

USE OF WOOD CHARCOAL POWDER IN QUICK DRYING OF FISH BY HEAT RADIATION

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Abstract-Use of wood charcoal powder for quick drying of fish after salting is suggested. Fishes of different species were subjected to differential treatments: a) salting, b) salt mixed with charcoal powder in the ratio of 1:0.5 and 1:1 and c) without treatment and exposed to uniform heat radiation. The rates of drying were found in the receding order except for the salted ones which were higher than the controls. Depending upon increase in the heat intensity, 16-29% reduction in the half loss period has been reported.

INTRODUCTION

Drying of fish after salting is one of the traditional ways of fish preservation [1 & 2] and still prevalent in most of the countries. But the technique as such is slow and takes several weeks for completion. Drying of fish depends upon the size, thickness of flesh and on the climate of the place [3]. Increase in size and reduction in the thickness can be effected to only limited degrees whereas the climate is a physical factor beyond man's control. Besides these, increase in the rate of drying can be effected by improving heat absorption using black pigments over its surface. Anand and Solimabi [4] in their study on the rate of evaporation of water in association with different forms of carbon (graphite, charcoal and lamp black) have reported that charcoal behaved as the second best to lamp black. Since lamp black particulates are generally associated with unoxidised hydrocarbons and some of them are known to be carcinogenic, charcoal was selected for the study. Therefore, an attempt was made to

reduce the half loss period i.e. time taken in evaporating 50% of the total moisture present in a fish by using wood charcoal in addition to mere salting.

EXPERIMENTAL

Fishes belonging to three species 1) Tilapia mossambica 2) Kowala covel 3) Ambassis nama were selected for the study and following estimations were made.

A. Moisture percentage on dry weight basis (W/d)

Fishes of different weights were selected at random. These were immersed in a solution containing 1% formaldehyde and 1% of sodium nitrite for one minute for anti maggot infestation treatment [5]. The solution was drained out and the moisture percentage on dry weight basis [6] for each fish was determined by oven drying. The moisture percentage against the wet weight of the fish [6] were plotted to know their relationship (Fig.1).

B. HALF LOSS PERIOD (HLP)

Four sets of fishes containing four of same species of nearly the same weight were given anti maggot infestation treatment and their wet weights (G') noted. Based on the relationship between W^d and G the expected total moisture (W) in the selected fishes were calculated as follows:

$$W = \frac{W^d}{W^d + 100} \times G'$$

Thereafter, one fish in each set was kept as control, the second covered with fine crystals of pure sodium chloride (0.6 - 0.8 g equivalent to 3% of the total moisture) [7], the third and the fourth were covered with a mixture of common salt and charcoal mixed in the ratios of 1:1 and 1:0.5 respectively. All the four fishes in each set were then exposed to infrared radiation of equal intensity for a period of four hours. After regular intervals of 60-80 minutes the moisture losses (X) from each fish were noted. From the values of W and x , the percentage of total moisture (M) remained in each fish were calculated using the following equation:

$$M = 100 - \left(\frac{X}{W} \times 100 \right)$$

The 'M' values were plotted against time intervals (Figs. 2-5) to know the HLP in each.

RESULTS AND DISCUSSION

The variations in the HLP among the fishes are given in Table 1.

*particle size 0.17-0.074 mm)

Table 1: HLP in fishes having different treatments & exposed to uniform heat radiation.

Set No.	HLP in minutes				Heat intensity *
	Con- trol	Salt- ed	Salt + coal	char-	
			1:1	1:0.5	
1	80	83	78	69	1.08
**2	91	95	85	80	0.42
**3	162	195	146	138	1.08
4	66	73	63	58	1.08

** Kowala covel; *cal min⁻¹ cm⁻²

The above results indicate that charcoal behaved as a good radiation selective coating. On account of its fine porosity it also behaved as a better absorber of the leached out water and thereby causing quick evaporation. This resulted in a substantial reduction (16-29%) in HLP as compared to the salted ones. Positive linear relationship between heat intensity and the rate of drying is also noticed (Figs. 3 & 4). In all of the sets, the salt carbon mixture of 1:0.5 worked better than 1:1, suggesting thereby that a mixture nearer to the lower ratio may give the optimum results. Kozyrev and Vershinin [8] have reported that to obtain the maximum heat absorption the black particulates should be bigger in size than the wave length of the incoming heat rays. This suggests that use of finer coal dust than the present one would not only be more effective but economical also.

