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STUDIES ON THE EFFECTIVENESS OF LOW COST SOLAR TUNNEL DRIER OVER TRADITIONAL SUN DRYING OF PRAWN, *Macrobrachium lamarrei* IN THE LABORATORY

K. Fatema[1], A. T. A. Ahmed[2], M. A. Khaleque[3] and M. Begum[4]

ABSTRACT

Laboratory experiment was carried out to compare the effectiveness of the new Low Cost Solar Tunnel Drying (LCSTD) technique with the Traditional Sun Drying (TSD) method of the Prawn, *Macrobrachium lamarrei*. Both salted and unsalted Prawn (*M. lamarrei)* required 4 hours for drying in LCSTD, while in sun drying it required 6 hours. During the experimental period the inside drying temperature and percentage of relative humidity varied from 43 to 50°C and 35 to 50%, respectively, whereas outside drying temperature and percentage of relative humidity varied from 29 to 38°C and 50 to 78%, respectively. Solar tunnel dried unsalted sample contained on an average of 14.65% moisture, 61.58% protein, 3.4% fat and 17.23% ash whereas sun dried unsalted sample contained 20.5% moisture, 58% protein, 3.1% fat and 15.5% ash.The rate of drying was greater in the Low Cost Solar Tunnel Drier (LCSTD), which effectively controlled the fly larva infestation during drying. The low cost solar tunnel drier produced superior quality dry prawn under hygienic conditions.

Key words: Effectiveness, low cost solar tunnel drier, traditional sun drying

INTRODUCTION

Traditional sun drying, salt curing and smoke curing of fish are the three traditional and old methods of fish processing and preservation throughout the world including Bangladesh. Scientists are working to focus the traditional sun drying of fish by improving the methodology, by constructing polythene tent drier, solar tent drier, cabinet tent drier, doom drier and finally a new low cost solar tunnel drier for producing improved quality of dried and dehydrated products in laboratory and also in commercial scale (Clucas, 1981). There is another method of fish drying, which is completed by using a freeze drier. Freeze drier is very costly equipment and its operation need skilled personnel. Solar Tunnel Drier with solar panel and small fan needs special attention with high cost, which is not possible for the low income generating people or groups. Research work and publications of Doe *et al.*(1977), Ahmed *et al.* (1979), Hoque (1975), Islam (1982), Bala and Hossain (1998), and Bala and Mondal (2001) enriched the field of fish drying by solar tent drier and solar tunnel drier.

Considering the above facts and circumstances a Low Cost Solar Tunnel Drier (LCSTD) was developed and constructed for drying prawn of improved quality with minimum cost of TK. 2500 only by using locally available materials. The operation of Low Cost Solar Tunnel Drier (LCSTD) is very much simple and it does not require very much skilled persons. Its product quality and performance have been assumed to be satisfactory. For this reason it was decided to find out the effectiveness of Low Cost Solar Tunnel Drier (LCSTD) over Traditional Sun Drying (TSD) of the prawn *M. lamarrei* in the laboratory.

MATERIALS AND METHODS

The study was carried out on the roof of the IFST building, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka in March, 2007. To conduct the present investigation, two types

[1]Lecturer, Department of Fisheries, [2] Professor, Department of Zoology, University of Dhaka, Dhaka, [3] Principal Scientific Officer, [4] Scientific Officer, IFST, BCSIR, Dhaka, Bangladesh.

of drier such as Low Cost Solar Tunnel Drier (LCSTD) and Traditional Sun Drying (TSD) were used for drying prawn (*M. lamarrei).*

Low Cost Solar Tunnel Drier (LCSTD) was constructed by using low cost raw materials such as galvanized iron sheet, black paint, bamboo mat, white polythene sheet, magic tape available in our country. The design of the LCSTD consisted of simple structure. A platform was constructed by bamboo, 1.07m above the ground, having 1.07m width and 3.66m length. On the top of the platform a further bamboo frame tunnel was constructed which was triangular in cross section, the base being 1.07m, with a short upright of 0.38m at the back and the long slope down to the front up to the base of the tunnel. Prawn *(M. lamarrei)* was collected from the local fish market (Hatirpul) and was taken to the Fish Technology Laboratory, IFST of the BCSIR, Dhaka. The prawns were washed by clean water and divided into two parts. One half portion of the prawns were treated with 3-5% brine solution for half an hour.Then weight of the salted and unsalted samples were recorded in electronic load balance and both the samples were placed inside the Low Cost Solar Tunnel Drier (LCSTD). Similar procedures were followed for sample preparation of Traditional Sun Drying (TSD). Performance of the Low Cost Solar Tunnel Drier (LCSTD) was monitored by recording temperature, relative humidity (RH) and weight (wt) of the prawn during the drying period both inside and outside of the tunnel drier. Biochemical composition (protein, moisture, fat, ash) of the experimental prawn and of the processed prawn products were done by AOAC method (1975). Student "t" test was followed to compare the difference between biochemical composition of salted and unsalted prawn.

