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USE OF POLYTHENE TENT DRYERS FOR PREPARATION OF SALTED DRIED FISH

by

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1.0 INTRODUCTION

The use of solar dryers has been investigated as an alternative to traditional sun drying in the tropical developing countries. (Szulmeyer, 1971; Doe *et. al.*, 1977; Chakraborty, 1978; Ismail, (1980). Solar dryers employ a means of collecting or concentrating solar radiation to achieve elevated temperatures and reduce relative humidity during drying. This results in increased drying rates, lower final moisture contents and higher quality products. Solar dryers are less susceptible to variations in weather, and they provide shelter from rain. Pests are discouraged from entering the dryers due to the high internal temperatures which can be lethal to those entering the dryer.

Sri Lanka has laid great emphasis on increased production of freshwater fish, namely Tilapia from its numerous fresh water tanks. This fish which is fairly popular now is sold both in the wet and salted dried form. But the salted dried Tilapia produced around most tanks is of poor quality. Therefore, the use of a simple solar tent was considered a good idea to produce salted dried fresh water fish of good quality. As "Solar tent drying of fish" is a new innovation to Sri Lanka, two experiments with polythene tent dryers to prepare salted dried Tilapia was carried out at the Institute of Post Harvest Technology (IPHT), to study the practicability of this method in Sri Lanka. A short trial under field conditions was also carried out at Kaudulla Tank, Polonnaruwa.

The "Polythene tent dryer" was developed by Doe *et. al* (1977) and initially tested in Bangladesh with fish. This had given favourable results. The dryer comprised of a bamboo frame covered with polythene sheeting. The IPHT model differed from the former in that no black material was used at the base and side of the tent. The shape of the dryer was chosen by Doe, partly for ease of construction and partly to present the clear polythene roughly normal to the suns rays. The dryer operates by absorbing the solar radiation through the clear polythene and as the floor warms up the temperature is increased within. With no wind blowing a draught was induced and the heated air at the base was exhausted through vents at the top of he dryer.

2.0 MATERIALS AND METHODS

2.1 Construction of solar dryer — A polythene tent dryer of dimensions (3x2.5x2M) was constructed for the study as given in Fig. 1. It consisted of a bamboo frame in the shape of a tent tied at nine points with rope. The four sides of the frame was covered with clear

