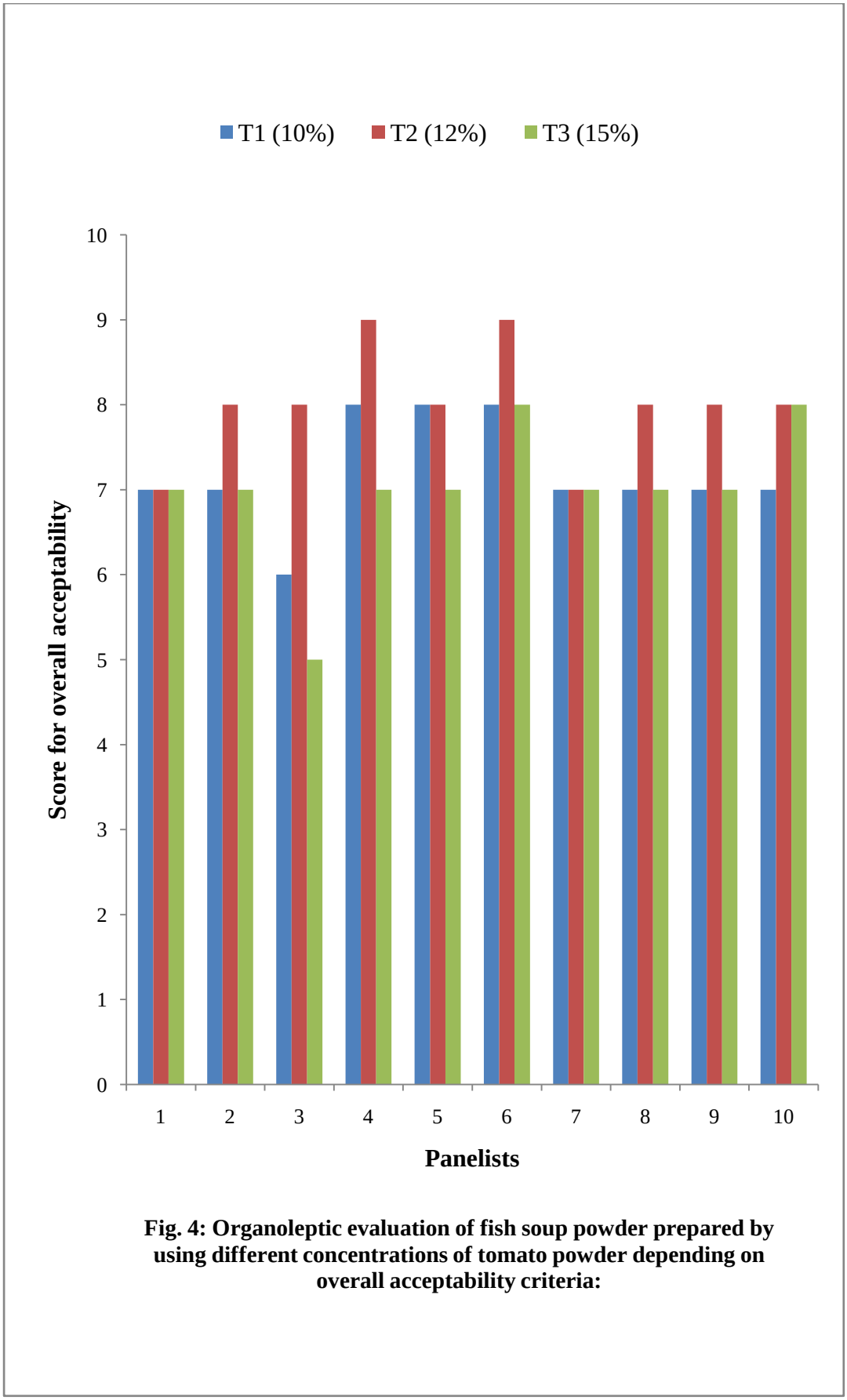


Fig. 4: Organoleptic evaluation of fish soup powder prepared by using different concentrations of tomato powder depending on overall acceptability criteria:

Table 12: ANOVA for organoleptic evaluation of fish soup powder prepared by using different concentrations of tomato powder depending on overall acceptability criteria:

Source of variation	Sum of square	Degree of freedom	Mean square	F	F- Crit.
Between group	5.6	2	2.8	5.558824	3.354131
Within group	13.6	27	0.503704		
Total	19.2	29			

Note: F-cal. > F-crit. All treatments given are significantly different at $P < 0.05$.

L.S.D. test:

Difference between the mean	More or less L.S.D. value	Significant/Not significant
Xc - Xa = 1	>	**Significantly greater**
Xc - Xb = 0.8	>	**Significantly greater**
Xb - Xa = 0.2	<	**Non significant**

Note: Xa, Xb and Xc = means of overall acceptability score of product prepared from three different concentrations of tomato powder.
Xb = Fish soup powder prepared with 10% tomato powder.
Xc = Fish soup powder prepared with 12% tomato powder.
Xa = Fish soup powder prepared with 15% tomato powder.

Expt.4: Standardization of fish soup powder using different concentrations of pepper powder:

Here the soup powders prepared with three different concentrations of pepper powder were made into soup and subjected to organoleptic evaluation. The concentrations of pepper powder were 1.5%, 2.5% and 3.5% of cooked fish meat. Rest all ingredients kept constant (Table 5). The overall acceptability was highest for the soup made by using 2.5% concentration of pepper powder. The scores for overall acceptability were 5.8, 8.02 and 5.46 (Table 13 and Figure 5). Hence the concentration of 2.5% pepper powder noted as an appropriate one.

ANOVA indicated that the three treatments i.e. soup powder with pepper powder 1.5% of cooked fish meat (T1), soup powder with pepper powder 2.5% of cooked fish meat (T2) and soup powder with pepper powder 3.5% of cooked fish meat (T3) were significantly different ($P<0.05$). Further L.S.D. test indicated that T2 was found to have high scores for all attributes (Table 14). Hence T2 was selected.

Table 13: Organoleptic evaluation of fish soup powder prepared by using different concentrations of pepper powder:

Panelists	Appearance			Colour			Taste			Odour			Consistency			Overall Acceptability		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	6	9	7	6	8	6	6	8	5	6	8	5	6	8	5	6	8.2	5.6
2	7	8	6	6	8	6	7	9	4	6	7	5	5	8	4	6.2	8	5
3	7	8	7	7	9	5	6	8	5	7	8	6	7	8	3	6.8	8.2	5.2
4	6	8	6	7	7	5	6	9	5	6	8	4	6	7	5	6.2	7.8	5
5	7	9	6	6	8	6	6	8	5	7	7	5	5	7	7	6.2	7.8	5.8
6	6	8	7	5	8	5	7	9	5	6	8	4	6	8	4	6	8.2	5
7	7	8	8	6	8	6	5	9	4	6	8	5	6	9	7	6	8.4	6
8	7	7	6	7	7	6	6	8	6	7	8	5	7	8	5	6.8	7.6	5.6
9	6	8	7	6	8	6	6	8	5	5	9	6	6	8	5	5.8	8.2	5.8
10	6	8	8	6	8	6	6	7	5	5	8	5	6	8	4	5.8	7.8	5.6
Average	6.5	8.1	6.8	6.2	7.9	5.7	6.1	8.3	4.9	6.1	7.9	5	6	7.9	4.9	5.8	8.02	5.46

T1 : Pepper powder 1.5%

T2 : Pepper powder 2.5%

T3 : Pepper powder 3.5%

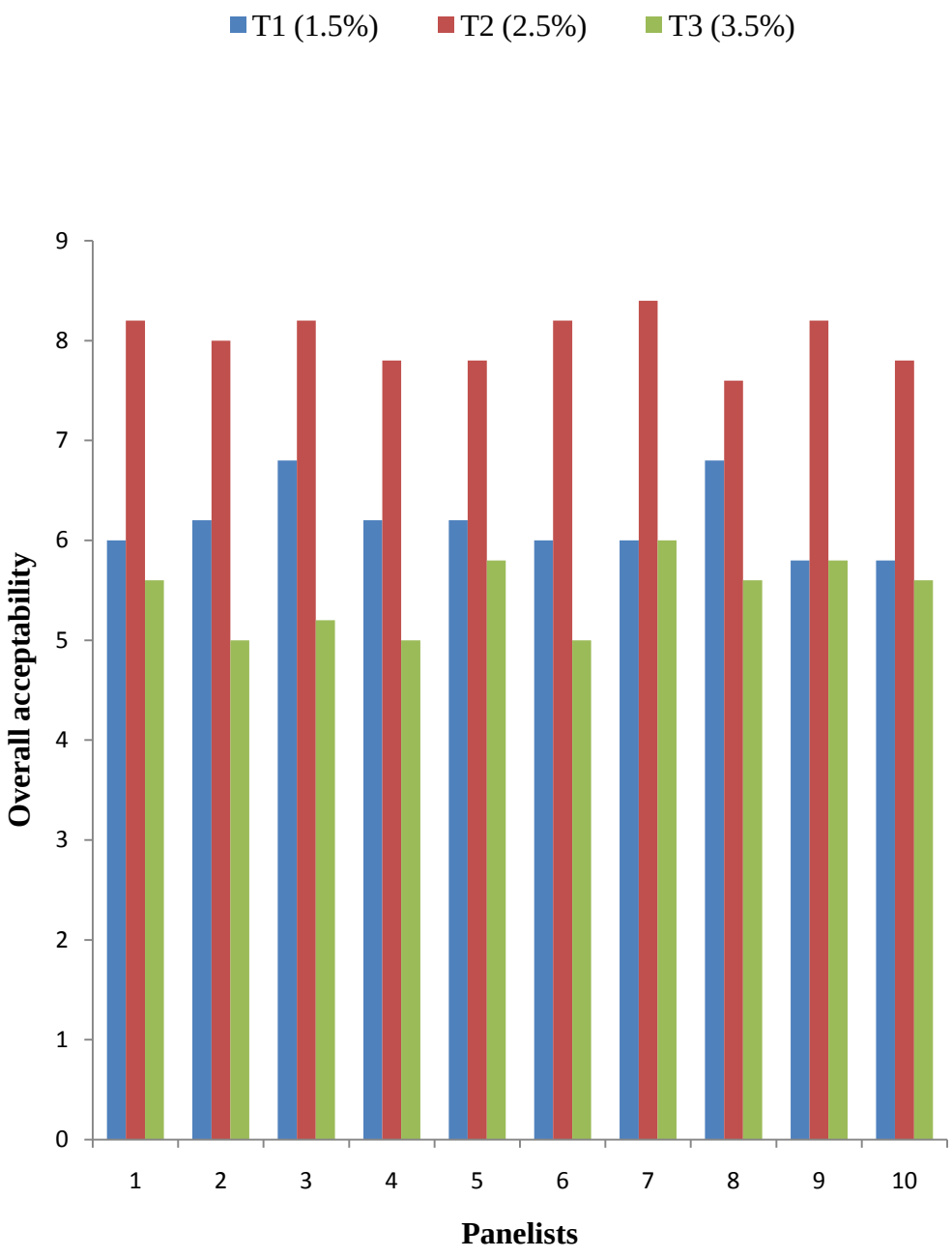


Fig. 5:Organoleptic evaluation of fish soup powder prepared by using different concentrations of pepper powder on overall acceptability criteria

Table 14: ANOVA for organoleptic evaluation of fish soup powder prepared by using different concentrations of pepper powder depending on overall acceptability criteria:

Source of variation	Sum of square	Degree of freedom	Mean square	F	F- Crit.
Between group	34.85867	2	17.42933	155.004	3.354131
Within group	3.036	27	0.112444		
Total	37.89467	29			

Note: F-cal. > F-crit. All treatments given are significantly different at $P < 0.05$.

L.S.D. test:

Difference between the mean	More or less L.S.D. value	Significant/Not significant
Xc - Xa = 2.56	>	**Significantly greater**
Xc - Xb = 2.22	>	**Significantly greater**
Xb - Xa = 0.34	>	**Significantly greater**

Note: Xa, Xb and Xc = means of overall acceptability score of product prepared from three different concentrations of pepper powder.

Xb = Fish soup powder prepared with 1.5% pepper powder.

Xc = Fish soup powder prepared with 2.5% pepper powder.

Xa = Fish soup powder prepared with 3.5% pepper powder.

Table 15: Standardized ingredients for the preparation of fish soup powder:

Sr. No.	Ingredients	Quantity (g.)
1	Fish meat	1000
2	Salt	170
3	Carrot	100
4	Coriander	55

5	Chopped onion	850
6	Garlic	25
7	Ginger	35
8	Pepper powder	25
9	Cinnamon powder	75
10	Tomato powder	120
11	Corn flour	250
12	Butter	250
13	Mono sodium glutamate	18
14	Ascorbic acid	2

4.3 Standardized method for preparation of fish soup powder:

The fish soup powder was prepared with standardized method given in Flow Chart 4 and recipe in Table 15.

The soup powder was prepared with corn flour as a source of starch. The concentration of starch used was 25% of cooked fish meat. The standardized concentrations of tomato powder and pepper powder were 12% and 2.5% of cooked fish meat respectively. All these ingredients were taken in required proportions (Table15) and mixed properly, homogenized into homogenizer. Then the paste was made into slurry form and spread into the trays. The slurry was dried in oven for 6 to 7 hours at 55^{o} C to 60^{o} C. The dried material was then powdered.

