

CHAPTER - 1

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THE EFFECTS OF AMBIENT CONDITIONS ON THE MOISTURE  
ABSORPTION AND DESORPTION PROPERTIES OF STORED  
MUSCLES OF PAMPUS CHINENSIS (EUPHRASEN)

INTRODUCTION

White pomfret, Pampus chinensis (Family - stromatidae) is a highly priced marine fish of India. Large quantities of pomfret are also salted and dried. India is now recognized as one of the leading exporters of marine fish products in the world. Export of dried fish is included in export growth. Major items of dried fish exports are Cybium, Thyrnus, Caranx, Bombay duck, Mackerel and Pomfret (Krishnan, 1983). A high proportion of dried fish products is destined for shipment in tropical climate. The conditions of storage are, therefore, extremely important, because losses of unprotected dried products during storage are economically too alarming to be over-looked.

Dried fish are normally kept in godowns without proper packaging and this cannot protect the fish from deteriorative changes due to the unfavourable environmental conditions which leads to avoidable wastage. In order to minimise wastage it is necessary to protect the dry fish from high temperature, high humidity and from infestation during storage. The evaluation of the moisture absorption/desorption properties of dried fish in relation to storage time and temperature is extremely

important for the extension of shelf-life of dried fish. In monsoon months dried fish absorb moisture from the air resulting in a water content, which is favourable for fungal infestation leading ultimately to dried fish becoming unfit for human consumption. Therefore, the experiment was carried out to find out the effect of ambient conditions on the moisture absorption and desorption properties of stored dried fish.

The stability of the dried fish products depends on their water contents which is a measure of the water available to support the growth of micro-organisms (Scott, 1957). A few moulds can grow at a relative humidity of 65% and most moulds grow rapidly at a relative humidity higher than 65%; hence some protection against the uptake of water is essential for long term storage.

The relation between fish muscle and moisture is of great value in predicting the acceptability of the fish muscle under storage. The temperature, atmosphere, moisture and the relative nature of the components comprising the fish muscle govern the chemical and physical reactions responsible for fish muscle alteration during storage (Acker, 1969; Rockland, 1969 and Labuza, 1972).

The keeping quality of dried fish during storage is greatly influenced by their moisture contents. Most dry fish products absorb and desorb water from its

surroundings attaining an equilibrium of moisture content. Spoilage of most fishes is initiated at the surface, therefore, a lack of available moisture at the surface may be an important preservation factor (Frazier, 1958; Burgess et al., 1965). So, efficient and scientific methods for storage of the dried fish are required which can prevent moisture during the wet and humid seasons of the year. After storage, certain changes occur which affect the texture, flavour and appearance. An understanding of moisture absorption, characteristics of the particular dried fish muscle is therefore necessary in order to ascertain as to what extent the materials can be dried under particular drying procedures? How much moisture the dry product will absorb during storage at a given set of conditions and what should be the optimum storage conditions to give the product a maximum storage stability?

The present study was, therefore, undertaken to obtain fundamental data on the absorption and desorption properties of dehydrated fish and to attempt an interpretation of these results in respect of their storage characteristics and find out the optimum conditions of their stability during storage.

#### MATERIALS AND METHODS

Experiment was carried out using fresh fish Pampus chinensis, more or less uniform in size (17-20 cm) which

were procured from local market in the morning and brought to the laboratory. They were immediately washed and cleaned under tap water. They were divided into the following batches of 10 individuals each and were subjected to storage at different temperature.

Batch-1 : Fish kept at  $-10^{\circ}\text{C}$

Batch-2 : Fish kept at  $0^{\circ}\text{C}$

Batch-3 : Fish kept at  $8^{\circ}\text{C}$

Batch-4 : Fish kept at  $30^{\circ}\text{C}$

Fish from all the four batches were stored for different period viz. 1, 3, 4, 6 and 8 days. After this step, a 1 cm thick slice of the fish body just posterior to dorsal fin was cut out and such samples were stored at room temperature for determination of moisture absorption and desorption properties. Two individuals were removed at each of the intervals and were subjected to sun drying procedure for three days in every case.