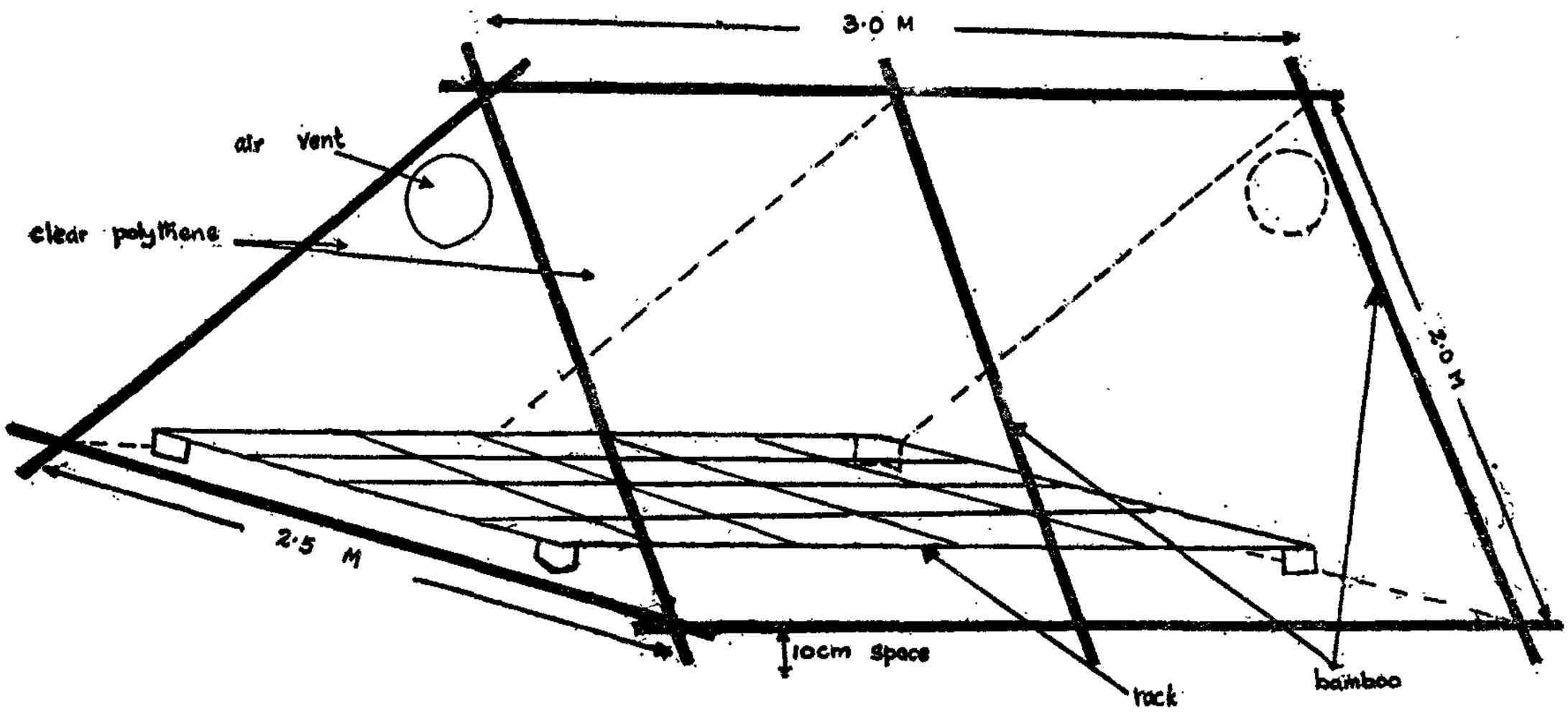

Fig. 1 : The polythene tent dryer and rack.

polythene of 700 micro meters thickness leaving small vents at the upper two ends for movement of air. A gap of about 8-15 cm was left between the lower bar of the tent and the ground to facilitate the "Chimney effect". A drying rack of dimensions approximately (2.8x2.3M) was also constructed in bamboo and placed within the tent about 15 cm above ground level. The dryer was placed in a North South direction. Once all the required bamboo was cut to size, each tent and rack took approximately 1½-2 man hours for construction.

2.2 Preparation of fish — Fresh Tilapia from Polonnaruwa was brought to IPHT in ice, stored overnight, thawed, descaled, cut and scarified. These fish which weighed approximately 1½-2 lbs, were eviscerated and washed thoroughly, salted by mixed salting technique and left overnight. The following morning the fish was washed and put out to dry in both experiments.

2.3 Drying of fish — The salted fish was divided into two lots weighed and put out to dry. One .lot of fish was dried in the tent (treatment I) and the second lot of fish was directly sun dried on a rack (treatment II or control). Both treatments were dried in the shade for half a day before commencing direct sun drying or solar tent drying. The fish was dried for a period of 5 days in Experiment I and 6 days in Experiment II. The performance of the tent was evaluated during a day's drying in Polonnaruwa (an area of Tilapia dry fish production).

2.4 Measurement of Temperature — The following temperatures were monitored on an hourly basis on each day of drying using a "Technothern Instant Action" metre (Testoterm K.G.) with a termister probel. An average of 3 readings were taken at each interval in both experiements.

1. Temperature of air inside tent
2. Temperature of air outside tent (ambient temperature)
3. Temperature of fish within tent
4. Temperature of fish outside tent.

2.5 Measurement of Humidity — The following Relative Humidity (RH) measurement were made on an hourly basis on each day of drying using an "Aspirated Hygrometer" (whirling sling). An average of three readings was taken at each interval for both experiments.

1. Relative humidity of air
2. Relative humidity within tent

2.6 Weight measurements — The fish of each treatment was weighed in the evening on each day of sundrying in both experiments.

Experiments I and II were carried out in a similar manner as indicated above, the differences being that the fish was left within the tent during the night in experiment I and it was taken indoors every evening and stored in an alibert plastic box with cover in Experiment II and the gap between the ground and lower bamboo was greater in Experiment II.

A small field trial was carried out at Polonnaruwa for one day to see whether the working of the tent showed a similar trend to that shown with trials carried out at IPHT.

3.0 RESULTS AND DISCUSSION

The Relative Humidity of air outside and inside the tent in Experiment I is shown in Fig. 2. The average relative humidity measurements during the experiment are 75.9% outside