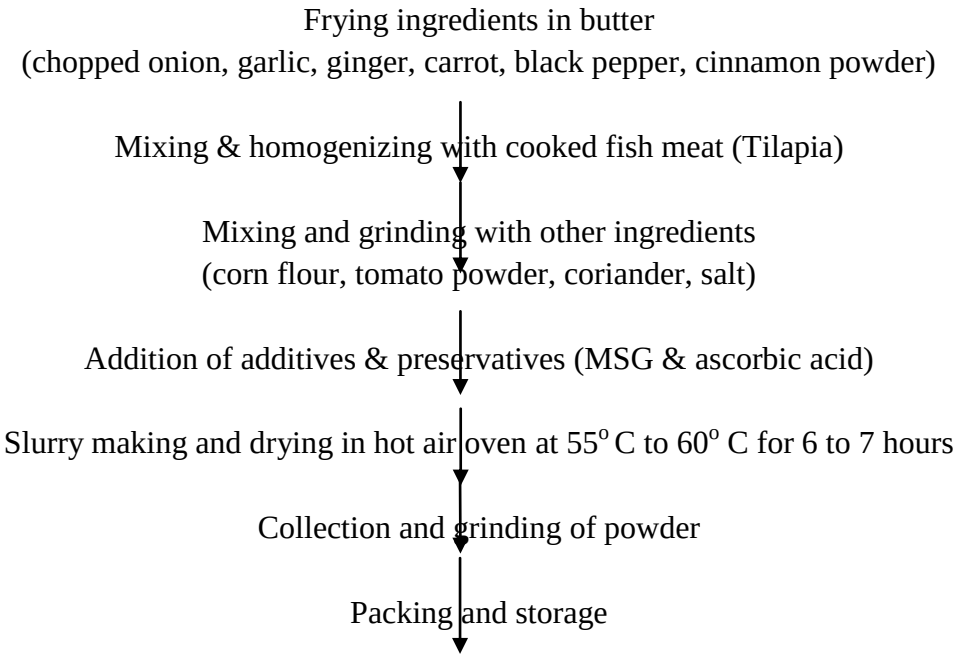
For preparation of soup, 5 g. of fish soup powder was made into paste with approximately 10 ml. luke-warm water. This paste was then added to boiling water and kept for one minute with continuous stirring. After that soya sauce, red chilli sauce and mono sodium glutamate was added as per taste. During the procedure the flame was kept on sim position to avoid clotting of starch (Flow Chart 5).

4.4 Proximate composition of fish soup powder prepared by adopting standardized method of fish soup powder preparation:

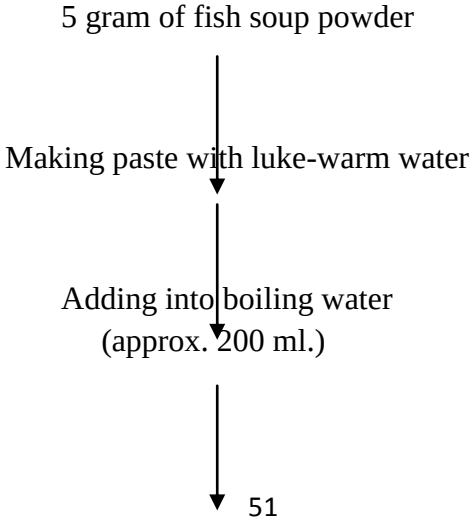
The moisture, crude protein, crude fat, carbohydrate and ash were determined. The values were moisture 1.74%, crude protein 17.59%, crude fat 12.65%,

carbohydrate 49.80% and ash 18.22% (Table 16 and Figure 6).

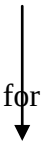
Flow Chart 4: Standardized method for preparation of tilapia fish soup powder:



Flow Chart 5: Method for preparation of fish soup from fish soup powder



Addition of MSG, soya sauce and red chilli sauce as per taste



Soup ready for consumption

4.5 Storage studies of fish soup powder:

The storage studies included changes in biochemical characteristics, microbiological characteristics and organoleptic characteristics etc.

4.5.1 Changes in biochemical characteristics:

4.5.1.1 Changes in moisture content:

The initial moisture content of all the three samples i.e. sample packed in metalized film, trend pouch, HDPE pouch and LDPE pouch was 1.74%.

In metalized film sample the moisture content after one month was 1.84% and after two months was 2.1%. After three months storage the moisture increased to 2.19%.

In trend pouch sample the moisture content after one month was 1.9% and after two months was 2.73%. After three months storage the moisture increased to 2.85%.

In HDPE pouch sample the moisture content after one month was 2.09% and after two months was 2.85%. After three months storage the moisture increased to 2.93%.

In LDPE pouch sample the moisture content after one month was 2.25% and after two months was 2.84%. After three months storage the moisture increased to 2.99%. Steady increase in moisture content was noted in all the packages.

The data presented in Table 17 and Figure 7 revealed that there was lowest moisture content in soup powder packed in metalized film pouch after three months of storage period.

Table 16: Proximate composition of Fish soup powder:

Parameters	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)
Tilapia fish	**1.74**	**17.59**	**12.65**	**18.22**	**49.80**

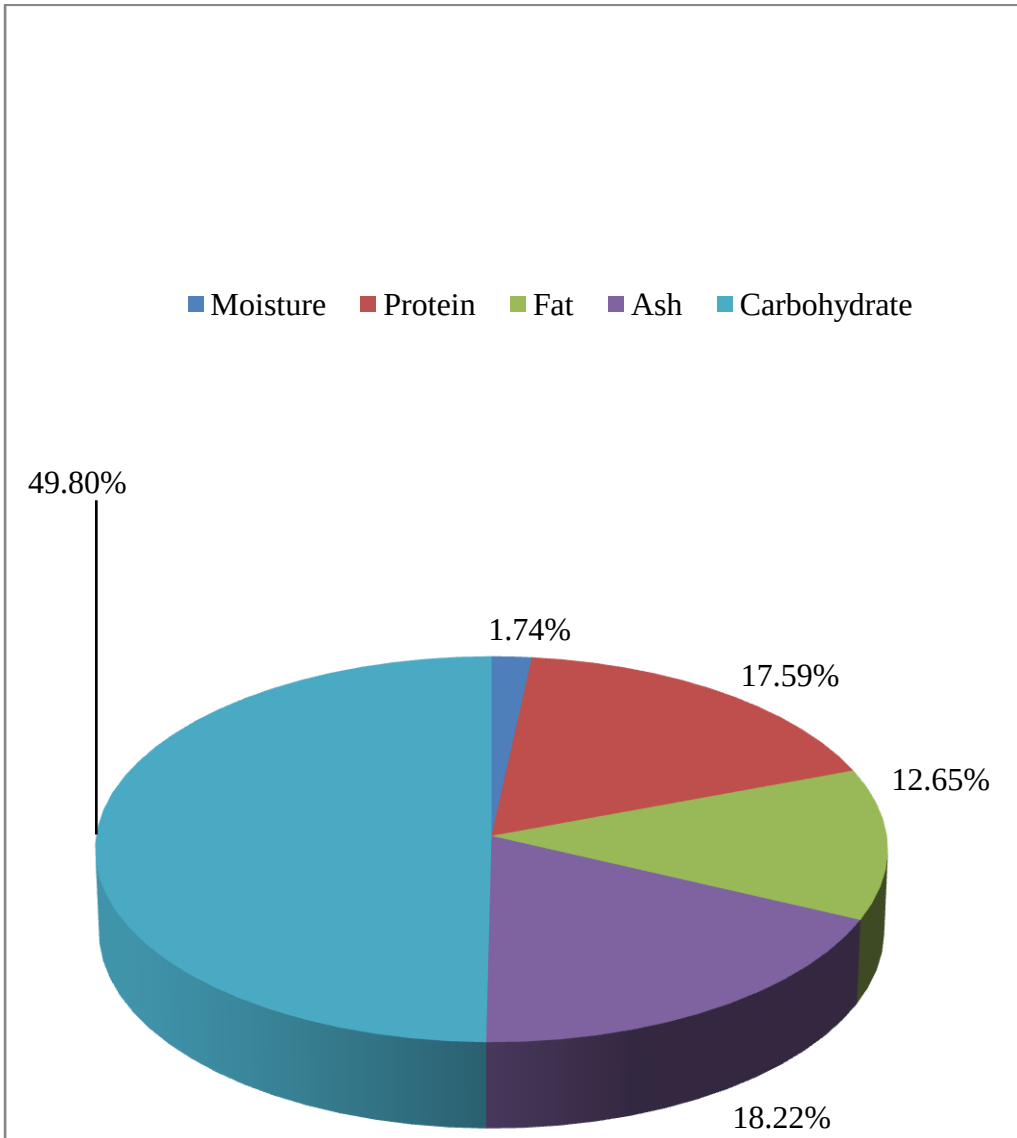


Fig.6 Proximate composition of Tilapia fish soup powder

Table 17: Changes in moisture content of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Metalized film (%)	Trend pack (%)	HDPE pouch (%)	LDPE pouch (%)
0	1.74	1.74	1.74	1.74
15	1.78	1.84	1.96	2.03
30	1.84	1.9	2.09	2.25
45	1.86	1.95	2.15	2.32
60	2.1	2.73	2.85	2.84
75	2.16	2.82	2.91	2.92
90	2.19	2.85	2.93	2.99

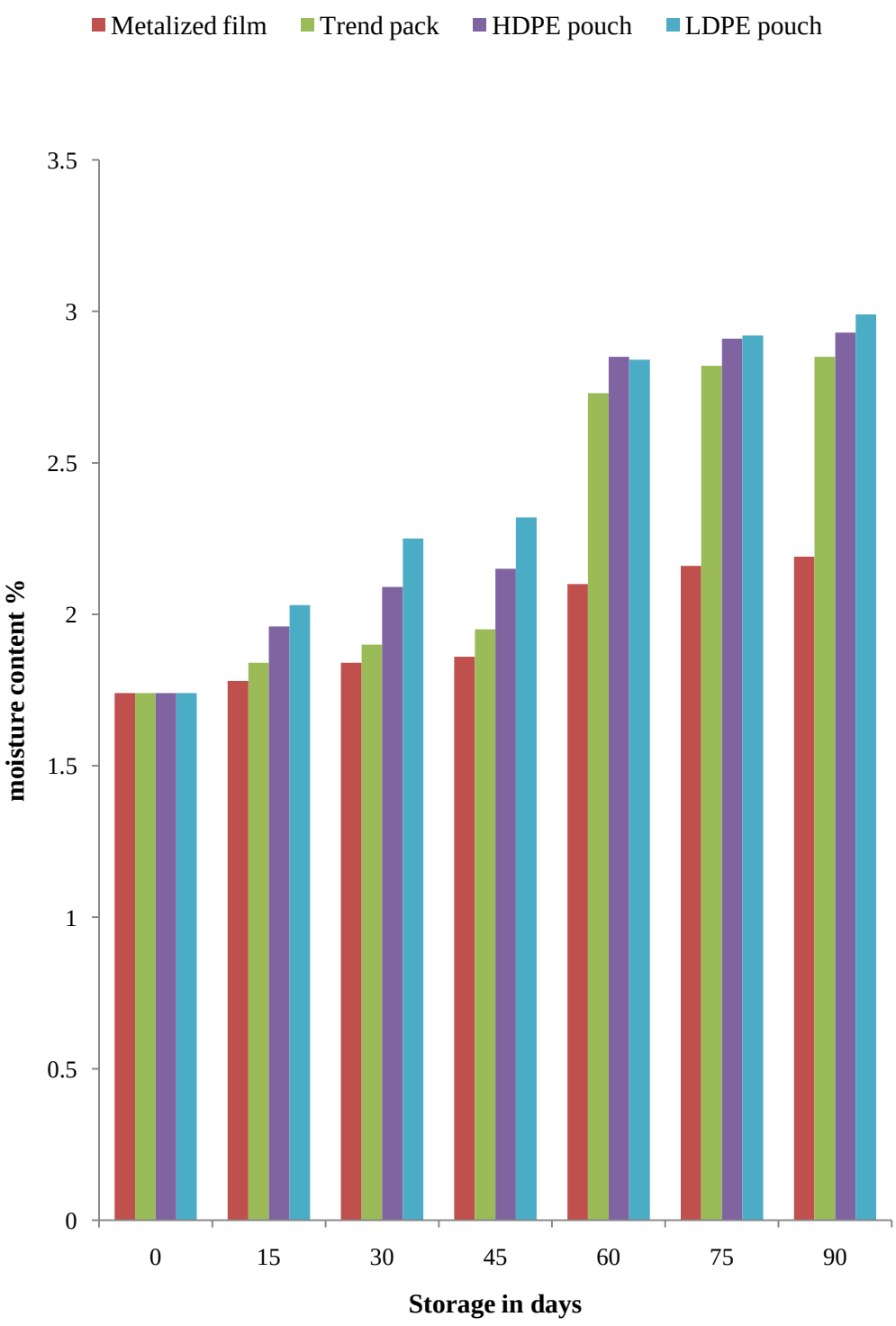


Fig.7 Changes in moisture content of fish soup powder packed in different packages during storage at room temparature

4.5.1.2 Changes in pH content:

The changes in pH during storage are shown in Table 18 and Figure 8. Initially, the value of pH was 5.36 in all the three packs.

In metalized film sample the pH after one month was 5.38; after two months it changed to 5.42 and after three months i.e. at the end of storage it changed to 5.47.

In trend pouch sample the pH after one month was 5.39; after two months it changed to 5.46 and at the end of storage it was found to be 5.55.

In HDPE pouch sample the pH after one month was 5.43; after two months it changed to 5.49 and at the end of storage it was found to be 5.56.

In LDPE pouch sample the pH after one month was 5.51; after two months it changed to 5.55 and at the end of storage it was found to be 6.07.

The lowest pH was found in metalized film sample.