The dried fish samples were cut into small pieces weighing approximately 2 gm and were utilized for further study. Care was taken to minimize the exposure to natural environment in order to prevent extra absorption or desorption of moisture. Before sampling the dried fish were wrapped in polythene sheets and kept in cardboard box (40X30X30 cm). Accurate weight was recorded using an electric balance every week upto six weeks. Care

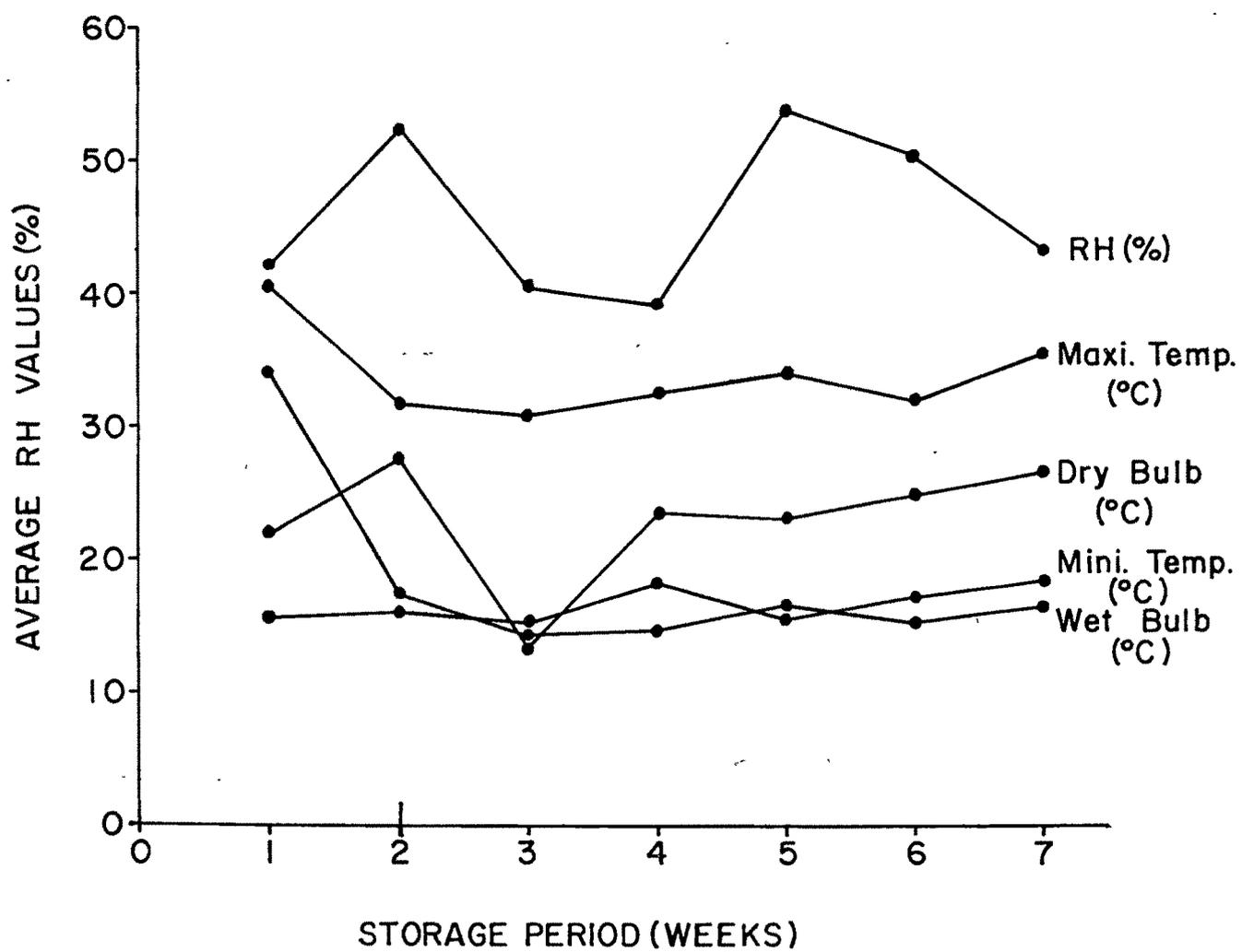


Fig. 5. Fluctuation of RH and temperature during the storage period

was taken during weighing so as to minimize possible errors resulting from the absorption of moisture due to exposure of the samples to the ambient RH. Percentage of water associated with the dried fish was determined on a dry weight basis.