RESULTS AND DISCUSSION

The comparative effectiveness of Low Cost Solar Tunnel Drier (LCSTD) and Traditional Sun Drying (TSD) on drying of prawn (*M. lamarrei*) was determined at different time intervals. It was observed (Fig.1) that the rate of decrease in weight of the samples of *M. lamarrei* was rapid at the initial stage of 1st two hours, slow in middle stage of 2nd two hours and became stable at last six hours and the system attained equilibrium finally. Charm (1963) and Jason (1965) observed 3 distinct phases in their drying rate curves, stage 1-setting down period, stage 2-constant rate period, stage 3- falling rate periods. Drying rate period in the present study became more or less similar with that of Charm (1963) and Jason (1965) observation.

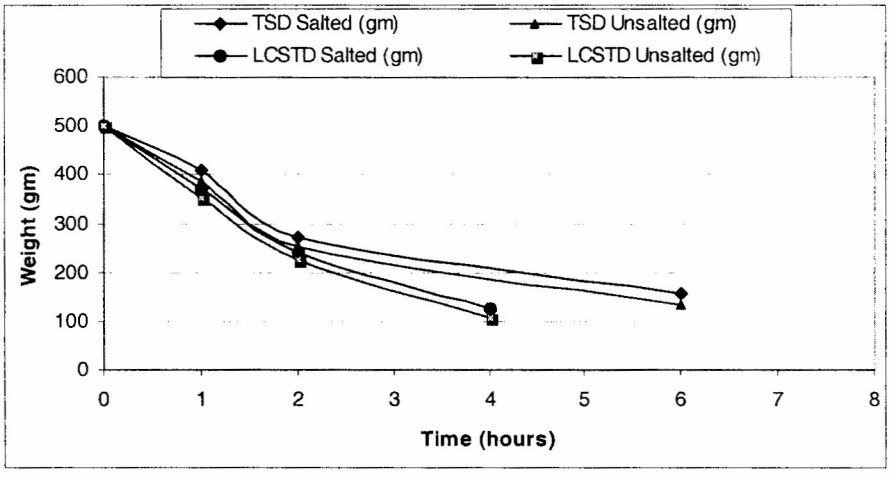

Fig.1. Drying rate of *M. lamarrei* in traditional sun drying (TSD) method and low cost solar Tunnel Drier (LCSTD)

Prawn (*M. lamarrei)* dried in tunnel drier, took 4 hours for drying of salted and unsalted samples, and sun drier took 6 hours for drying salted and unsalted samples. Sufi *et al.* (2005) observed that 12 hours open sun and Tunnel dried salted and unsalted mola fish was dried at rate of 56.4%, 61.4%, 66% and 71%, respectively. Bala and Hossain (1998) observed that the Silver Jew fish could be dried within 3-4 days in the tunnel drier as compared to 5-6 days in natural sun drying. The experiment on solar drying of fish were carried out by Bala and Hossain (1997) in April and May whereas the present investigation was carried out in March (2007).

The rate of drying is influenced by several factors such as intrinsic nature of fish being dried and several external factors employed in the drying atmosphere. The individal nature of fish, its chemical composition and physical structure are important factors influencing the rate of drying.