Table 18: Changes in pH values of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Metalized film	Trend pack	HDPE pouch	LDPE pouch
0	5.36	5.36	5.36	5.36
15	5.37	5.37	5.37	5.49
30	5.38	5.39	5.43	5.51
45	5.4	5.41	5.47	5.53
60	5.42	5.46	5.49	5.55
75	5.45	5.51	5.51	5.65
90	5.47	5.55	5.56	6.07

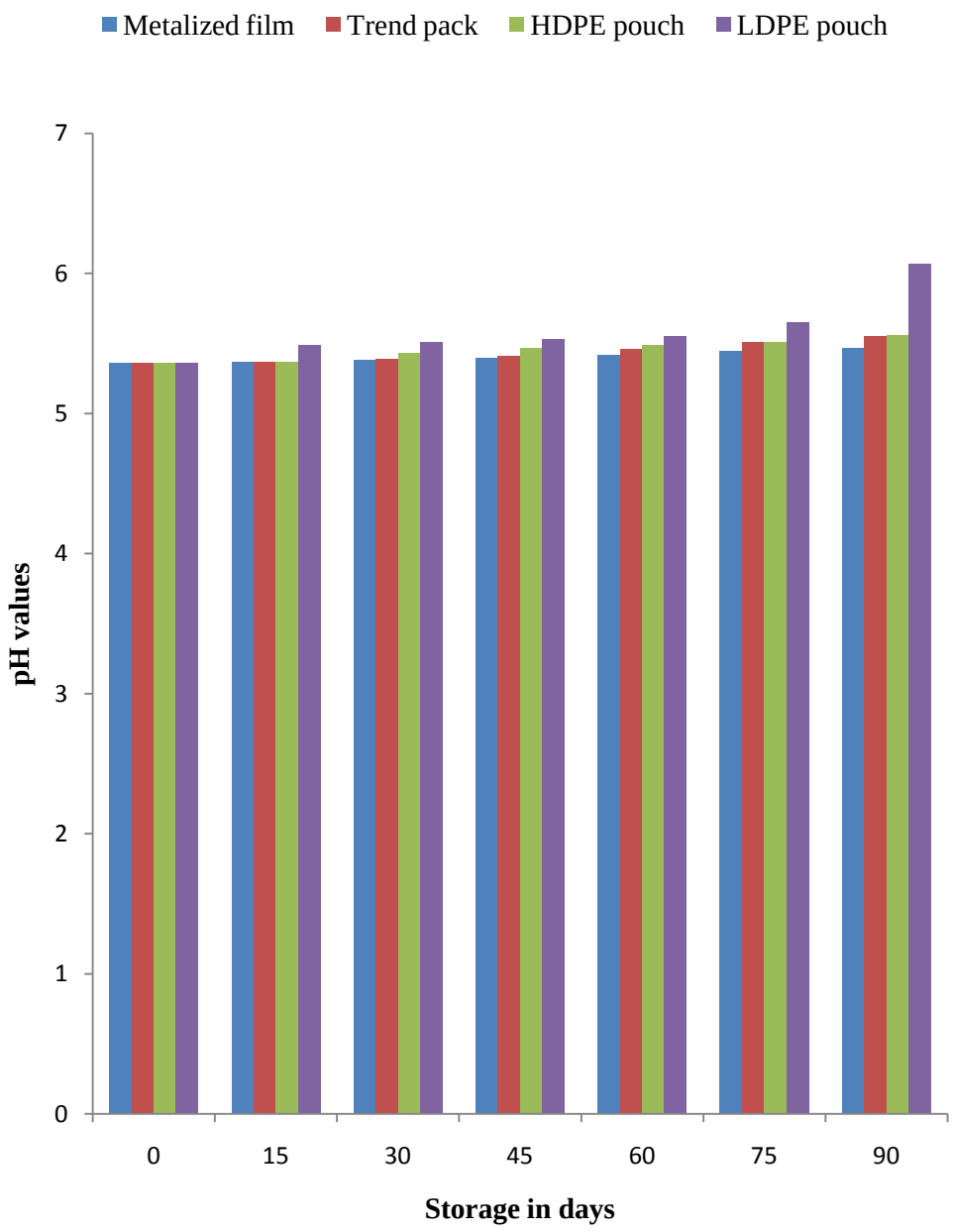


Fig.8 Changes in pH values of fish soup powder packed in different packages during storage at room temperature

4.5.1.3 Changes in TVB-N values of fish soup powder during storage:

There was slight change in TVB-N values among the samples packed in metalized film, trend pouch, HDPE pouch and LDPE pouch. The initial TVB-N content of all the three samples was 22.2 mg % (Table 19 and Figure 9).

In metalized film sample the TVB-N value was found to be 22.2 mg % at the end of second month. In third month the TVB-N content increased to 22.3 mg %.

In trend pouch sample the TVB-N value was found to be 22.2 mg % at the end of second month. In third month the TVB-N content increased to 22.4 mg %.

In HDPE pouch sample the TVB-N value was found to be 22.2 mg % in second month. In third month the TVB-N content increased to 22.4 mg %.

In LDPE pouch sample the TVB-N value was found to be 22.3 mg % after one month; 22.4 mg % in second month; 22.6 in third month.

The least changes in TVB-N values were found in the soup powder packed in metalized film pouches.

Table 19: Changes in Total Volatile Base – Nitrogen (TVB-N) of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Metalized film (mg %)	Trend pack (mg %)	HDPE pouch (mg %)	LDPE pouch (mg %)
0	22.2	22.2	22.2	22.2
15	22.2	22.2	22.2	22.2
30	22.2	22.2	22.2	22.3
45	22.2	22.2	22.2	22.3
60	22.2	22.2	22.2	22.4
75	22.2	22.3	22.3	22.5
90	22.3	22.4	22.4	22.6

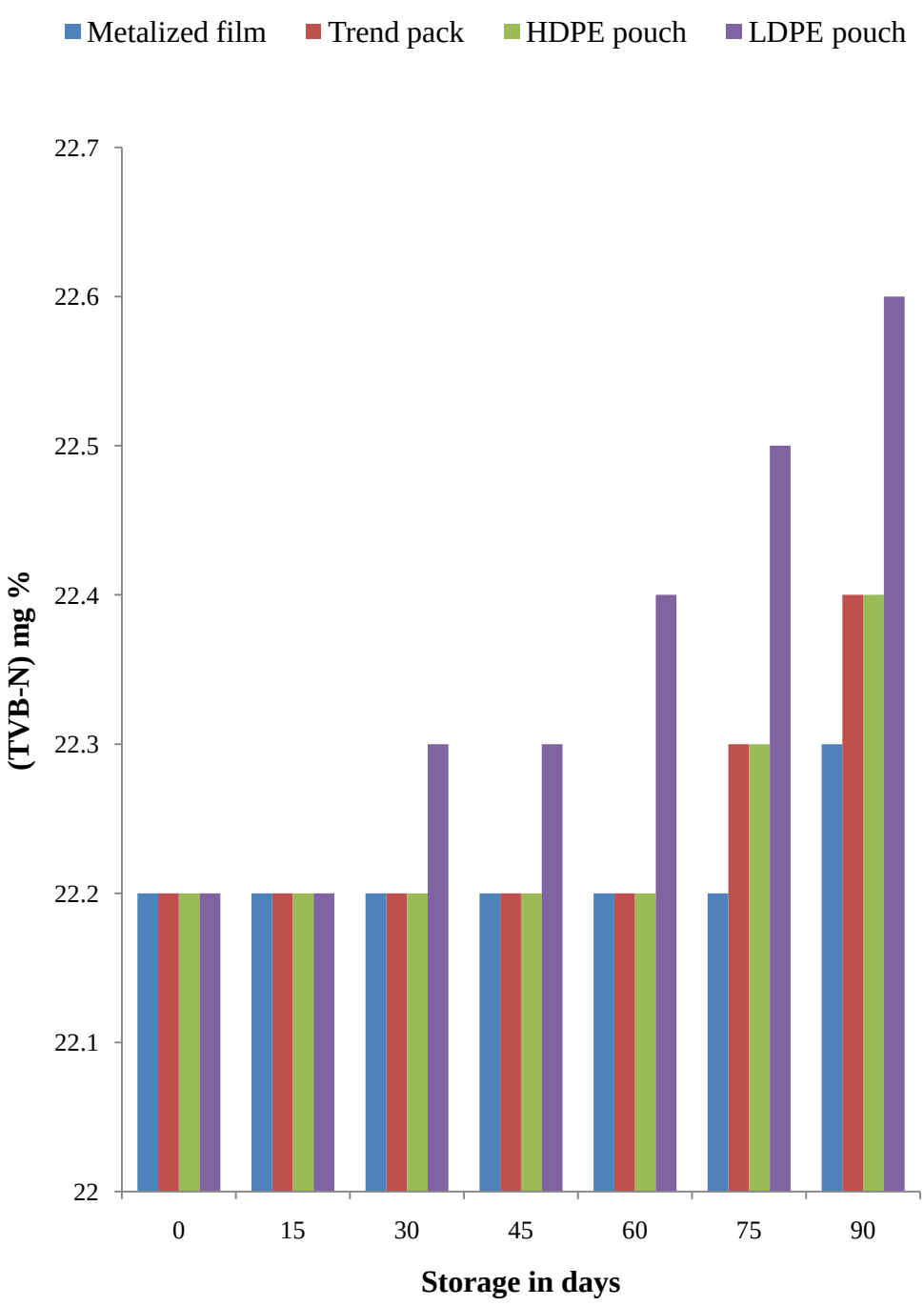


Fig.9 Changes in Total Volatile Base-Nitrogen (TVB-N) of fish soup powder packed in different packages during storage at room temperature

4.5.1.4 Changes in peroxide value of fish soup powder:

The initial peroxide value was found to be 1.0 milimoles of oxygen per kg of fat in all pouches. In metalized film sample and trend pouch sample after three months of storage it increased to 1.1 and 1.2 respectively. In HDPE pouch sample the peroxide value was found to be 1.3 milimoles of oxygen per kg of fat after three months of storage. In LDPE pouch sample, the PV showed increasing trend i.e. PV after one month was 1.5 milimoles of oxygen per kg of fat; after two months it changed to 1.9 milimoles of oxygen per kg of fat and after three months of storage period it was found to be 2.2 milimoles of oxygen per kg of fat.

The data presented in Table 20 and Figure 10 revealed that there was lowest PV content in soup powder packed in metalized film and trend pouch.

Table 20: Changes in Peroxide Value of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Metalized film	Trend pack	HDPE pouch	LDPE pouch
	(Milimoles of oxygen/ kg of lipid)			
0	1	1	1	1
15	1	1	1	1.3
30	1	1	1	1.5
45	1	1	1	1.7
60	1	1	1	1.9
75	1	1.1	1.2	1.9
90	1.1	1.2	1.3	2.2

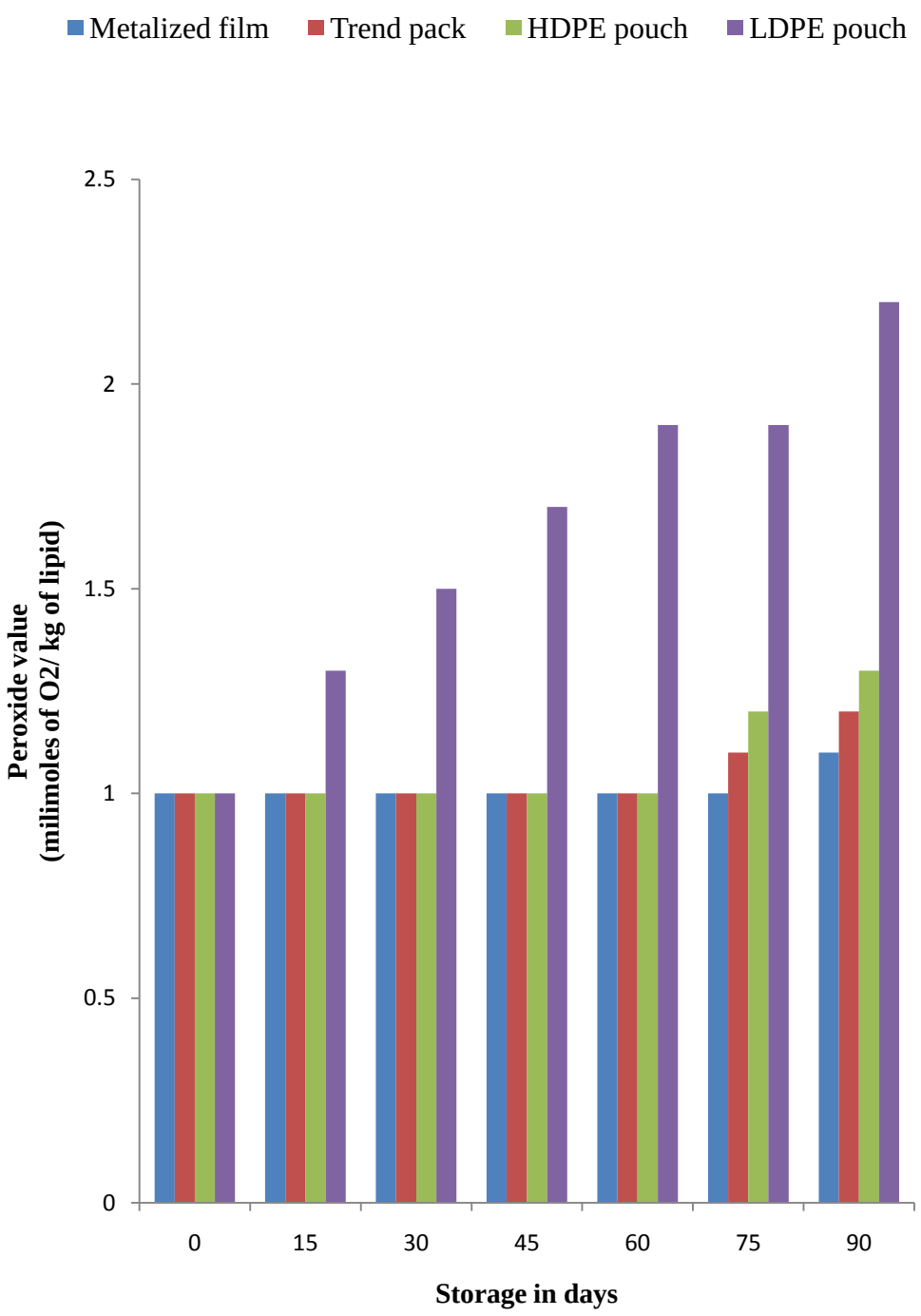


Fig.10 Changes in Peroxide Value (PV) of fish soup powder packed in different packages during storage at room temperature

4.5.2 Changes in microbiological characteristics:

During storage studies, changes in microbiological characteristics i.e. changes in TPC, moulds and other pathogenic micro-organisms were studied.

4.5.2.1 Changes in Total Plate Count:

The initial total plate count was found to be 2.0 $x10^3$ cfu/g in all the packs i.e. metalized film, trend pouch, HDPE pouch and LDPE pouch samples (Table 21 and Figure 11).

In metalized film sample the TPC was not changed even after three months of storage. In trend pouch sample, the TPC was found to be 2.0 $x10^3$ cfu/g at the end of second month. After three months it changed to 2.2 $x10^3$ cfu/g.

In HDPE pouch sample, the TPC was found to be 2.0$x10^3$ cfu/g at the end of second month. In third month it changed to 2.5 $x10^3$ cfu/g.

In LDPE pouch sample, the TPC at the end of first month was 3.0 $x10^3$ cfu/g. In second month it was found to be 3.5 $x10^3$ cfu/g. In third month it changed to 4.5 $x10^3$ cfu/g.