Temperature and humidity were monitored by means of thermometer and hygrometer respectively (Fig. 5).

#### RESULTS AND DISCUSSION

The results of moisture absorption and desorption properties are shown in Figs. 1 to 4. The results showed that the differences in the moisture contents were mainly related to duration of storage period. In general, in all the four batches the trend of weight gain was more or less similar, but maximum weight gain was observed in batch-1 and the least gain was observed in batch-3 samples. The moisture content increased as the storage time increased. It was also observed that few samples lost weight after few days of storage. The changes of loss and gain were found to be due to initial moisture content, ambient conditions and different regions of fish body. The results showed that the differences in moisture absorption were highly significantly related to the ambient conditions, viz. temperature, RH and initial moisture content. There was a great variation in the potential for moisture absorption in case of initial and final storage samples

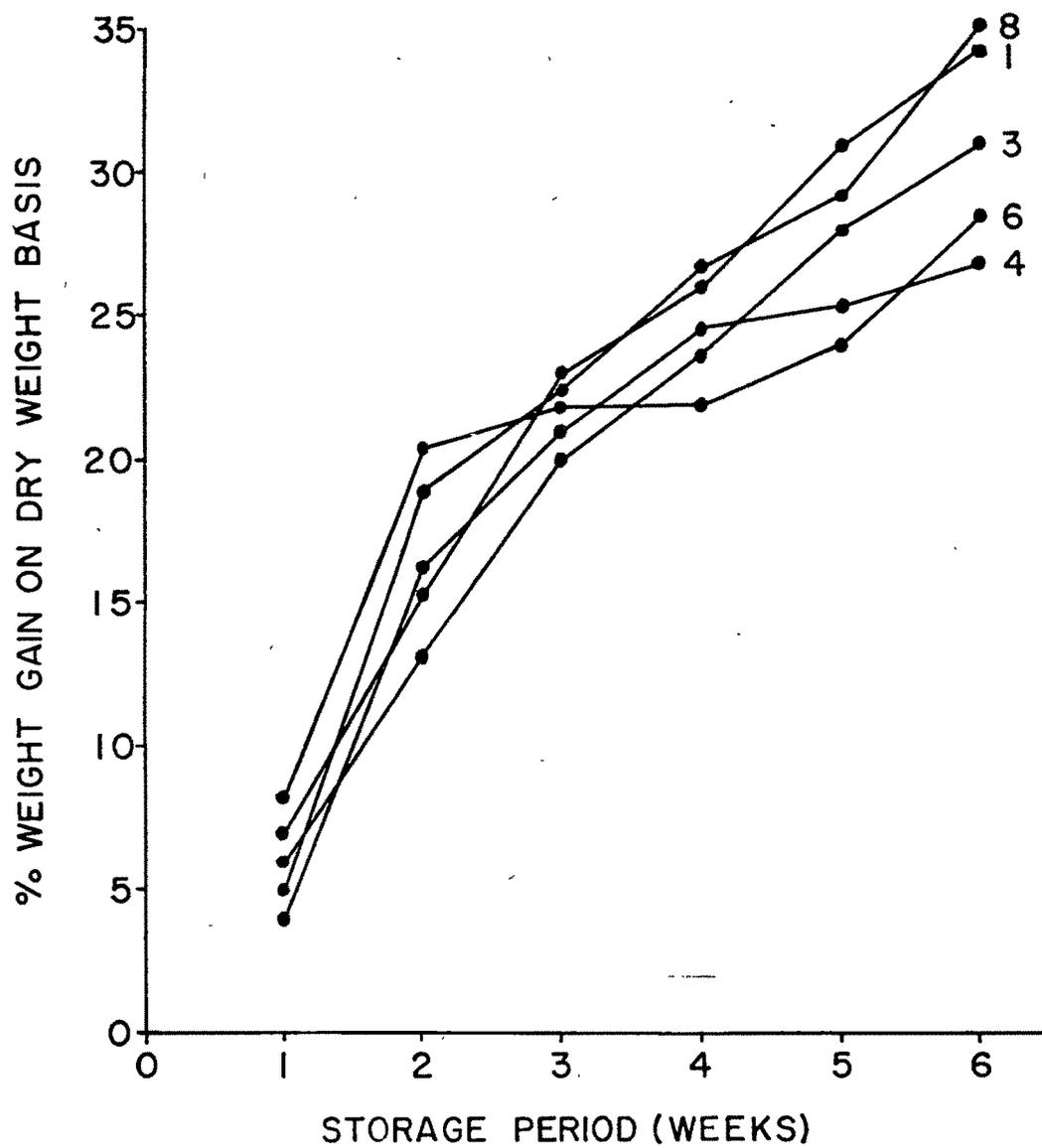


Fig. 1. Moisture absorption/desorption curve of P. chinensis during storage (Batch-1).

Table-1 : Variations of initial moisture contents among different batches

Samples (storage days before drying)	Weight gain by dried fish muscle, expressed as % of initial dry weight, after one week of storage at room temperature			
	Batch-1	Batch-2	Batch-3	Batch-4
1	7.16	4.10	4.24	3.77
3	6.73	5.52	7.92	5.19
4	4.53	8.70	9.57	8.79
6	8.91	6.15	6.57	7.94
8	5.84	7.50	8.14	9.90

Table-2 : Percentage variation in weight of samples due to gain of moisture among different batches

Samples (storage days before drying)	Weight gain by dried fish samples at room temperature for 49 days expressed as % of initial dry weight when stored			
	Batch-1	Batch-2	Batch-3	Batch-4
1	34.35	30.10	11.07	25.04
3	31.59	31.49	13.65	24.51
4	27.17	27.76	17.12	16.93
6	26.84	28.35	21.35	21.78
8	32.12	25.39	19.08	19.40