It is significant that fishes treated with salt alone showed longer HLP than the controls. It appears that the salt crystals in dry salting technique not only caused high reflectivity but also utilised a portion of the heat

(1.18 K Cal mole⁻¹) 9 in dis-
 solution. Over and above, the
 salt caused a reduction in the
 water vapour pressure which in
 turn induced more absorption of
 moisture from the atmosphere
 since high relative humidity >70%
 was noted during experiments. The
 above findings show clearly that
 salting technique alone is not
 congenial for quick drying. But
 on account of the bacteriostatic
 and fungicidal action, the salt-
 ing cannot be dispensed with. It
 is recommended that increase of
 the salt concentration to slight-
 ly >15% [10] for fish preservation
 is essential. Further, the salt
 solution after its impregnation
 into fish tissue, also extracts
 the bound water from the proteins.
 In this way, salting makes the
 protein impervious to the putre-
 factive action of enzymes and
 aids indirectly in drying when
 combined with the charcoal.

It may be mentioned that the
 experiments were done using in-
 frared radiation instead of the
 solar heat due to the prevailing
 inclement weather (monsoon).
 Daniels (Farrington) [11] has re-
 ported that the relative intensi-
 ty of solar energy is the highest
 at wave lengths 3×10^7 to 10×10^7
 angstroms. Black bodies in gene-
 ral are known to absorb radiated
 energy at all wave lengths. Hence
 the fish coated with charcoal can
 be expected to dry much faster in
 solar radiation than in the in-
 frared radiation. Further, in-
 natural drying the fish are gene-
 rally hung to dry on the racks
 whereby entire surface area of
 fish are exposed to the radiated
 heat. In the present experiment
 only 50% of the fish area could
 be exposed to the heat energy.
 Obviously, a reduction more than
 double in HLP can be expected.

Regarding the removal of char-
 coal from the dried fish it may

be mentioned that on an average 95%
 of coal could be dusted off easily
 while 50% of the remainder gets
 stripped off on soaking in water.
 This is a normal step in cooking of
 all the dried fishes (Figs. 6a & 6b).
 It is noticed that the unstripped
 charcoal i.e. 2.5% (Fig. 6c) mostly
 remained in the eye sockets, fin
 rays and over the scales. These are
 the parts of the fish which are
 generally discarded. However, the
 admissibility of charcoal powder in
 traces from toxicity point of view
 for human consumption remains to be
 tested.

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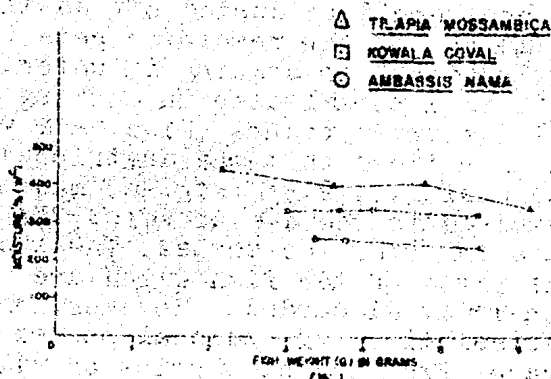


Fig. 1. Relationship between moisture percentage (w^d) and weight of the fishes.