Table 21: Changes in Total plate count (TPC) Value of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	TPC (cfu/g.)			
	Metalized film	**Trend pack**	**HDPE pouch**	**LDPE pouch**
0	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$
15	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$
30	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	3.0 $x10^3$
45	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	3.4 $x10^3$
60	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	3.5 $x10^3$
75	2.0 $x10^3$	2.0 $x10^3$	2.0 $x10^3$	4.0 $x10^3$
90	2.0 $x10^3$	2.2 $x10^3$	2.5 $x10^3$	4.5 $x10^3$

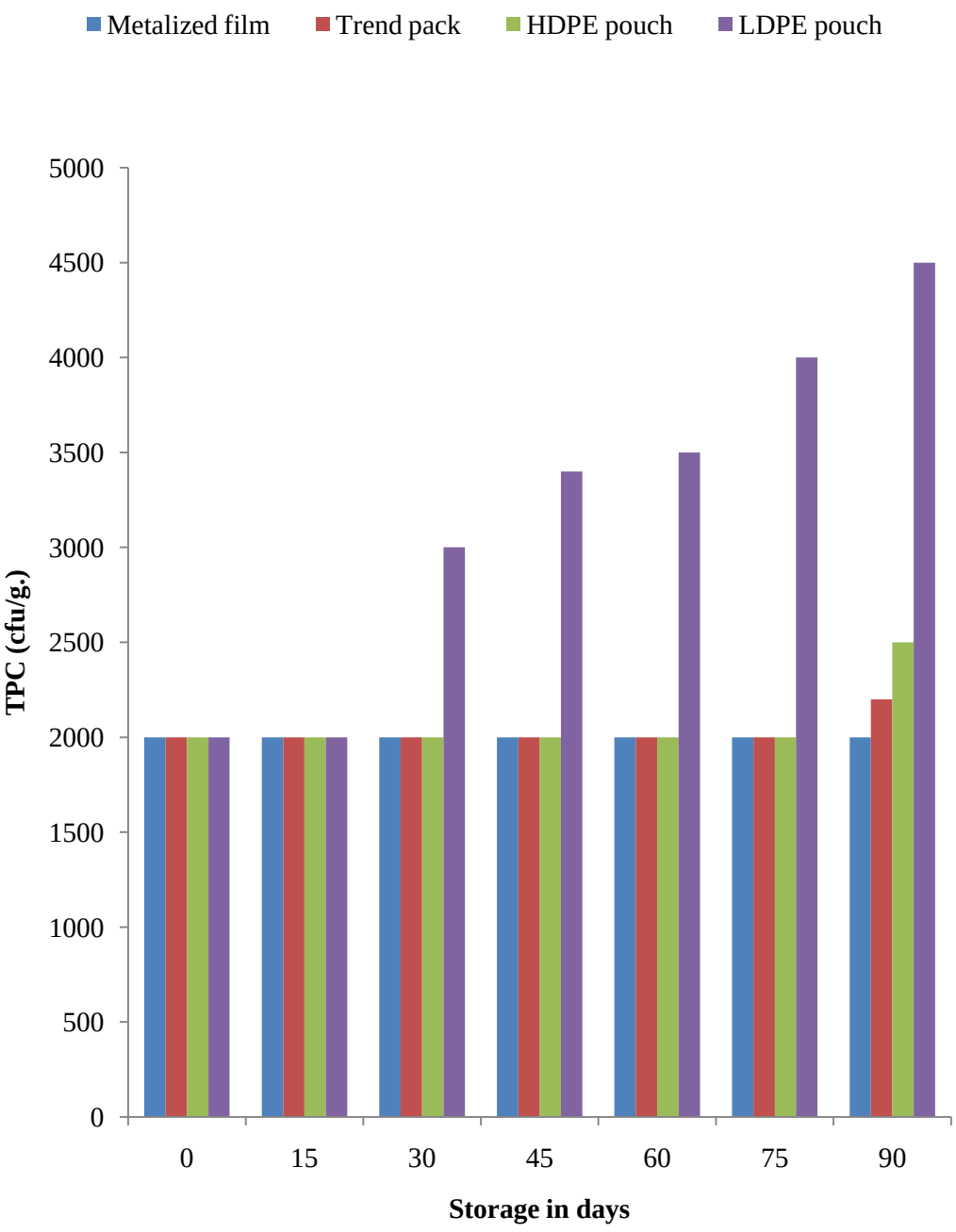


Fig.11 Changes in TPC of fish soup powder packed in different packages during storage at room temperature

4.5.2.2 Changes in mould count:

There was absolutely no evidence of mould growth even after storage of three months (Table 22), in all the samples packed in metalized film, trend pouch, HDPE pouch and LDPE pouch.

Table 22: Changes in Mould Count (MC) of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Mould count (cfu/g.)			
	Metalized film	**Trend pack**	**HDPE pouch**	**LDPE pouch**
0	ND	ND	ND	ND
15	ND	ND	ND	ND
30	ND	ND	ND	ND
45	ND	ND	ND	ND
60	ND	ND	ND	ND
75	ND	ND	ND	ND
90	ND	ND	ND	ND

*ND = Not detected

4.5.2.3 Changes in pathogenic microflora:

The other pathogenic microorganisms namely *E.coli, Salmonella* and *Staphylococci* were found to be absent during entire storage period (Table 23).

Table 23: Changes in micro flora of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Staphylococci (cfu/g.)				Salmonella (cfu/g.)				E.coli (cfu/g.)			
	A	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
90	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

A : Metalized film	**B : Trend pack**	**C : HDPE pouch**	**D : LDPE pouch**

*ND = Not detected

4.5.3 Changes in organoleptic quality characteristics of fish soup powder:

The results of organoleptic evaluation during the storage of fish soup powder at room temperature are shown in Table 24. It was noticed that there was decline in overall quality characteristics namely appearance, colour, taste, odour, consistency and overall acceptability during storage period of three months.

The initial score for appearance was 8.2 in all the packs. In metalized film pouch sample, the score for appearance, after two months storage was reduced to 7.9 and in third month, the score was 7.8. In trend pouch sample the, score for appearance, after two months storage was reduced to 7.7 and in; third month, the score was 7.4. In HDPE pouch sample, the score for appearance was 7.7 in second month and 7.3 in the third month. In LDPE pouch sample, the score for appearance was 7.5 after two months storage; 7.1 in third month (Figure 12).

The initial score for colour was 8.2 in all the packs. In metalized film pouch sample, the score for colour was 7.9 after two months storage; 7.8 in third month. In trend pouch sample, the score for colour was 7.6 after two months storage; 7.3 in third month. In HDPE pouch sample the, score for colour was 7.5 after two months storage; 7.1 in third month i.e.at the end of storage. In LDPE pouch sample, the score for colour was 7.3 after two months storage; 6.9 in third month i.e.at the end of storage (Figure 13).

The initial score for taste in all the packs was 8.4. In metalized film pouch sample, the scores were found to be 8 and 7.9 in second month and third month of storage respectively. In trend pouch sample, the scores were found to be 7.8 and 7.6 in second month and third month respectively. In HDPE pouch sample, the scores were found to be 7.8 and 7.5 in second month and third month respectively. In LDPE pouch sample, the scores were found to be 7.3 and 7 in second month and third month of storage respectively (Figure 14).

There were minor changes observed in the scores for consistency throughout the storage period. It changed from initial value of 8.2 to 7.9 at the end of storage in metalized film packs. In trend pouch and HDPE pouch it changed from 8.2 to 7.8 at the end of storage period. In LDPE pouch it changed from 8.2 to 7.7 at the end of storage period (Figure 15).

The initial score for odour was 8.4 in all the packs. In metalized film pouch, the score for odour was 8 in second month and 7.9 in third month of storage period. In trend pouch, the score for odour was 8 in second month and 7.7 in third month of storage period. In HDPE pouch, the score was 7.8 in second month and 7.7 in third month. In LDPE pouch, the score was 7.4 in second month and 7.2 in third month of storage period (Figure 16).

The overall acceptability scores changed along with storage. The initial score for overall acceptability in all the packs was 8.3. In metalized film pouch, the score for overall acceptability was 8 in second month, reduced to 7.9 in third month. In trend pouch, the score for overall acceptability was 7.8 in second month, reduced to 7.6 in third month of storage period. In HDPE pouch, the score was 7.8 in second month, 7.5 in third month of storage period. In LDPE pouch, the scores were 7.4 and

7.1; after two months and three months respectively (Figure 17).

4.5.4 Statistical analysis:

The ANOVA ($P<0.05$) for overall acceptability criteria during storage of soup powder packed in four different packaging viz. Metalized film pouch, Trend pouch, HDPE pouch and LDPE pouch revealed that the metalized film pouch is better in all four types of packaging materials used. Results shows that metalized film pouch, trend pouch and HDPE pouch are suitable for packaging of soup powder. The LDPE pouch is not suitable for packaging of soup powder (Table 25).

Table 24: Changes in organoleptic quality of fish soup powder packed in different packages during storage at room temperature:

Storage (in days)	Appearance				Colour				Taste				Odour				Consistency				Overall acceptability			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
0	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.3
15	8.2	8	8	7.9	8.1	8	7.9	7.7	8.2	8.1	8	7.8	8.3	8.2	8.1	7.9	8.1	8	8	8	8.2	8	8	7.8
30	8.1	8	8	7.8	8	7.9	7.9	7.6	8.1	8	8.1	7.8	8.2	8.1	8.1	7.8	8	7.9	7.9	7.9	8.1	8	7.9	7.7
45	8.1	7.9	7.9	7.7	7.9	7.7	7.7	7.5	8	8	8	7.5	8.1	8.1	8	7.6	7.9	7.9	7.9	7.9	8.1	7.9	7.9	7.6
60	7.9	7.7	7.7	7.5	7.9	7.6	7.5	7.3	8	7.8	7.8	7.3	8	8	7.8	7.4	7.9	7.9	7.9	7.8	8	7.8	7.8	7.4
75	7.8	7.5	7.4	7.3	7.8	7.4	7.2	7.1	7.9	7.8	7.7	7.1	8	7.8	7.7	7.3	7.9	7.8	7.8	7.8	7.9	7.7	7.6	7.2
90	7.8	7.4	7.3	7.1	7.8	7.3	7.1	6.9	7.9	7.6	7.5	7	7.9	7.7	7.7	7.2	7.9	7.8	7.8	7.7	7.9	7.6	7.5	7.1

A = Metalized film **B = Trend pack** **C = HDPE pouch** **D = LDPE pouch**

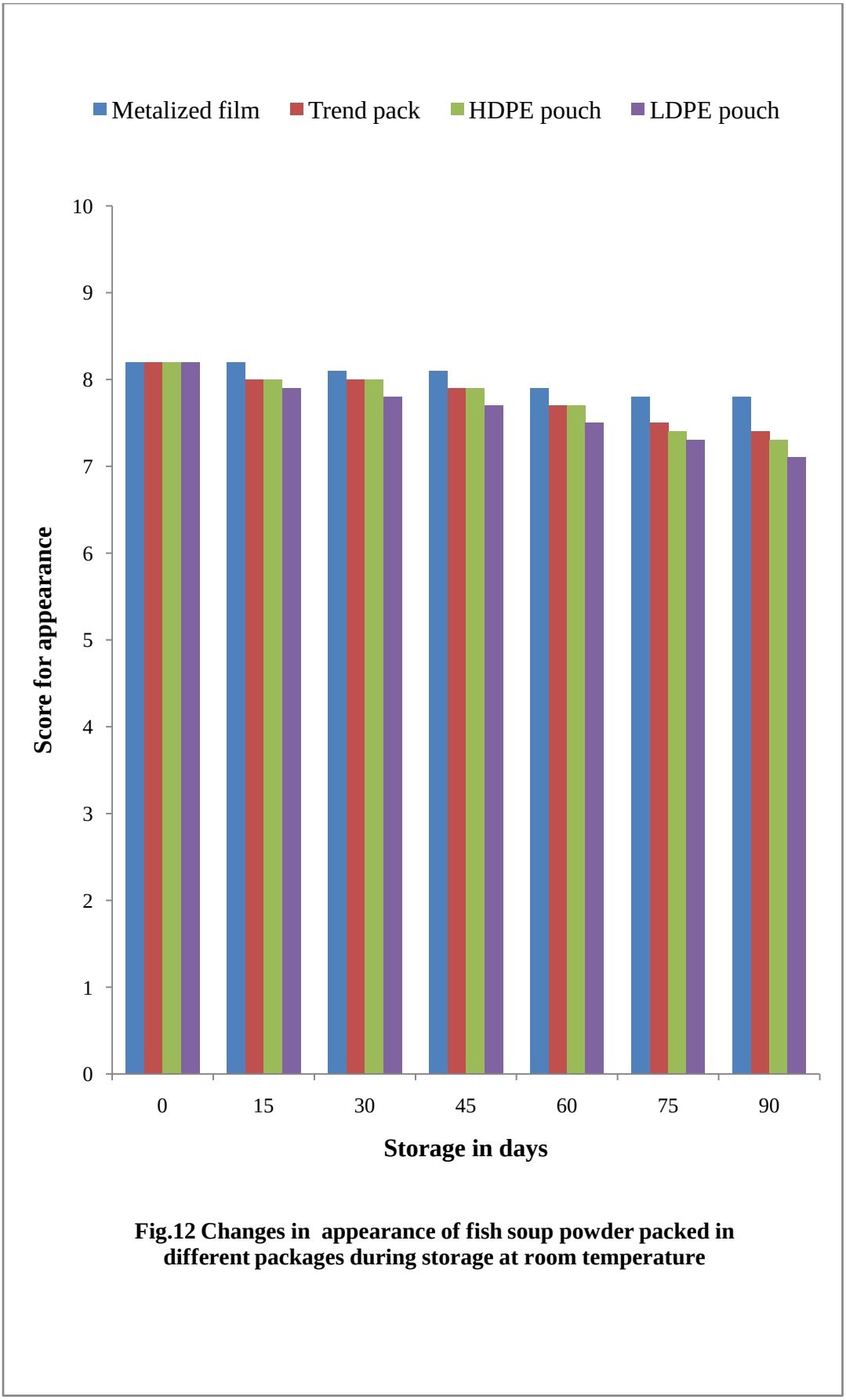


Fig.12 Changes in appearance of fish soup powder packed in different packages during storage at room temperature