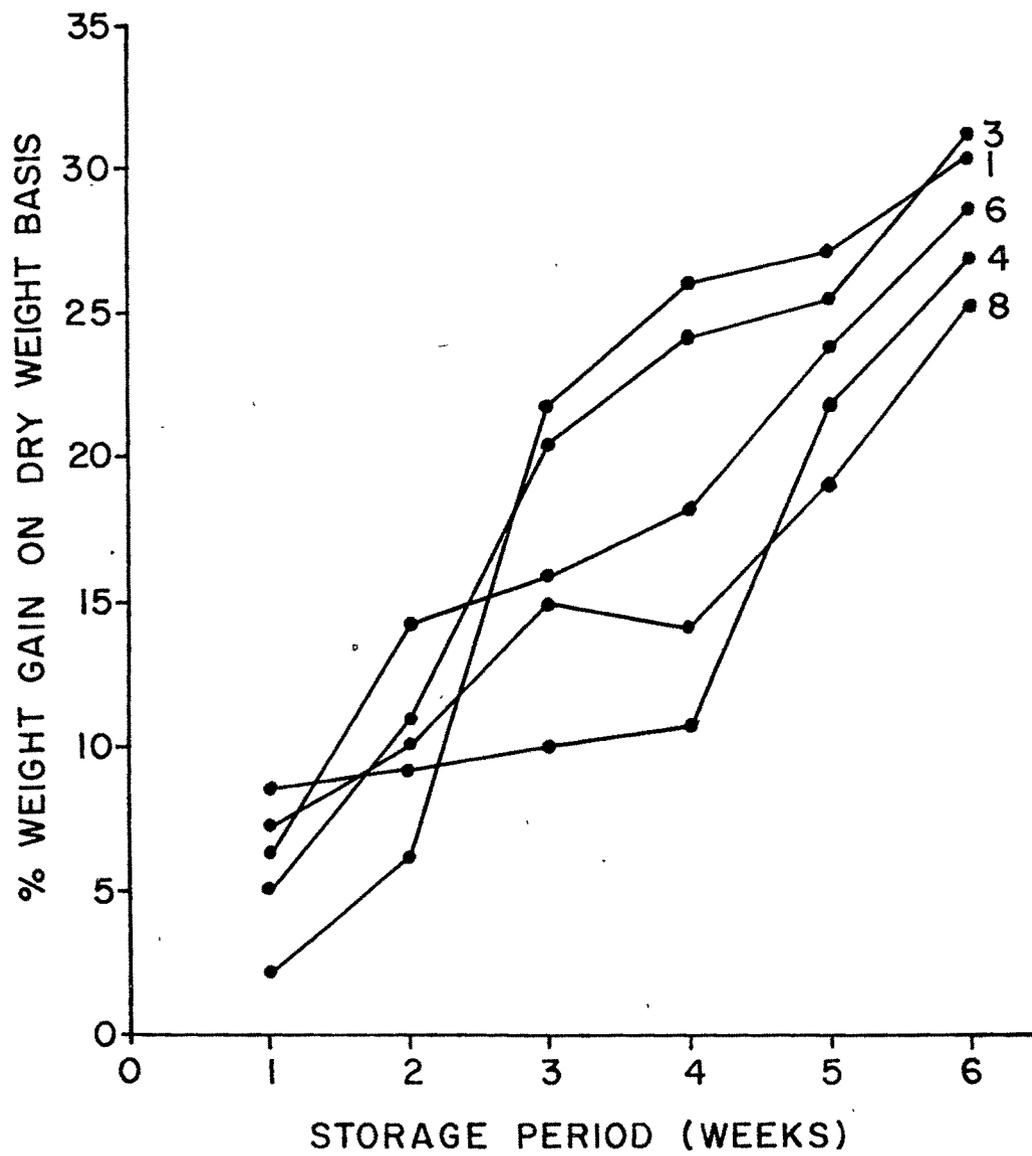


Fig. 2. Moisture absorption/desorption curve of *P. chinensis* during storage (Batch-2)

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(Tables 1 and 2), but no such variation was found in initial stage of different batches (Table-1). Regarding absorption at different temperatures, moisture content increased as the temperature decreased. Waterman (1976) reported that higher is the temperature of air higher is the loss of water. Arsdel (1963) suggested that the rate of water loss of fish is directly proportional to wet-bulb depression of the air. If the difference between the dry-bulb and wet-bulb is zero, no loss of weight takes place. If the wet-bulb depression is doubled the rate of gain of weight will also be double. The rate of change of weight also depends on the form, size of the samples and initial moisture content.

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The equilibrium moisture content rather than the total moisture content is closely related to the stability of a dehydrated fish muscle during storage. Equilibrium relative humidity determines whether it will gain or lose moisture in a particular environment and so this property is more relevant to storage behaviour than is the moisture content (Taylor, 1961). When the relative humidity of the air around the fish muscle corresponds to the available moisture or water activity of the fish muscle, the fish muscle will be in equilibrium in regard to moisture. If the RH of the air is correspondingly lower than the water content of the fish muscle, the fish muscle will loose moisture. From the data presented here it was apparent that since all occasions there was