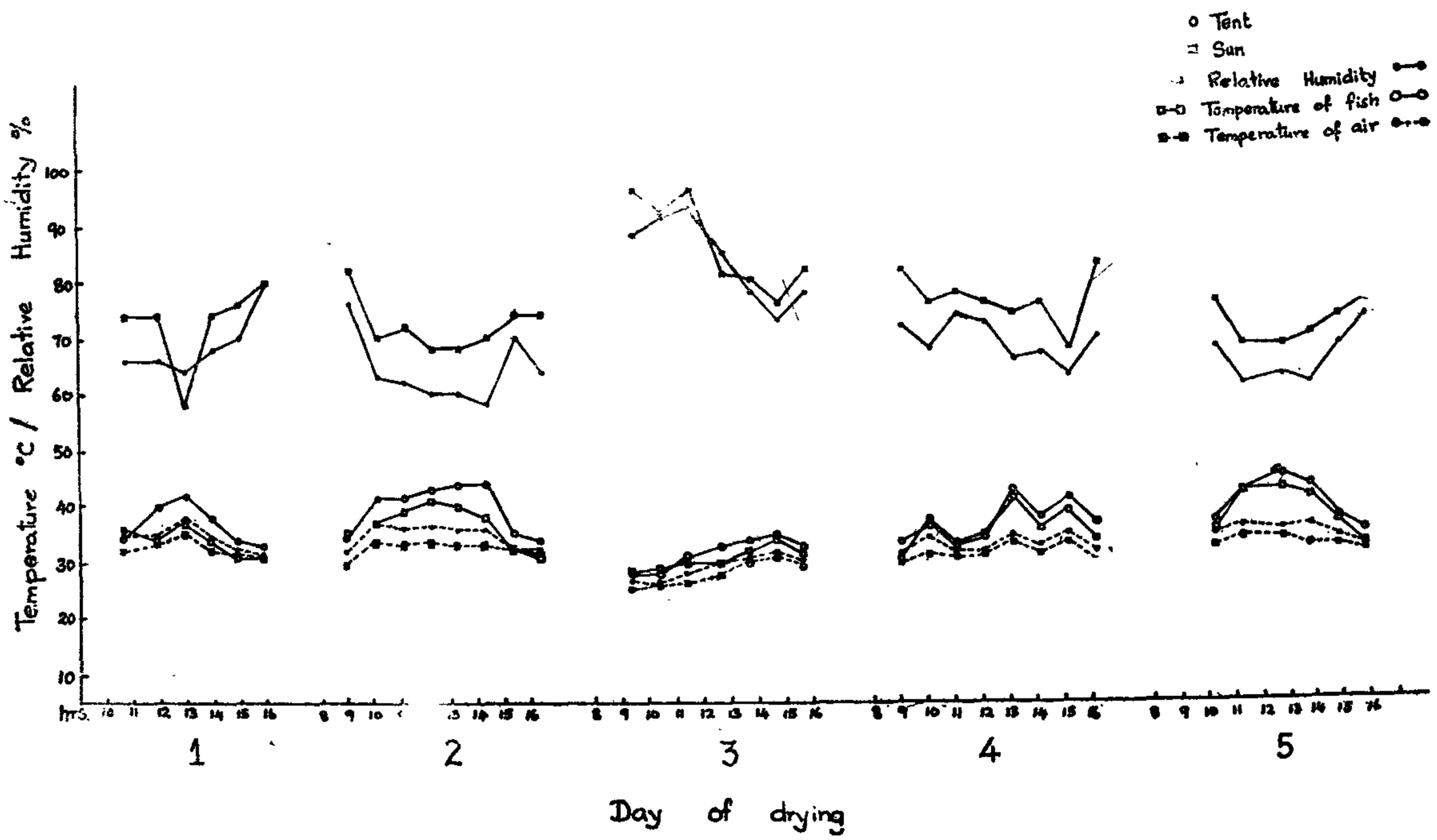

Fig. 2 : Temperature and relative humidtiy measurements during experiment I.

and 70.3% inside the tent. Experiment II (Fig. 3) gives average relative humidity measurements of 76.6% outside and 68.0% inside the tent. In both experiments the relative humidity inside and outside the tent is similar on the 1st day of drying, and from the second day onwards the relative humidity inside the tent was lower (except day 3 in exp. I, when it was overcast and very humid). In experiment II the relative humidity was exceptionally lower within the tent, from the 3rd day onwards.