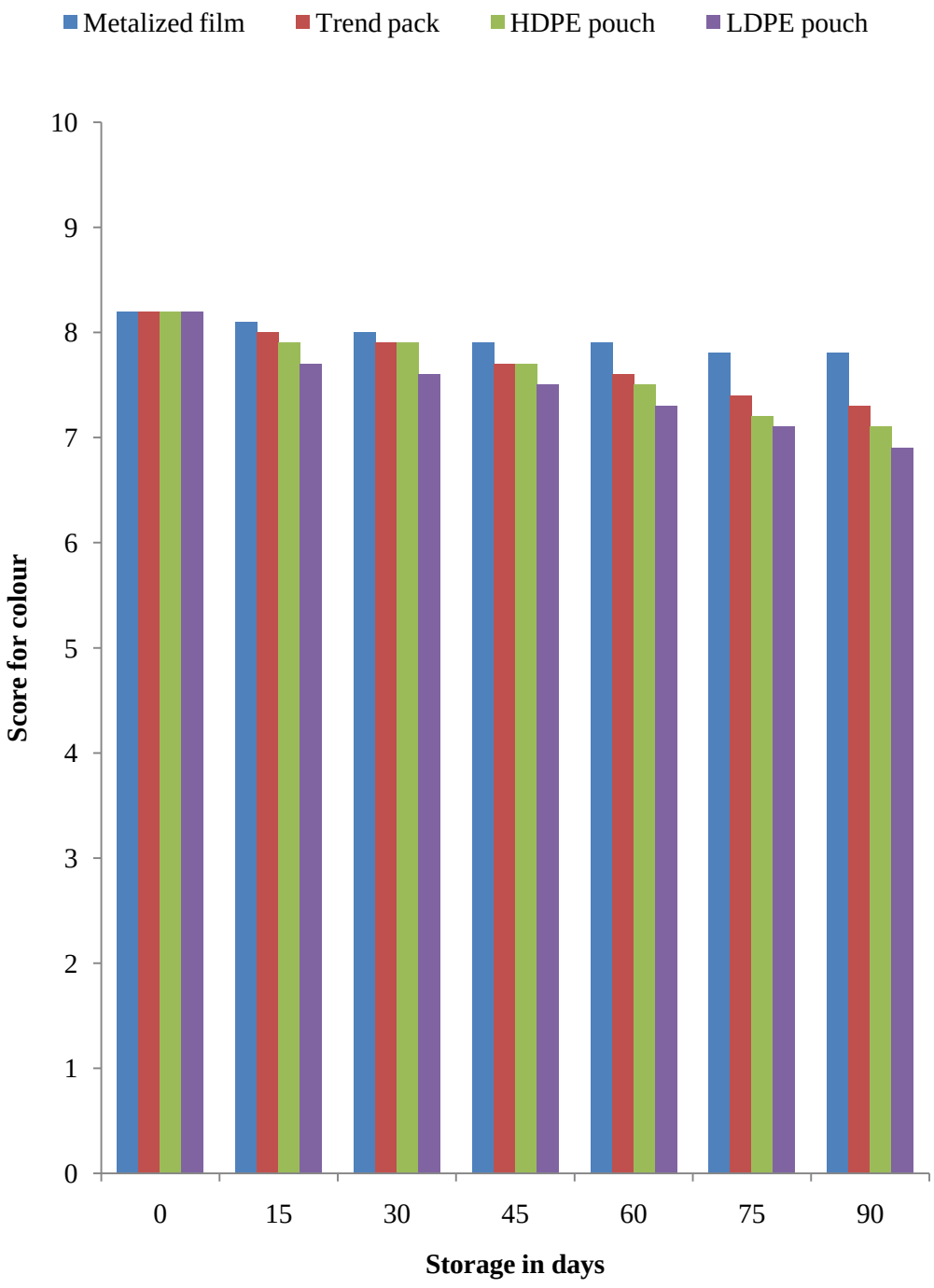


Fig 13 Changes in colour of fish soup powder packed in different packages during storage at room temperature

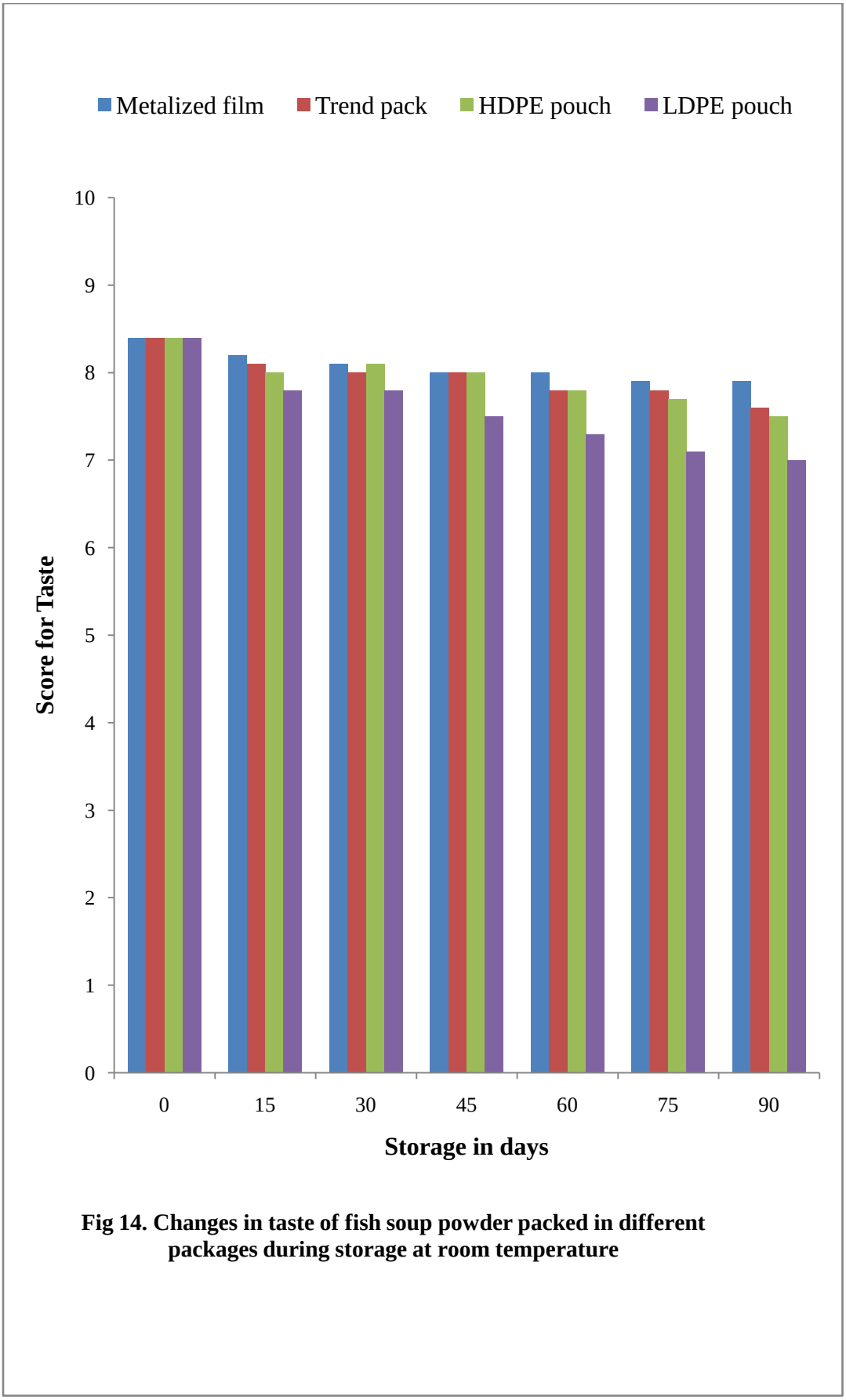


Fig 14. Changes in taste of fish soup powder packed in different packages during storage at room temperature

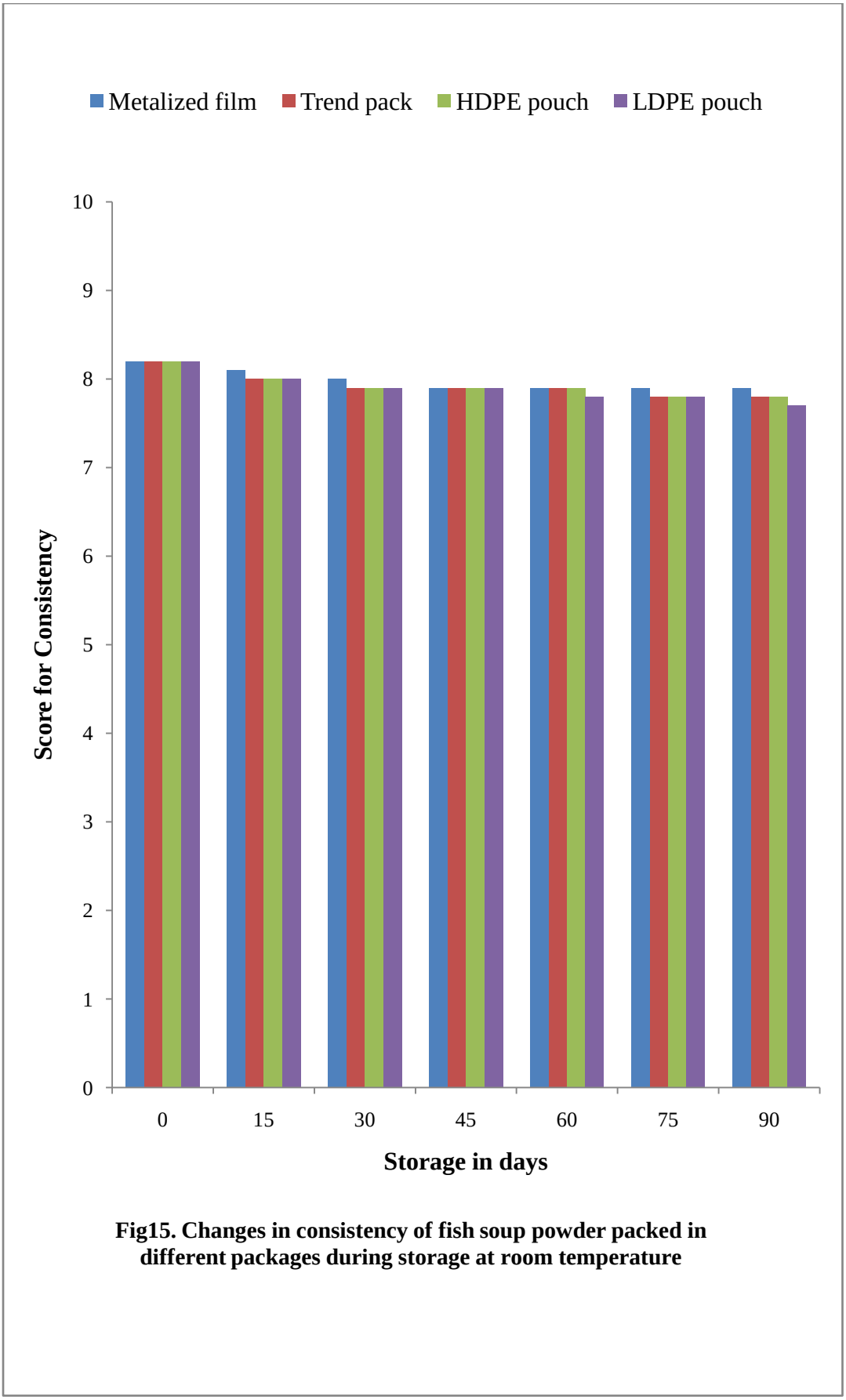


Fig15. Changes in consistency of fish soup powder packed in different packages during storage at room temperature

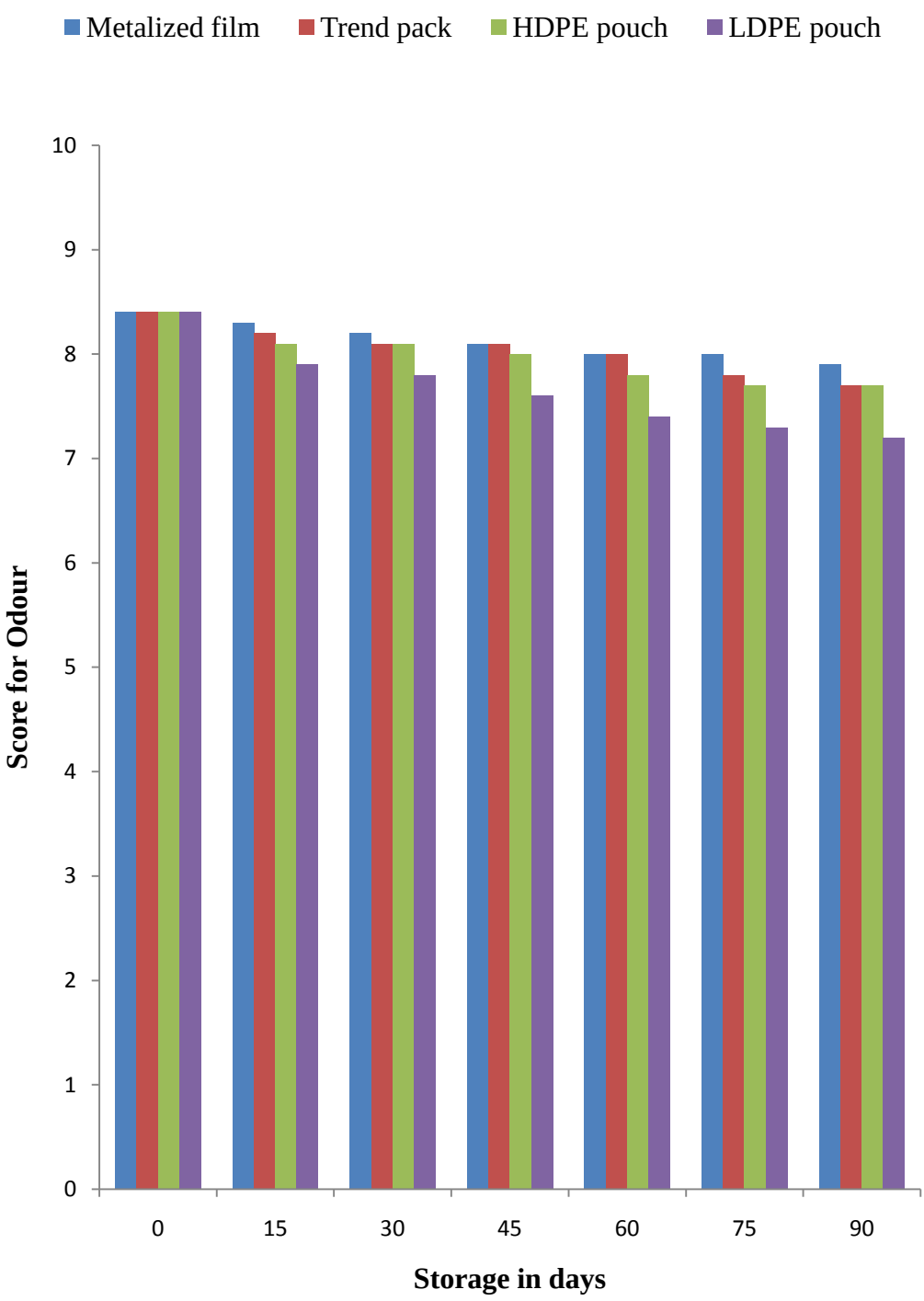


Fig16. Changes in odour of fish soup powder packed in different packages during storage at room temperature