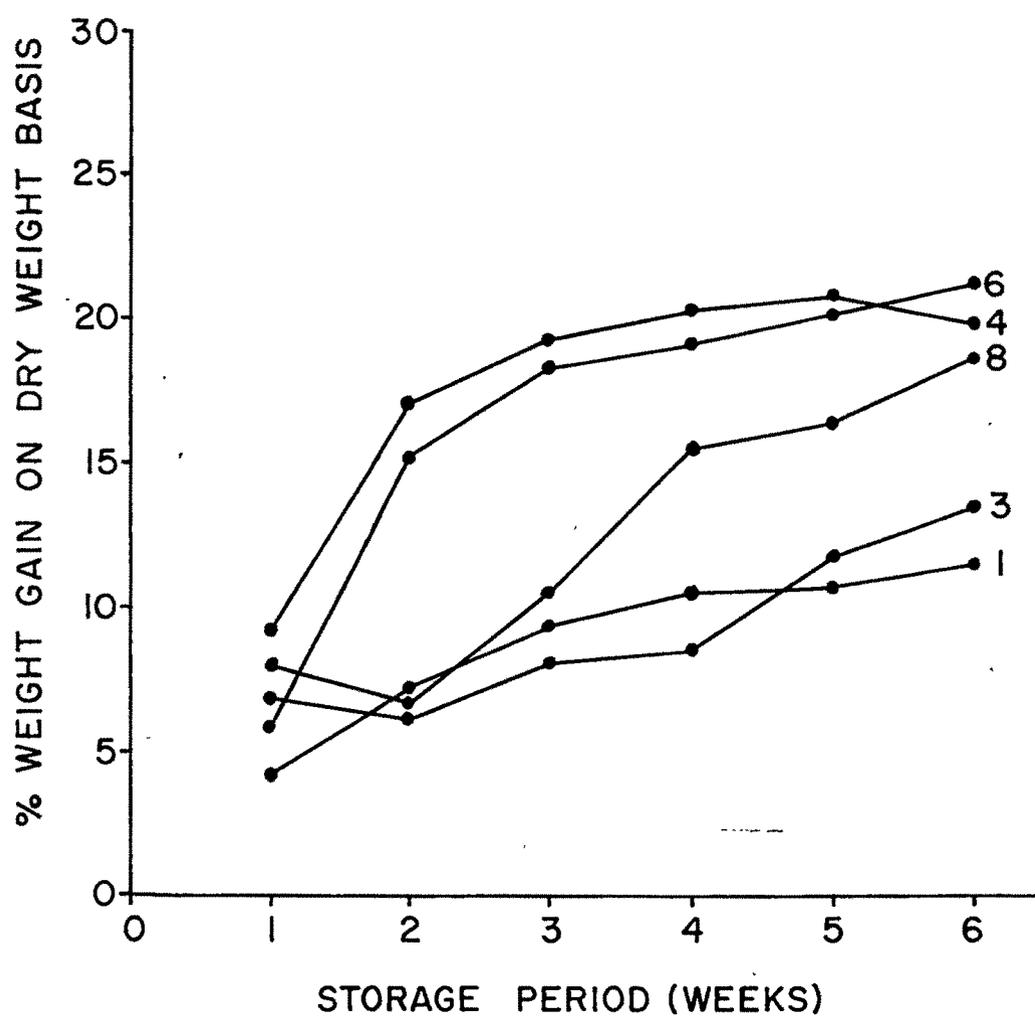


Fig. 3. Moisture absorption/desorption curve of *P. chinensis* during storage (Batch-3)

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always some weight gain, the environmental RH must have been greater than the equilibrium moisture content of the dried fish fillets. When the environmental RH is greater than the equilibrium moisture content of fish, the fish will gain moisture (Frazier, 1958).

#### STORAGE LIFE

The microbial stability of dried fish product during processing and storage life is dependent upon their water content. If the fish become rehydrated under condition of high relative humidity, through exposure to rain or when condensation occurs within the packaging due to rapid fall in temperature, the water content will rise and the storage life will be reduced. Obviously, it is desirable to control the temperature and humidity in store houses to combat these problems (Doe et al., 1983).

The chemical and physical reactions responsible for moisture absorption or desorption of dried samples during storage are governed by temperature, atmosphere, initial moisture content and the relative nature of the components comprising the fish muscle (Acker, 1969). Otcott (1962) reported that the deterioration of storage in air was due to lipid oxidation and protein deterioration resulting in rancidity and insolubility respectively. Doty (1953) reported that protein denaturation