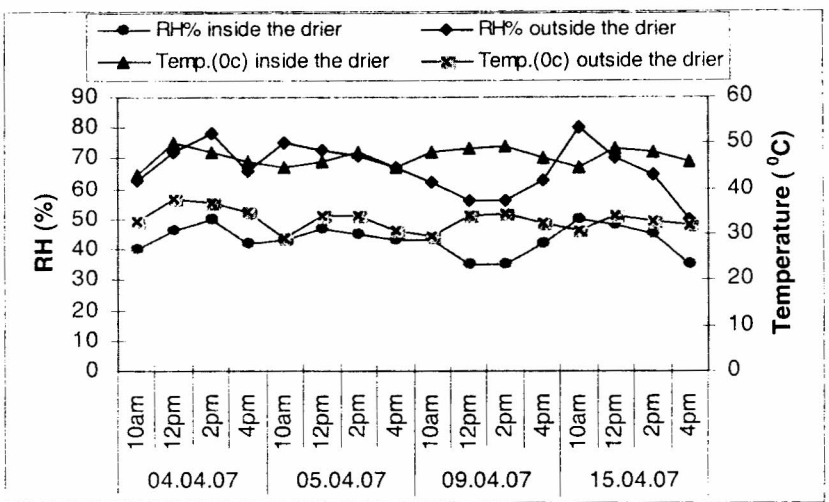

Fig. 2. Variation of temperature and relative humidity of Low Cost Solar

Tunnel Drier (LCSTD) and out side of the drier during expremential run

Fig.2 shows that during the experimental run the inside drying temperature and percentage relative humidity of LCSTD during the study period. During the experimental period the inside drying temperature and percent relative humidity varied from 43 to 50^{0}C and 35 to 50%, respectively; whereas outside drying temperature and percentage of relative humidity varied from 29 to 38^{0}C, and 50 to 78%, respectively. Increased air temperature and decreased percentage of relative humidity inside the tunnel drier helped in rapid drying of the prawn in comparision with the open sun drying at ambient temperature. A change in air temperature is usually accompanied by a change in rtelative humidity (RH). By increasing the air temperature, its moisture content capacity can be decreased (Cutting, *et al* 1956). In the present study, temperature was high and percentage of relative humidity (%RH) was low inside the tunnel drier and the drying rate of unsalted prawn was higher than that of salted prawn. Cutting, *et al* (1956) showed that the higher the amount of salt added the more slowly the moisture diffuses to the surface. The solar tunnel dried prawn showed more water loss than that of sun dried prawn on the rack. Tunnel drier was shaded with transparent polythene through which solar radiation could easily pass and the polythene sheet prevented the solar radiation escaping out. Furthermore, a tin sheet coated with black paint was used to absorb the solar radiation inside the tunnel drier. The results of biochemical composition of *M. lamarrei* in raw and dried condition have been represented in the Fig.3 and 4.

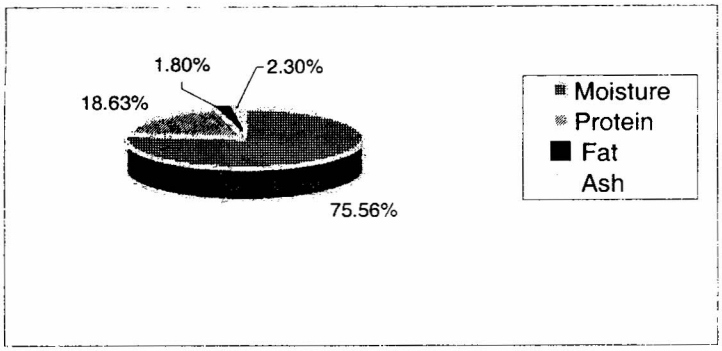

Fig. 3. Biochemical composition of raw *M. lamarrei*

Moisture retaining capacity of salted prawn was significantly higher than the unsalted prawn in case of LCSTD. Similarly, salted prawn was significantly higher than unsalted prawn in case of TSD. When unsalted prawn was compared, moisture percentage was significantly higher in TSD than in LCSTD and similar situation was observed in case of salted prawn both in LCSTD and STD.

Percent of Protein was significantly higher in unsalted prawn in case of LCSTD.Similar result was found in case of TSD. Protein percentage was significantly higher in unsalted prawn in LCSTD than in TSD. Similar result was found in case of salted prawn. There was no significant difference in fat

Table 1. 't' test comparison between different biochemical composition of dried salt and unsalted prawn

Status of prawn	Moisture		Protein		Fat		Ash	
	%	't' values	%	't' values	%	't' values	%	't' values
LCSTD Unsalted	14.65	9.53**	61.58	2.33**	3.40	0.70	17.23	5.63**
LCSTD Salted	18.50		58.50		3.50		15.50	
TSD Unsalted	20.20	15.83**	58	3.32**	3.10	0.29	15.50	3.14*
TSD Salted	24		56		3.40		14.25	
LCSTD Unsalted	14.65	11.61**	61.56	3.11*	3.40	1.20	17.23	3.67**
TSD Unsalted	20.50		58		3.10		15.5	
LCSTD Salted	18.50	23.10**	58.50	5.73**	3.50	0.60	15.50	3.38**
TSD Salted	24		56		3.40		14.25	

Significant at 5% level, ** Significant at 1%level
Tabulated 't' value at p=0.01 is 3.25, at p=0.05 is 2.26
percentage both in salted and unsalted as well as LCSTD and TSD.

Ash percentage was significantly higher in unsalted prawn both in LCSTD and TSD. Percentage of ash was significantly higher in LCSTD both in unsalted and salted prawn. The average biochemical

composition of raw *M. lamarrei* was found to be moisture 75.56%, protein 18.63%, fat 1.8% and ash 2.3%. Low cost solar tunnel dried unsalted sample contained average value of 14.65% moisture, 61.58% protein, 3.4% fat and 17.23% ash whereas Low ost solar tunnel dried salted sample contained 18.5% moisture, 58.5% protein, 3.5% fat and 15.5% ash and 4% salt respectively. Traditional sun dried salted sample contained 24% moisture, 56% protein, 3.4% fat and 14.25% ash and 5% salt content and unsalted sample contained 20.5% moisture, 58% protein, 3.1% fat and 15.5% ash respectively. Ahmed *et al.* (1981) and Hoque (1975) also found results which were found to be similar with the result of the present study.

Overall findings of the present study indicated that the prawn while dried in the low cost solar tunnel drier took comperatively shorter drying period compared to that of the dried prawn out side of the low cost solar tunnel drier.The dried prawn products dried in the tunnel drier was found to be of improved quality than that of the traditional sun dried prawn.

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