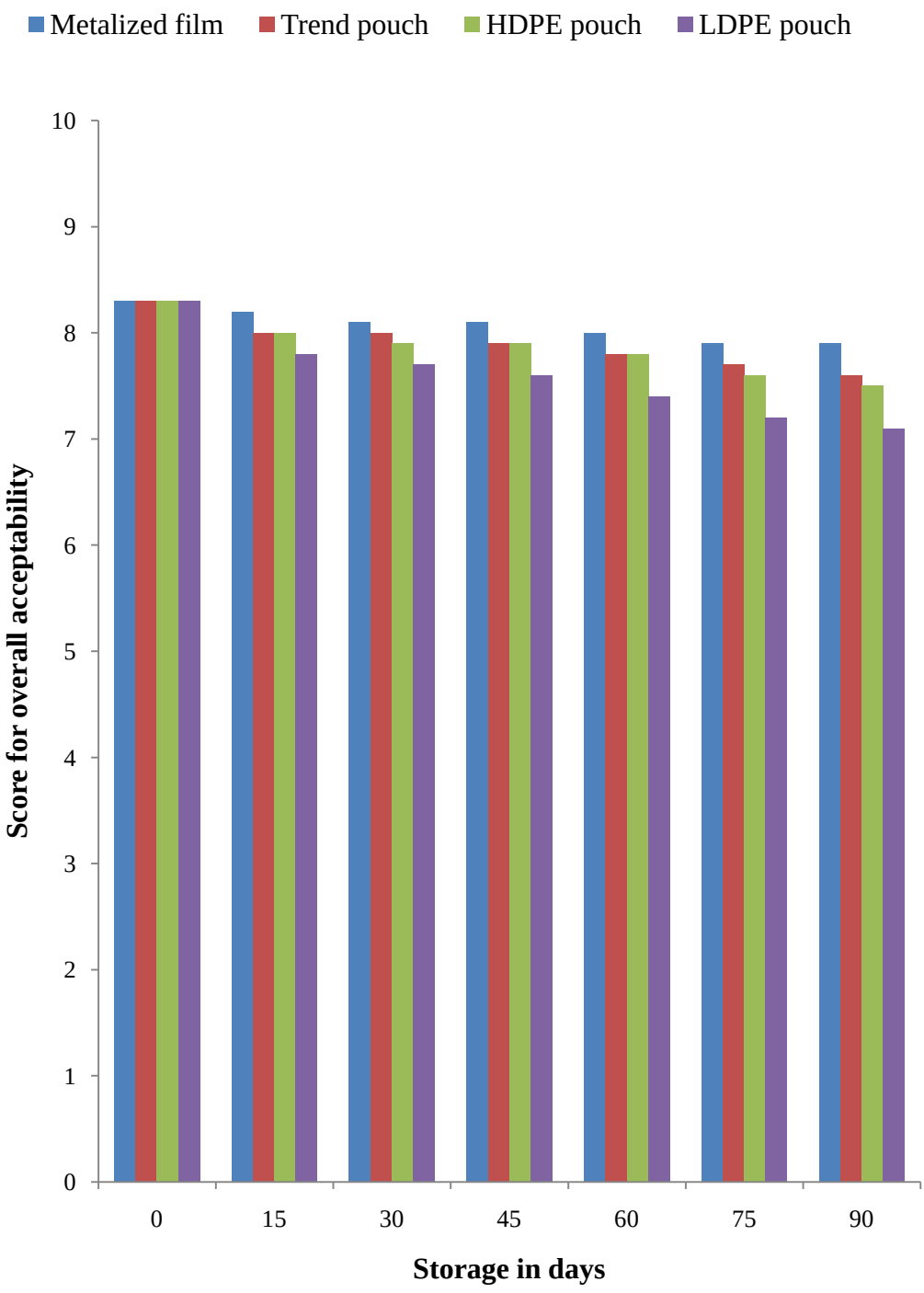


Fig.17 Changes in overall acceptability of fish soup powder packed in different packages during storage at room temperature

Table 25: ANOVA for changes in organoleptic quality of fish soup powder packed in different packages at 90 days of storage depending on overall acceptability criteria:

Source of variation	Sum of square	Degree of freedom	Mean square	F	F- Crit.
Between group	0.84	3	0.2812	3.7679	3.009
Within group	1.79	24	0.0746		
Total	2.63	27			

Note: F- Cal. > F- Crit. all treatments given are significantly different at P < 0.05.

L.S.D. test:

Difference between the mean	More or less L.S.D. value	Significant/Not significant
Xd - Xa = 0.457	>	**Significantly different**
Xd - Xb = 0.193	>	**Significantly different**
Xd - Xc = 0.181	>	**Significantly different**

Note: Xa, Xb and Xc, Xd = means of overall acceptability score of product packed in four different types of packages.

Xa = Fish soup powder packed in LDPE pouch,

Xb = Fish soup powder packed in HDPE pouch,

Xc = Fish soup powder packed in Trend pouch,

Xd = Fish soup powder packed in Metalized film pouch.

4.6 Proximate composition of fish soup powder packed in four different pouches at the end of storage period of 3 months:

The moisture, crude protein, crude fat, carbohydrate and ash were determined again at the end of storage period of three months.

In metalized film pouch; the values were moisture 2.19%, crude protein 16.25%, crude fat 14.05%, carbohydrate 48.10% and ash 19.41% (Table 26 and Figure 18).

In trend pouch; the values were moisture 2.85%, crude protein 15.15%, crude fat 15.35%, carbohydrate 46.85% and ash 19.80% (Table 27 and Figure 19).

In HDPE pouch; the values were moisture 2.93%, crude protein 14.38%, crude fat 15.88%, carbohydrate 46.31% and ash 20.50% (Table 28 and Figure 20).

In LDPE pouch; the values were moisture 2.99%, crude protein 13.49%, crude fat 16.80%, carbohydrate 45.83% and ash 20.92% (Table 29 and Figure 21).

The least changes were found in the proximate composition of fish soup powder packed in metalized film pouches after the end of storage period of three months.

Table 26: Proximate composition of fish soup powder packed in the metalized film pouch at the end of storage period of 3 months:

Parameter	Moisture	Protein	Ash	Fat	Carbohydrates
Tilapia fish	2.19%	16.25%	19.41%	14.05%	48.10%

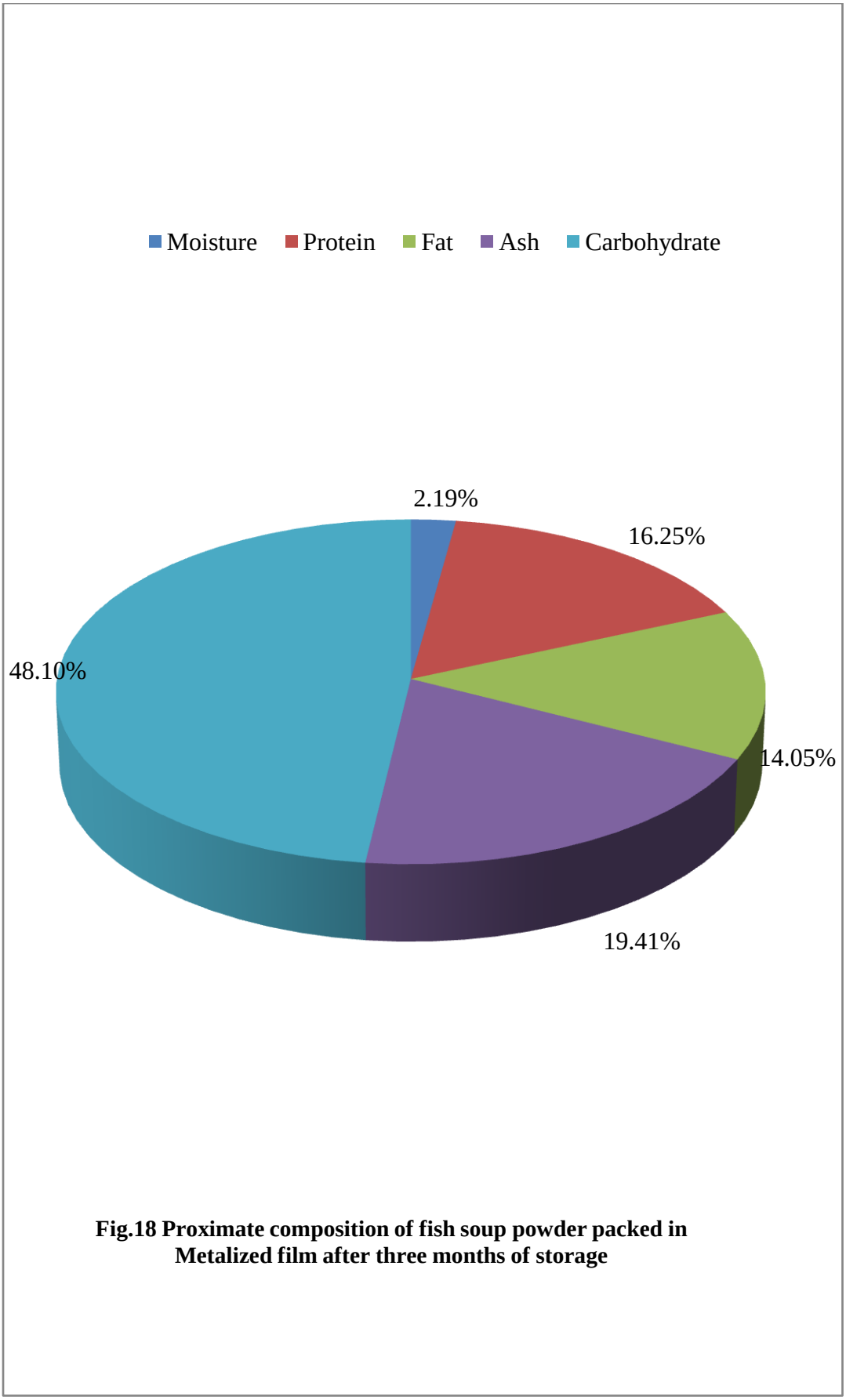


Fig.18 Proximate composition of fish soup powder packed in Metalized film after three months of storage

Table 27: Proximate composition of fish soup powder packed in the trend pouch at the end of storage period of 3 months:

Parameter	Moisture	Protein	Ash	Fat	Carbohydrates
Tilapia fish	2.85%	15.15%	19.80%	15.35%	46.85%

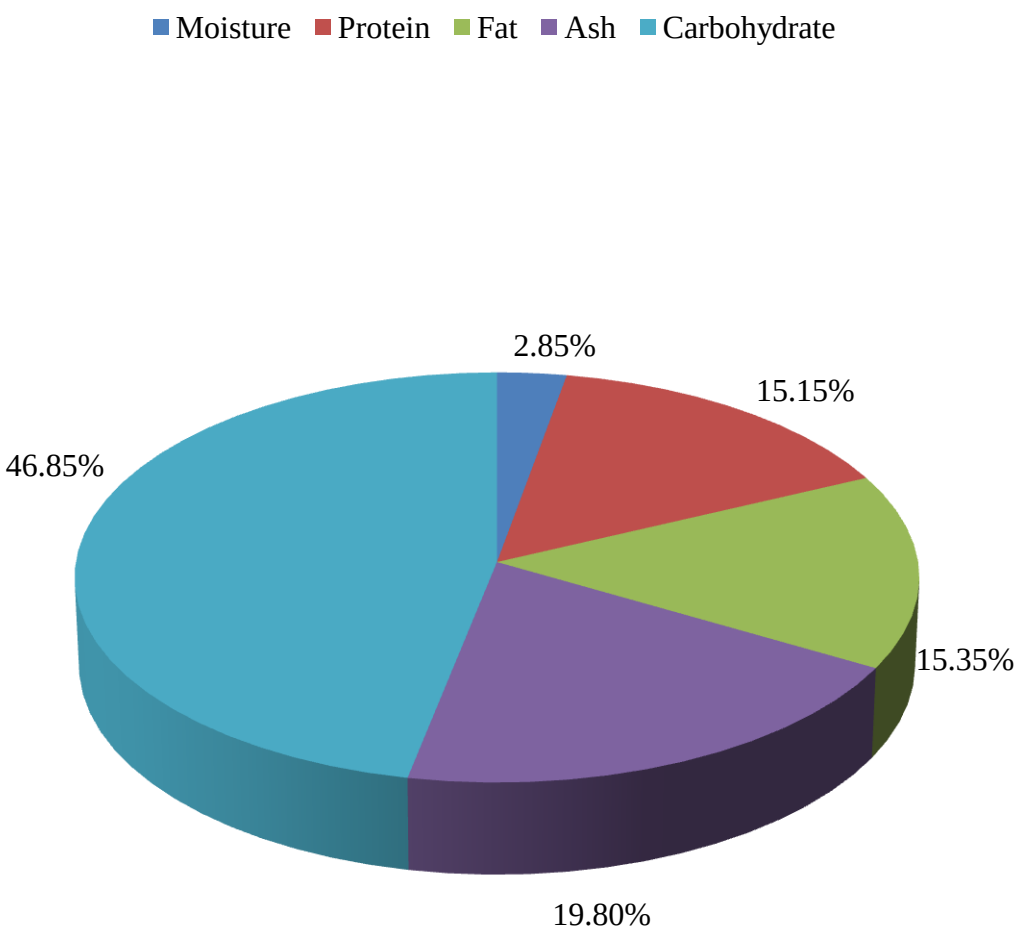


Fig 19. Proximate composition of fish soup powder packed in Trend pouch after three months of storage period