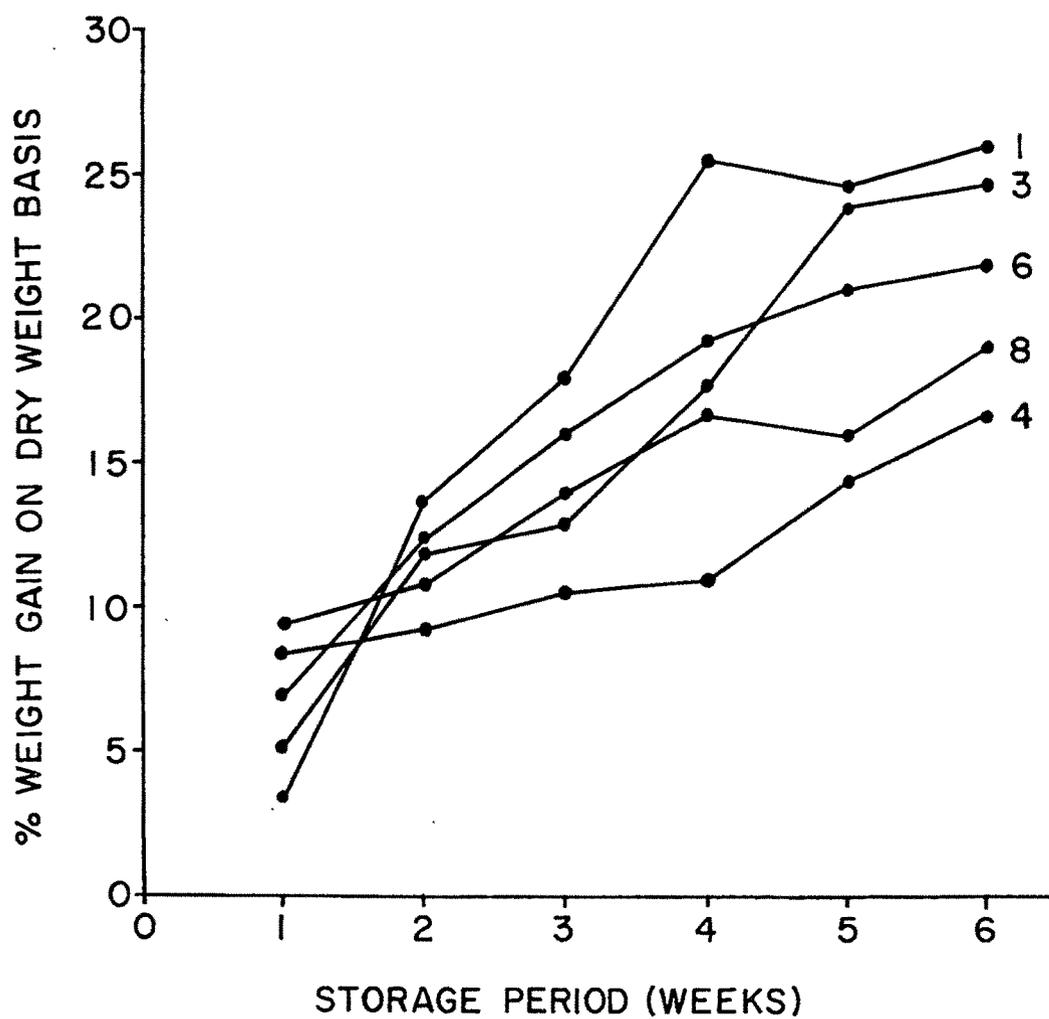


Fig. 4. Moisture absorption/desorption curve of P. chinensis during storage (Batch-4).

is influenced by the product itself and initial moisture content. Immediately after drying the quality of product is high but upon subsequent storage any of the factors stated above may change leading to losses.

From the data presented it becomes obvious that if the fish bodies are kept at a temperature range of 8°C to about 30°C for two to four days and then dried in open sun, led to least possible absorption of moisture (percentage of weight gain) upto six weeks of storage of dried fillets at a convenient RH range of 39 to 42%. It can therefore be suggested that the fisherman going for pomfret fishing need not invest large sums of money in refrigeration equipment on boat if they would return to land within the periods of two to four days and immediately dried the fish, preferably after cutting up into fillets of about one to two centimeter thickness, in the open sun for three days. It is necessary to add here that proper care should be taken to prevent insect or microbial infestation during drying stage. If this is not possible then whole fish body may also be subjected to sun drying after dressing and washing. It is hoped that such instructions given to fisherman would significantly economize the fishing practice. Additionally, if the fisherman can afford, it would be advisable to maintain preferably lower temperatures around fish catch with the help of few ice slabs in the hold to

minimize microbial spoilage and autolytic changes. From the results reported here, it is apparent that storage of fish catch at low temperatures ranging between 0°C to -10°C is not necessary as it does not improve the storage life, after sun drying, but on the contrary it leads to greater moisture absorption in case of sun dried fillets in the initial week of storage.