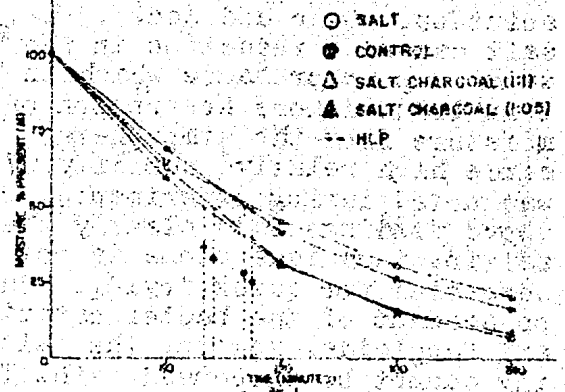


Fig. 3. Percentage of total moisture present in relation to time in Kowala coval after differential treatment and exposure to uniform heat intensity.

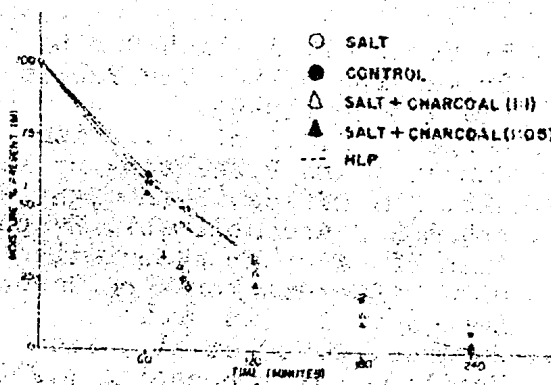


Fig. 2. Percentage of total moisture present in relation to time in Tilapia mossambica after differential treatment and exposure to uniform heat intensity.

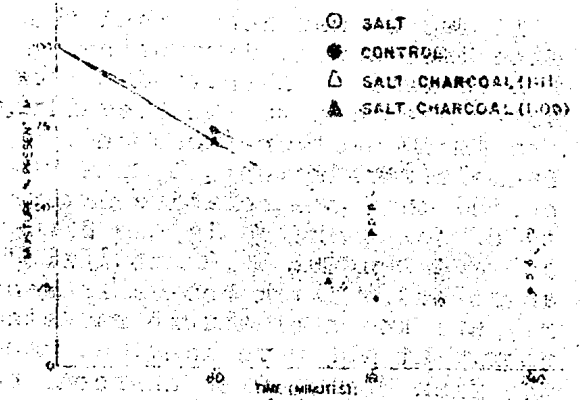


Fig. 4. Percentage of total moisture present in relation to time in Kowala coval (2nd batch) after differential treatment and exposure to uniform heat intensity.

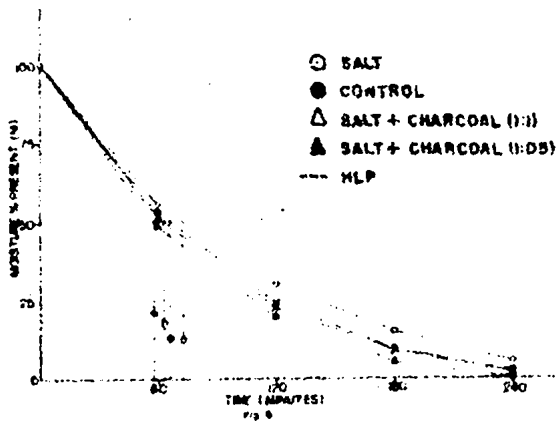


Fig. 5. Percentage of total moisture present in relation to time in Ambassis nana after differential treatment and exposure to uniform heat intensity.



Fig. 6(b). Dry fish after dusting off the charcoal powder.

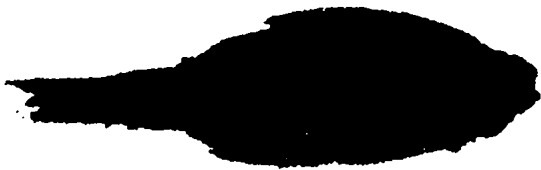


Fig. 6(a). Dry fish treated with salt charcoal mixture (1:0.5).



Fig. 6(c). Dry fish after soaking in water showing fractions of unstripped charcoal powder sticking mostly near the eye socket, fin rays and over the scales.