Table 28: Proximate composition of fish soup powder packed in the HDPE pouch at the end of storage period of 3 months:

Parameter	Moisture	Protein	Ash	Fat	Carbohydrates
Tilapia fish	2.93%	14.38%	20.50%	15.88%	46.31%

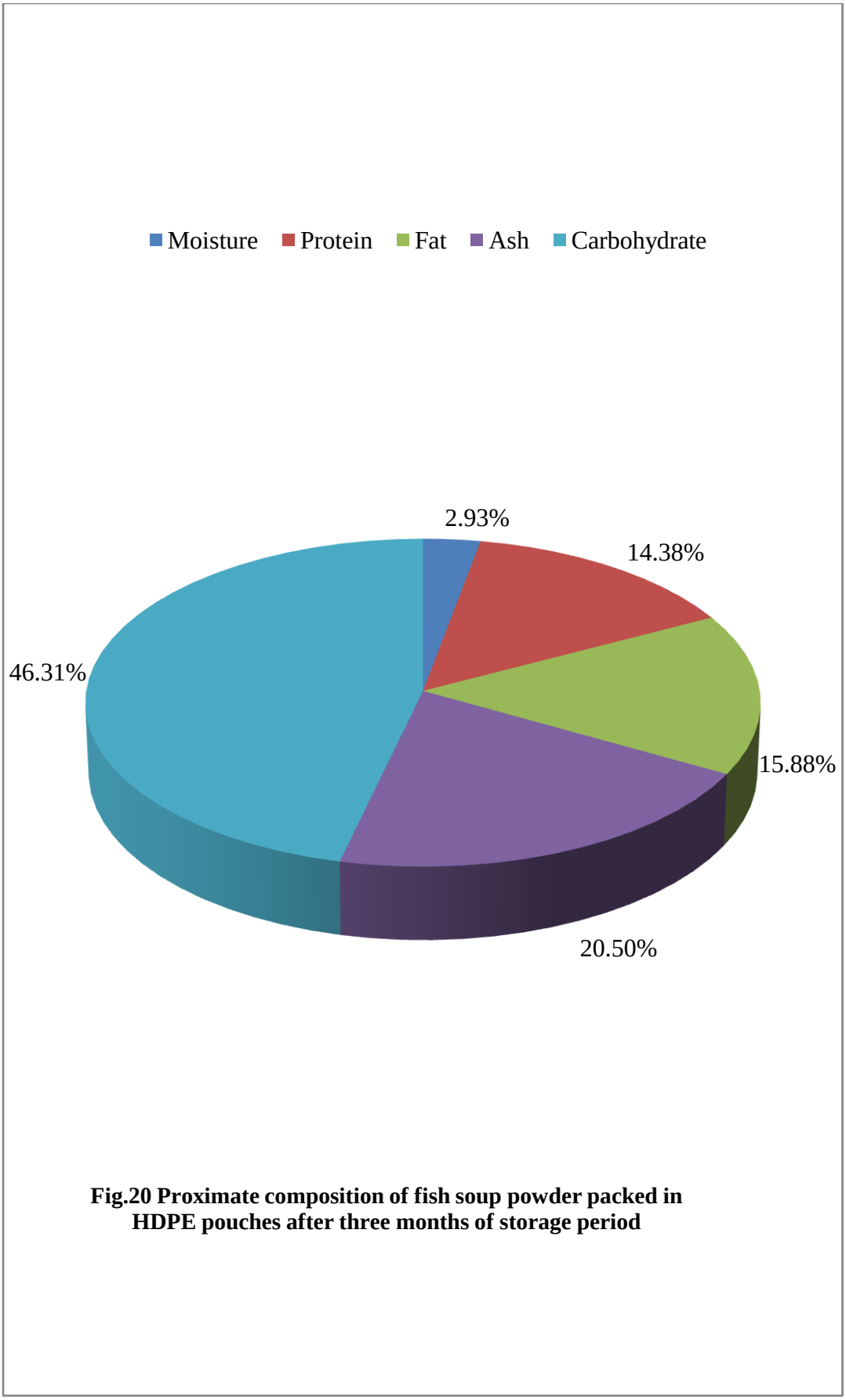


Fig.20 Proximate composition of fish soup powder packed in HDPE pouches after three months of storage period

Table 29: Proximate composition of fish soup powder packed in the LDPE pouch at the end of storage period of 3 months:

Parameter	Moisture	Protein	Ash	Fat	Carbohydrates
Tilapia fish	2.99%	13.49%	20.92%	16.80%	45.80%

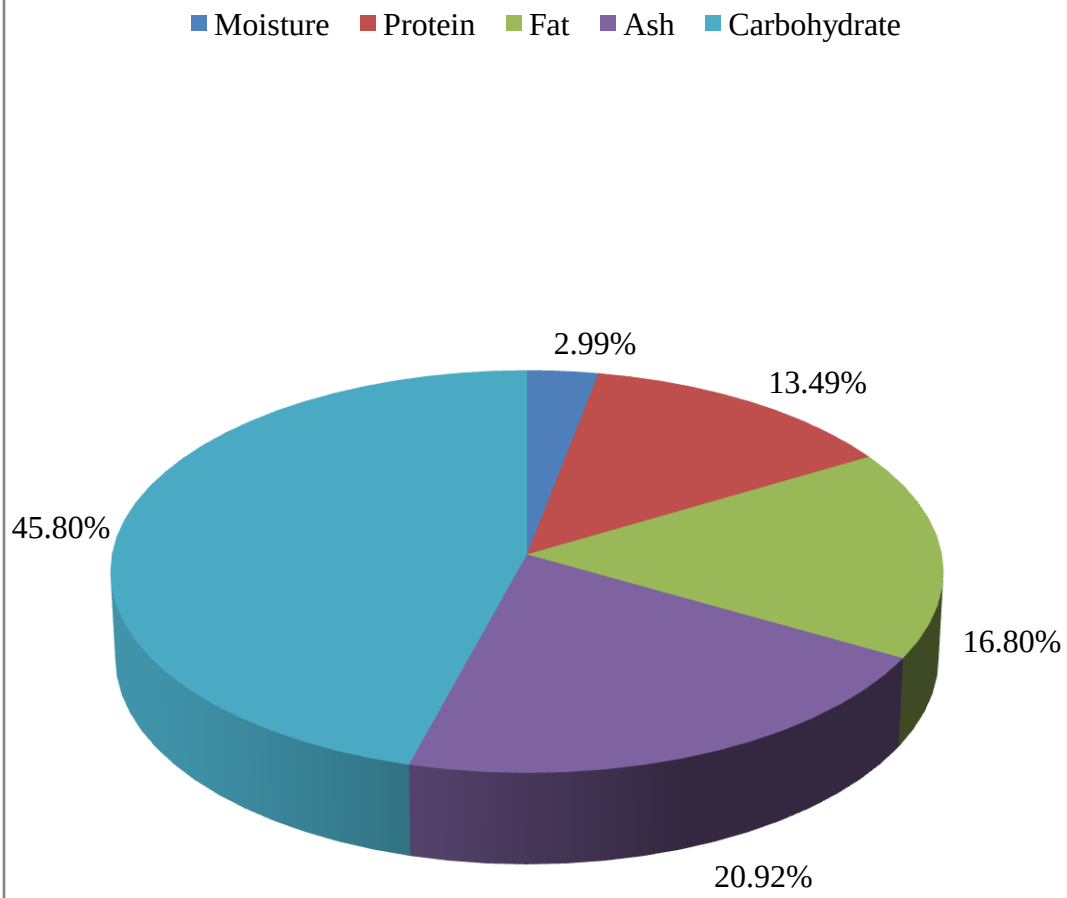


Fig.21 Proximate composition of fish soup powder packed in LDPE pouches after three months of storage period

4.7 Conclusion:

The present studies indicated that a tasty and nutritionally rich soup can be prepared using tilapia fish (Plate 7). The standardization of ingredients for soup powder indicated that the starches namely corn flour @ 25%, pepper powder @ 2.5% and tomato powder @ 12% of the fish meat are the standard proportions of the ingredients for the fish soup powder. At every stage organoleptic evaluation of fish soup powder was carried out.

The use of four different types of packages namely Metalized film, Trend pouch, HDPE pouch and LDPE pouch for storing the soup powder revealed that the metalized film pouch was the best packaging material for storing the fish soup powder (Plate 6) upto 3 months, since the biochemical, microbiological and organoleptic changes were least in the soup powder stored in the metalized film pouches.

5. DISCUSSION

Tilapia is a lean variety of fish with white flesh and therefore an ideal choice as raw material for the development of value added fish products for both domestic and international markets. Studies on the physical, chemical, and microbiological qualities of fresh tilapia meat revealed its suitability for the preparation of ready to eat and value added products (Dhanapal *et al*., 2010).

There comes a need to develop different, low valued at the same time nutritionally enriched products. The fishes like tilapia which is generally not consumed by people can become a cheaper source of nutritional diet for low income groups because a small quantity of fish often provides a critical nutritional support (Whittle, 1984). Keeping this in view an attempt was made in the present work to prepare fish soup powder- a fish product rich in nutrients.

5.1 Proximate composition of fresh fish:

In present work, the moisture, crude protein, crude fat and ash of fresh tilapia fish were recorded to be 76.26%, 18.69%, 3.86% and 1.19% respectively. Foh (2011) reported the moisture, crude protein, crude fat and ash of fresh tilapia fish meat and it was 77.81%, 19.04%, 3.73%, 1.04% respectively which supports the results obtained in the present study.

5.2 Standardization of different ingredients in fish soup powder:

5.2.1 Standardization of starch type for the preparation of fish soup powder:

The results of organoleptic analysis revealed that among the three soup powders i.e. the soup powder prepared with corn flour, tapioca starch and maida, the soups having corn flour as a source of starch scored 7.7 points. But the soup having tapioca and maida starch scored 6.6 and 5 respectively for overall acceptability. This was due to poor consistency of soup i.e. the powder was not mixing properly into the water.

Maida was used as a source of starch while preparing fish soup powder from kilimin (*Synagris* spp.), jew fishes (*Otolithes* spp.) and silver bellies (*Leiognathus* spp.) etc. (Venugopalan and James, 1969). However these researchers didn't mention any problem in the consistency of soup.

The organoleptic evaluation revealed that the soup containing corn flour starch scored highest points in overall acceptability compared to the soup containing these two starches individually. Hence, corn flour was chosen as a source of starch in present study.

5.2.2 Standardization of corn flour concentration for the preparation of fish soup powder:

The soups having corn flour concentrations of 15%, 20% and 25% of cooked fish meat were subjected to organoleptic analysis by panelists. The panelists remarked that the soup containing 25% corn flour was thicker and better in texture. Hence the highest concentration of corn flour i.e. 25% (of cooked fish meat) was chosen as an ideal concentration.

Working in the same line Venugopalan and James (1969) prepared fish soup mix with 18.6% maida starch. Gopakumar *et al*. (1974) prepared fish soup powder with 25% tapioca starch and Shenoy *et al.* (1987) prepared fish soup powder with 30% tapioca starch of dressed fish meat.

Warang *et al*. (2005) prepared soup powder of croaker fish with 25% starch which was made from 1:1 proportion of tapioca and corn flour.

Yadav (2008) prepared seaweed soup powder of *Sargassum tenerrimum* in which 14% corn flour was used.

In the present work, the soup had better consistency due to appropriate type and concentration of starch. According to panelists, the soup was basically sweet in taste and was having non required fishy odour. Hence, to reduce the sweetness and to retain the characteristic fish odour; further standardization was carried out for finding appropriate quantity of tomato powder to be used.

5.2.3 Standardization of tomato powder concentration for the preparation of fish soup powder:

Among the three concentrations used namely 10%, 12% and 15% of tomato powder of cooked fish meat, the concentration of 12% tomato powder scored highest points in overall acceptability criteria. According to panelists, the soup prepared with 12% concentration was most appropriate and yielded the required good taste.

For comparison purpose, no reports are available on the use of tomato soup powder in the preparation of fish soup powder.

5.2.4 Standardization of pepper powder concentration for the preparation of fish soup powder:

Among the three concentrations used, namely 1.5%, 2.5% and 3.5% of pepper powder of cooked fish meat. The concentration of 2.5% pepper powder scored highest points in overall acceptability criteria. According to panelists, the soup prepared with 2.5% concentration was most appropriate and yielded the required spicy taste.

Working in the similar direction Venugopalan and James (1969) used 1% pepper powder while preparing fish soup mix. Gopakumar *et al.* (1974) prepared fish soup powder using 1.5% pepper powder concentration and Shenoy *et al.* (1987) prepared fish soup powder using 2.4% pepper powder of dressed fish meat. Warang *et al*. (2005) used 3.5% pepper powder of total cooked fish meat.

While preparing fish soup powder, different researchers have used different quantities of pepper powder. This may be in consideration with the taste of local people.

5.3 Proximate composition of fish soup powder prepared by adopting standardized method of fish soup powder preparation:

There is an increasing demand of ready to eat products all over the world. However, the consumers are very much conscious about two things. Firstly the product should have nutritional value and secondly it should be free from pathogenic bacteria.

In the present work, the fish soup powder contained 17.59% crude protein, 12.65% fat, 18.22% ash and 49.80% carbohydrate. So the product is rich in nutrients.

Gopakumar (1973) attempted preparation of fish soup powder using trash fishes and reported slightly higher protein content (21-28%). Similarly Shenoy *et al*. (1987) prepared fish soup powder using miscellaneous fishes and reported higher protein values (21-25%). In both these cases the higher protein values may be due to the use of multiple fish species for preparation of fish soup powder.

Warang *et al*. (2005) reported that the croaker fish soup powder contained 21.125% crude protein, 7.5% fat, 20.05% ash and 43.518% carbohydrate.

Yadav (2008) studied on seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* and other ingredients which found to contain 19.55% protein, 1.003% fat, 6.71% ash, 11.33% crude fibre and 50.95% carbohydrate.