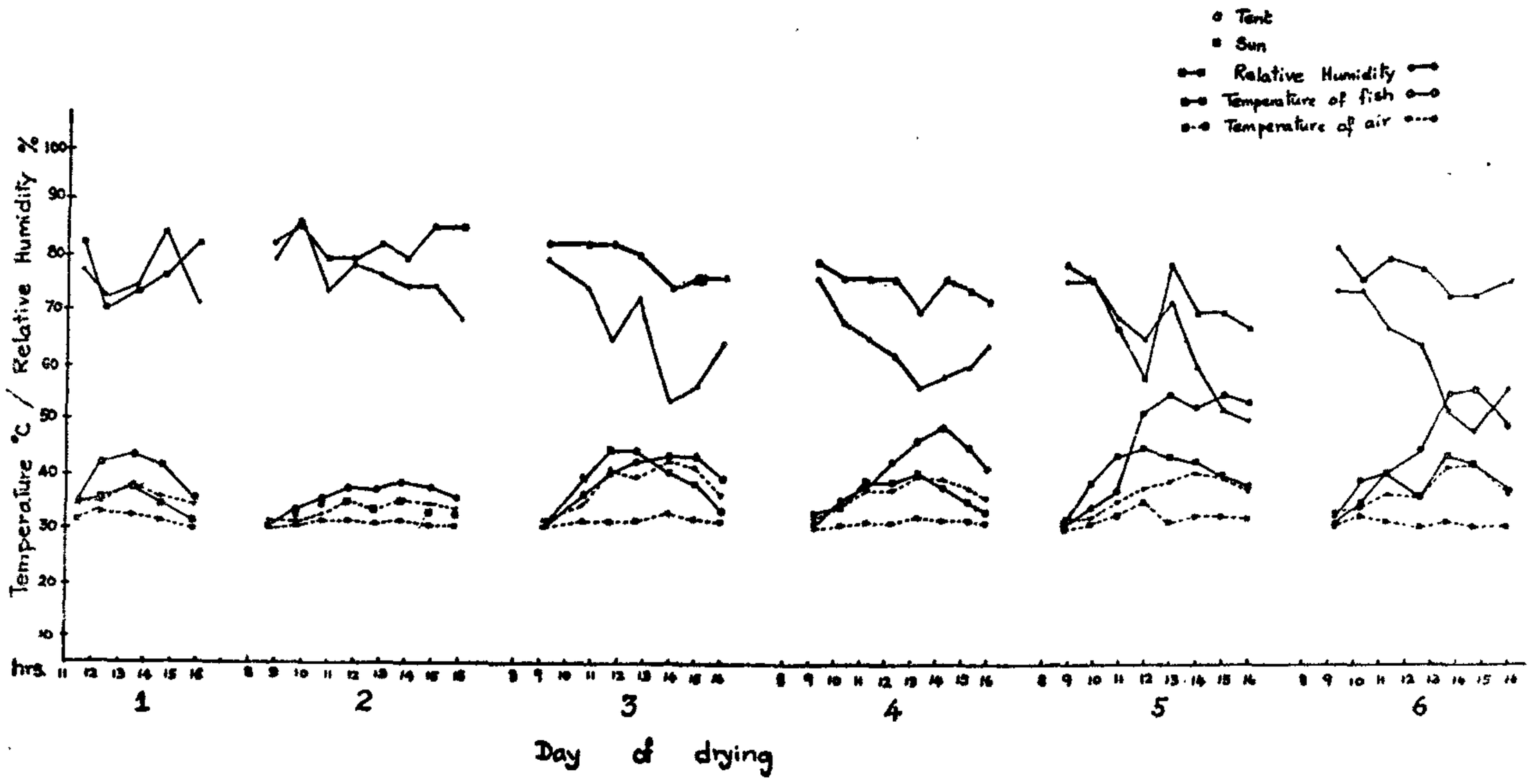

Fig. 3 : Temperature and relative humidity measurements during Experiment II.

The average ambient temperatures were 31.4°C in Experiment I and 31.8°C in Experiment II, and the air temperatures inside the tent were 33.3°C and 35.78°C respectively. The higehest temperature of air recorded in Experiment I was 35.0°C (air) and 37.0°C (tent), and for Experiment II 35.0°C (air) and 42.5°C (tent). The temperatures achieved duirng Experiment II were very good and could have been due to the larger air space at the bottom (better air circulation).

TABLE I.

WEIGHT LOSS OF FISH DURING SUNDRYING AND SOLAR TENT DRYING IN EXPERIMENT I.

Day of drying	*Weight of fish dried in the sun/kg*	*Weight of fish dried in the tent/kg*	*%wt loss of fish dried in the sun*	*%wt loss of fish dried in the tent*
Before drying	6.5	6.5	—	—
1	4.8	4.9	26.2	24.6
2	4.3	4.3	33.8	33.8
3	4.1	3.9	36.9	40.0
4	3.9	3.6	40.0	44.6

TABLE 2.