In the present study, when the fat values of fish and fish soup powder were considered, we found significant increase from 3.86% to 12.65%. The reason behind increase in fat content in fish soup powder might be the use of butter while onion frying.

Also, in the present work, the fat content in the soup powder was found to be 12.65%. This value is similar to the value reported by Gopakumar (1973) and Shenoy *et al*. (1987) i.e. 12% -15% and higher than the one reported by Warang *et al*. (2005) i.e. 7.5%.

In the present work, moisture content of fish soup powder was lower i.e. 1.74% as compare to the moisture content of fish soup powder made by Shenoy *et al*. (1983) i.e. 5 to 6%, Warang *et al*. (2005) i.e. 7.807% and Yadav (2008) i.e. 9.01%.

The reason of getting low moisture content was the use of hot air oven for drying thick paste instead of using sun drying.

5.4 Storage studies:

5.4.1 Changes in biochemical characteristics:

5.4.1.1 Changes in pH of fish soup powder:

In the present study, the pH showed slight increasing trend from the initial value of 5.36 in all the four packs i.e. metalized film pouch, trend pouch, HDPE pouch and LDPE pouch. The increase in pH content may be due to increase in moisture and bacterial activity (Fields, 1979).

Cobb and Hyder (1972) discussed the effect of pH on protein recovery from fish muscle during the production of fish protein concentrate. The protein recovery was 54% at pH 2 and at pH 7 the protein recovery was 48%.

Gopal *et al*. (1988) carried out the storage study of prawn soup powder using different packaging materials such as Low Density Polythene (LDPE), High Density Polythene (HDPE), High Molecular weight Low Density Polythene (HM-LDPE) and Low Density Polythene-High Density Polythene (LDPE-HDPE) co-extruded film etc. The pH value found to be decreasing.

Warang *et al*. (2005) reported increasing trend of pH in the stored material during the storage period of 4 months and attributed the increase to increase in moisture and bacterial activity. Yadav (2008) reported that the pH of seaweed soup powder was increased from the initial value 5.53 to 6.0 after 3 month of storage.

5.4.1.2 Changes in moisture content of fish soup powder :

In the present study, moisture content of fish soup powder was found to increase along with the storage period of three months. The values ranged from 1.74% to 2.19%, 1.74% to 2.85%, 1.74% to 2.93% and 1.74% to 2.99% in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively. This may be due to water-vapour transmission through packaging materials. Gopal *et al*. (1988) reported that the Low Density Polythene (LDPE) has high gas and moisture transmission rates. Hence increase in moisture content is higher in this pack.

Increase in moisture content during storage has been reported by several workers. Gopal *et al*. (1988) reported that the moisture content of prawn soup powder was increasing from initial value of 5.63% to 9.15% after six months, when packed in Low Density

Polythene -High Density Polythene (LDPE-HDPE) co-extruded film packaging. The moisture content of dried fish-cereal mixture was also found to increase from 9.14% to 11.92% upto 240 days of storage (Basu, 1990).

Warang *et al*. (2005) reported that the moisture content of soup powder made by using Croaker fish was increased after 120 days of storage from 7% to 8.19%, 7% to 8.23% and 7% to 8.31% in trend pouch, HDPE pouch and LDPE pouch respectively.

Yadav (2008) reported that the moisture content of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* was increased after 90 days from 9.01% to 10.46% in trend pouch.

5.4.1.3 Changes in TVB-N values of fish soup powder:

In the present study, TVB-N values showed an increasing trend. Total Volatile Base-Nitrogen (TVB-N) value is the index of spoilage. The spoilage is accompanied by release of several volatile compounds like Trimethyl amine, ammonia etc. The recommended upper acceptable limits vary from 30-60 mg % (Balachandran, 2001).

In the present work though the value showed increasing trend, after three months of storage period, TVB-N values were found to be 22.3 mg %, 22.4 mg %, 22.4 mg % and 22.6 mg % in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively, which were below the acceptable limits.

Katadi (2000) working on similar line reported an increase in TVB-N values of prawn wafers along with extended storage.

Warang *et al*. (2005) reported that the TVB-N values of soup powder made by using Croaker fish was increased after 120 days of storage from 23.2 mg % to 23.4 mg %, 23.2 mg % to 23.4 mg % and 23.2 mg % to 23.7 mg % in trend pouch, HDPE pouch and LDPE pouch respectively.

5.4.1.4 Changes in peroxide value (PV) of fish soup powder:

PV is a measure of degree of oxidation of fat hence termed as index of spoilage due to oxidative rancidity. The upper acceptable limit for peroxide value is between 10-20 milimoles of oxygen per kg of fat (Balachandran, 2001).

In the present work, the initial peroxide value was 1 and after 3 months of storage period, it increased to 1.1, 1.2, 1.3 and 2.2 in metalized film, trend pouch, HDPE pouch and LDPE pouch respectively, which were below the acceptable limits. Gopal *et al.* (1988) reported that the increase in peroxide value is due to high oxygen transmission rate of LDPE pack. The values ranged from 1.0 to 2.2 milimoles of oxygen per kg of fat in LDPE pouch sample. The values increased but within the level of acceptance (15-20 milimoles of oxygen per kg of fat).

Venugopalan and James (1969) reported the increasing trend of PV of fish soup mix during shelf life studies. Katadi (2000) determined the PV content of prawn wafers and also found an increase in peroxide value along with extended storage.

Warang *et al*. (2005) reported that the peroxide values of soup powder made by using Croaker fish was increased after 120 days of storage from 0 to 0.1 milimoles of oxygen per kg of fat and 0 to 1.75 milimoles of oxygen per kg of fat in HDPE pouch and LDPE pouch respectively. In trend pouch it remained 0 milimoles of oxygen per kg of fat throughout the storage period.

5.4.2 Changes in microbial count of fish soup powder:

5.4.2.1 Changes in Total Plate Count:

The TPC showed an increasing trend in all the packs. The limit of TPC is $5x10^5$ cfu/g. for fresh/chilled/frozen fishery products and for cooked/boiled fishery products it is $1x10^5$ cfu/g. (EIA, 1995).

In the present study though the trend is increasing till storage period of 90 days, the values remained within the limits i.e. $2.0x10^3$ cfu/g., $2.2x10^3$ cfu/g., $2.5x10^3$ cfu/g. and $4.5x10^3$ cfu/g. In metalized film, trend pouch, HDPE pouch and LDPE pouch respectively. The reason for slight increase in content may be presence of moisture in product itself. In LDPE pouch the increasing moisture due to high vapour moisture transmission rate of pack may contributed to the increasing TPC.

Venugopalan and James (1969) while working on identical lines reported that on storage at 37^o C, the TPC decreased from initial value of $6.1x10^4$ cfu/g. to $7.5x10^3$ cfu/g. after eight weeks of storage. Basu (1990) while studying the storage characteristics of dried fish-cereal mixture reported that the TPC was increasing from initial value of $1.5x10^2$ cfu/g. to $1.9x10^7$ cfu/g. after 240 days of storage.

Warang *et al*. (2005) reported that the TPC of soup powder made by using Croaker fish was increased after 120 days of storage from the initial value $2.0x10^3$ cfu/g. to $2.2x10^3$ cfu/g., $2.5x10^3$ cfu/g. and $7.0x10^3$ cfu/g. in trend pouch, HDPE pouch and LDPE pouch respectively.

Yadav (2008) reported that the TPC of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* packed in trend pouch was increased after 90 days, from the initial value $2.0x10^3$ cfu/g. to $2.2x10^3$ cfu/g.

5.4.2.2 Changes in mould count:

Absolutely no mould growth was observed till the end of storage period (i.e. 90 days) in soup powders packed in metalized film, trend pouch, HDPE pouch and LDPE pouch in present storage study of fish soup powder. The present observation of total absence of mould in fish soup powder during storage is in agreement with identical observations by Basu (1990) in case of dried fish-cereal mixture wherein there was no mould growth at the end of 175 days of storage.

5.4.2.3 Changes in other pathogenic organisms:

The pathogenic organisms such as *E.coli, Salmonella* and *Staphylococci* were found to be absent during entire course of storage study. This may owe to the perfect hygiene maintained during the entire process of soup powder preparation.

The bacteriological characteristics of fish soup powder (Gopakumar *et al*., 1974) and fish soup mix (Venugopalan and James, 1969) revealed that there was total absence of pathogenic micro organisms such as *E.coli, Salmonella, Vibrio, Staphylococci* and *Streptococci* etc.

5.4.3 Changes in organoleptic quality characteristics:

The organoleptic analysis during the storage of soup powder at room temperature indicated that there was decline in overall quality characteristics namely appearance, colour, odour, taste and overall acceptability etc. during storage. The consistency of soup remained almost same and there were slight differences in scores throughout the storage period. The other characteristics such as appearance, colour, odour, taste and overall acceptability decreased with extended storage. Compared to metalized film, trend pouch and HDPE pouch,

the decline in quality was faster in LDPE pouch. After three months of storage the colour of LDPE sample became dark (score 6.9) and there was slight off odour (score 7.2). According to panelists organoleptic evaluation, the soup powder packed in LDPE pouch appeared to be slightly poor after storage of three months on overall acceptability criteria. The decline in quality was slowest in Sample packed in metalized film and organoleptic evaluation showed that it scored highest points in all four types of packaging material used.

Gopakumar *et al.* (1974) also carried out the organoleptic evaluation of fish soup powder depending on overall acceptability criteria. The results of which revealed that the product, fish soup powder was acceptable upto four months when stored at ambient conditions.

Warang *et al*. (2005) carried out the organoleptic evaluation of fish soup powder made by using Croaker fish depending on overall acceptability criteria. The results of which revealed that the product, fish soup powder was acceptable upto four months when stored at ambient conditions in trend pouch, HDPE pouch and LDPE pouch.

Studies carried out by Yadav (2008) on the organoleptic evaluation of seaweed soup powder prepared from dried powder of *Sargassum tenerrimum* proved that the soup powder was acceptable upto three months when stored at ambient conditions in trend pouch.

6. SUMMARY

An attempt was made to prepare fish soup powder from Tilapia fish (*Oreochromis* spp.). The moisture, crude protein, crude fat and ash content of fresh Tilapia fish (*Oreochromis* spp.) were 76.26%, 18.69%, 3.86% and 1.19% respectively.

Some of the ingredients used in the fish soup powder were standardized step by step. At each stage, the organoleptic evaluation was conducted by the expert group of panelists. The report of organoleptic evaluation was supported with the statistical analysis were used as base for standardization.

Finally, the fish soup powder was prepared by using standardized proportions of ingredients mainly corn flour @ 25% of the cooked fish meat, pepper powder @ 2.5% of the cooked fish meat and tomato soup powder @ 12% of cooked fish meat. The other ingredients used were salt, butter, onion, carrot, monosodium glutamate, ascorbic acid, ginger, garlic and cinnamon powder.

The proximate composition studies of the standardized fish soup powder revealed that it contained 1.74% moisture, 17.59% crude protein, 12.65% fat, 49.80% carbohydrates and 18.22% ash.

The standardized fish soup powder was packed in four different types of packaging materials; namely Metalized film, Trend pack, HDPE pouch and LDPE pouch and storage study was carried out for three months.

During storage, moisture showed an increasing trend in all the packages. However, the increase was maximum in LDPE pouch.

The pH values also showed an increasing trend in all the packages. The TVB-N values ranged from 22.3 mg % to 22.6 mg %. So, TVB-N values showed slight increasing trend; but the values were still within the acceptable limits. An initial PV was found to be 1.0

and it increased to 1.1, 1.2, 1.3 and 2.2 milimoles of oxygen per kg of fat in metalized film, trend pouch, HDPE pouch and LDPE pouch sample respectively.

After 90 days of storage, the TPC in different packages was ranged from $2.0x10^3$ to $4.5x10^3$ cfu/g.

The total absence of pathogenic bacteria namely *Staphylococci, Salmonella and E.coli* indicated that the complete process was carried out under hygienic condition.

There was decline in the quality characteristics namely appearance, colour, taste, odour and overall acceptability during storage period of 90 days. The quality deterioration was found to be highest in LDPE pouch sample and lowest in metalized film sample. The storage studies revealed that the metalized film, trend pouch and HDPE pouch were suitable for packing soup powder. The LDPE pouch was found to be unsuitable for soup powder storage.

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Appendix- I

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH, DAPOLI.

POST GRADUATE INSTITUE OF POST HARVEST MANAGEMENT KILLA-ROHA, DIST- RAIGAD

DEPARTMENT OF POST HARVEST MANAGEMENT OF MEAT, POULTRY AND FISH

Score Sheet for Organoleptic quality Evaluation

Sample Characteristics	A	B	C	D
Appearance				
Colour				
Taste				
Texture				
Odour				
Overall acceptability				

Remarks:

Name: Signature:

Date:

Score marks:

Where,

9 point scale

9 Like extremely 8 Like very much 7 Like moderately

6 Like a little 5 Neither like Nor dislike

4 Dislike a little 3 Dislike moderately

2 Dislike very much 1 Dislike extremely

Appendix- II

ECONOMICS OF TILAPIA FISH SOUP POWDER

SR.NO.	INGREDIENTS	QUANTITY (g.)	COST (Rs.)
1	Fish meat	1000	200
2	Butter	250	57.5
3	Corn flour	250	50
4	Cinnamon powder	75	112.5
5	Pepper powder	25	18
6	Ginger-garlic	60	10
7	Chopped onion	850	10.2
8	Tomato powder	120	2
9	Tata salt	170	2.38
10	Coriander	55	10
11	Carrot	100	2
12	MSG	18	2
13	Ascorbic acid	2	2
	Total	**2975**	**478.58**

After drying, total weight of fish soup powder = 1 kg.

A] Cost of production:

Total cost of ingredients = Rs. 478.58 /-

Miscellaneous charges = Rs. 10 /-

Price of 10 pouches = Rs. 30 /-

Therefore, total cost of production (Rs./kg)

= 478.58 + 10 + 30

= 518.58

Therefore cost of production for 100 gram pouch of fish soup powder is Rs. 51.858 /- i.e. approx. Rs. 52 /-

B] Selling cost with 100 % profit = 104 /-

Selling cost with 75 % profit = 91 /-

Selling cost with 150 % profit = 130 /-

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