WEIGHT LOSS OF FISH DURING SUNDRYING AND SOLAR TENT DRYING IN EXPERIMENT II

Day of drying	*Weight of fish dried in the sun/kg*	*Weight of fish dried in the tent/kg*	*%wt loss of fish dried in the sun*	*%wt loss of fish dried in the tent*
Before drying	12.0	13.0	—	—
1	11.4	10.8	5.0	16.9
2	9.9	10.1	17.5	22.3
3	9.4	9.3	21.7	28.5
4	8.4	8.1	30.0	37.7
5	8.15	7.8	32.1	40.0
6	7.8	7.3	35.0	43.8

The drying rate of fish in Experiment I (table I) is almost the same for sun and tent drying, in the first two days. But there onwards the drying rate in the tent is faster, and a 40% weight loss is obtained in fish dried inside the tent after 3 days of drying, where as it takes 4 days of drying to reach a 40% weight loss in the fish outside the tent. In Experiment I the fish was not removed from the tent in the night and they had absorbed moisture by morning. But in Experiment II (table 2) both the fish in the tent and the control (sundrying) were taken in during the night. Therefore from the second day itself there was a marked difference in the drying rate between the tent drying and sun drying. At the end of the 5th day of drying a 40% weight loss was achieved in the tent dried fish, but the fish dried in the sun had reached only a 35% loss of weight even on the 6th day of drying.

Drying rate is initially dependent upon the rate of air flow over the fish as moisture evaporates from the surface and is removed by the air. During the latter stages, as the internal moisture migrating to the surface controls the drying rate, it is dependent upon the air temperature (Waterman, 1976). Both temperature and airflow exert an influence during the intermediate stages. The similar initial drying rates for the tent and sun drying is due to the natural breezes during sundrying being as effective as the air flow caused by natural convection within the tent. As drying continues air flow exerts less and higher temperatures (inside tent) exerts more influence on drying, resulting in better drying rates within the ent (Curran & Trim, 1982).

The average temperatures of the fish flesh were 35.1°C (sun) and 37.0°C (tent) in Experiment I and 35.7°C (Sun) and 40.7°C (tent) in Experiment II. The highest termperatures of fish recorded during Experiment I were 42.5°C (sun) and 45.0°C (tent) and 45.0°C (sun) and 56.0°C (tent) in Experiment II. In Experiment II a temperature above 45.0°C was recorded for 3-4 hours on the 5th and 6th day of drying. A time temperature tolerance study of flies and larvae has shown that high temperatures over long period kill fry larvae (Doe *et. al.* 1977). They found that even in partially sun dried fly infested fish which were subsequently dried under the tent the fly larvae previously hidden in the flesh came to the surface and perished or dropped off, as the temperatures increased.

The quality of the product dried in the tent was better than the one dried in the sun. As shown in Table 3 the moisture content was lower and also it was free of sand and dirt and kept for a longer time in good condition.

TABLE 3.

MOISTURE AND SAND CONTENT OF FISH AT THE END OF THE EXPERIMENTS

	Exp I		*Exp II*	
	Sun	*Tent*	*Sun*	*Tent*
Moisture %	36.81	33.24	39.13	33.72
Acid insoluble ash % (dry basis)	0.3988	0.0799	0.3516	0.0622

TABLE 4.

THE TEMPERATURE AND RELATIVE HUMIDITY MEASUREMENTS OF THE DRYING TRIAL CARRIED OUT AT KAUDULLA TANK, POLONNARUWA

	SUN DRYING			*TENT DRYING*		
Time	*Temperature of Fish°C*	*Temperature of Air°C*	*Relative humidity %*	*Temperature of Fish°C*	*Temperature of Air°C*	*Relative humidity %*
8.20	27	29.5	65	28	29.5	65
9.20	28	30.0	65	33	39.0	46
10.20	30	29.0	65	34	28.0	48
11.20	36	30.0	65	39	35.0	54
12.20	34	31.0	55	40	39.0	38
1.20	39	35.0	43	45	42.0	39
2.20	40	34.0	47	50	40.0	39
3.20	33	33.0	46	41	36.0	40
4.20	31	31.0	54	35	33.0	51

The results of the trial carried out at Kaudulla tank, Polonnaruwa are as given in Table 4. It can be seen that the average temperature of air was 31.4°C and 35.7°C within the tent. The relative humidity was very low, 56.0% (air) and 50.0% (tent). The highest temperatures recorded were 35.0°C (air) and 42.0°C (tent). The temperatures were higher and the relative humidity lower than the amounts achieved in the trials at IPHT, on the very first day of drying, thus indicating better performance in the field trial.

4.0 CONCLUSIONS

The drying rate is faster in the solar tent and thereby saves about two days of drying to reach the desired moisture content. The quality of the product which was dried in the tent was far superior to the product dried in the sun, and it kept in good condition for a longer period.

The trial carried out under field conditions at Kaudulla tank, Polonnaruwa, showed that in the areas that the dry fish is made the performance of the tent was better.

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