Prevention of Infestation by *Dermestes maculatus* Degeer in East African Dried Fish by Solar Treatment

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East African sun-dried fish infested by *Dermestes maculatus* were exposed to tropical sunlight at ambient temperature and analysed for insect mortality and weight losses. Solar treatment for 6 to 8 h was highly effective for one layer of split sun-dried fish and 100% insect mortality was noted, while pest species were still present in the four layer batch. Weight losses between 1.2% and 10.2% were recorded, the top layer suffering the highest loss. The high surface temperature of 60°C caused fish to become brittle and quality losses occurred. A reduction in length of exposure/temperature is probably a presupposition for application of the method to local conditions.

Solar treatment has been recommended as an effective countermeasure to insect infestation by several workers (Doe *et al.*, 1977; Diouf, 1980; Walker and Wood, 1985). However, in many tropical countries the ambient temperature is too low to exceed the level for pest extermination and the goal for many researchers has therefore been the construction of an apparatus aimed at reducing quantity and quality losses by increasing the temperature. In some tropical regions, however, the ambient temperature exceeds the lethal level of insect development making the use of additional temperature increasing equipment unnecessary. Lake Turkana, Kenya is one such region.

Materials and Methods

The studies were carried out in Kalokol, the main centre of fish processing at Lake Turkana in November 1985. The local fish chubule, *Labeo horie*, ranging in length between 45 and 48 cm with an average weight between 450 and 500 g was chosen for the studies. Each fish was split, dried at ambient temperature and stored for 3 to 6 months before trial. The fish had become heavily infested by *D. maculatus* during storage. The moisture content was 11.58% estimated in a random sample of 25 fish. The fish were spread out on a concrete floor and exposed to the sun from 09 00 to 17 00 h A total of 30 fish (Batch A) and 120 fish (Batch B) were spread on the compound forming one square metre layer of split dried fish with one layer of fish, 4 cm thick and one square metre layer of split dried fish with four layers of fish, 20 cm thick.

Each batch was exposed to sun for 8 h and again for three replicate trials on the three following days, while temperature on the fish, ambient temperature, number of insects and weight changes were recorded. During the final weighing, fish were carefully examined for insects and moisture content was compared with the initial moisture of the fish.

Results and Discussion

The ambient temperature varied between 31 and 36°C and the temperature was recorded both for the top, middle and bottom of the fish layers every 2 h. The results are presented in Fig. 1 and 2. The surface of both Batch A and B reached a temperature of between 55 and 60°C at 11 00 hours. A slight increase in temperature was apparent between 11 00 and 15 00 hours while there was a decrease to approximately 50°C by 17 00 hours Batch A had a middle temperature similar to the top temperature, while the middle temperature for Batch B was considerably lower; 44°C at 11 00 hours;

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43°C at 15 00 hours and 41°C at 17 00 hours, The bottom temperature for Batch A showed a steady increase from 43°C at 11 00 hours to 47°C at 17 00 hours. The pattern for Batch B was similar but lower temperatures were recorded; 37°C at 11 00 hours and 42°C at 17 00 hours.

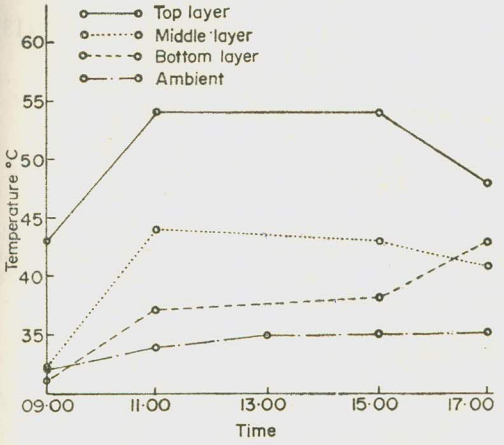

Fig.. 1. Temperature changes during solar treatment (four layers of fish)

Number of *D. maculatus* adults and larvae pupae were counted and a total mortality was achieved for Batch A at 1500 hours while Batch B was still infested at 1700 hours. The results are presented in Tables 1 and 2.

The weight losses during solar treatment are presented in Fig. 3 and it is apparent that the losses were considerable in Batch A, amounting to 10.2% after 8 h, while the total losses in Batch B varied between 1.2 and 8.5% with an average of 4.58%.

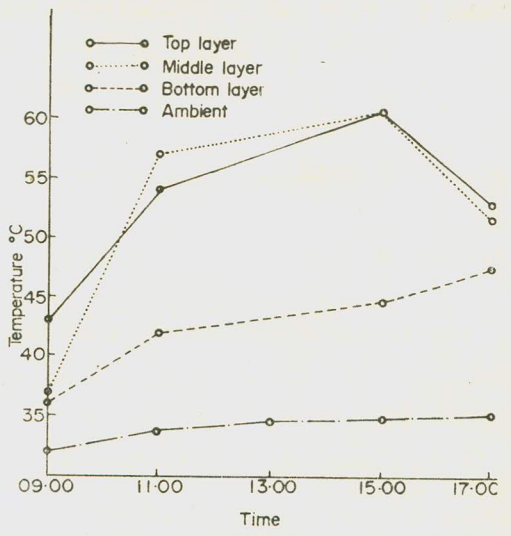

Fig. 2. Temperature changes during solar treatment (one layer of fish)

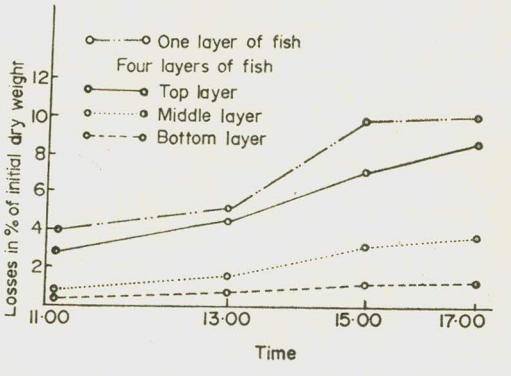

Fig. 3. Weight losses during solar treatment

Table 1. *Total number of Dermestes maculatus recorded during solar treatment (one layer of fish)*

Time	0900	1100	1300	150	1700
Number of adults	numerous	78 (20) ± 15.3	12 (13) ± 7.0	0 (10) ± 0	0 (9) ± 0
Number of larvae	numerous	12 (>100) ± 5.0	10 (86) ± 3.0	0 (12) ± 0	0 (10) ± 0

( ) = number of dead insects. Each data represents mean of 3 replicates ± SD

Table 2. *Total number of Dermestes maculatus recorded during solar treatment (four layers of fish)*

Time	0900	1100	1300	1500	1700
Number of adults	numerous	> 100 (> 100)	37 (20) ± 15.0	40 (10) ± 9.0	90 (17) ± 13.3
Number of larvae	numerous	>100 (> 100)	40 (10) ± 6.3	20 (15) ± 6.0	>100 (13)

( ) = number of dead insects. Each data represents mean of 3 replicates ± SD

A total mortality was achieved for the single layer fish in Batch A after 6 h in sun. When 4 layers were employed, beetles were migrating from the hot surface to the cooler bottom level and mortality was thus only achieved in part of the heap and fish became re-infested after one night's storage. A total extermination was found for Batch A having a bottom temperature of 47°C at 1700 hours compared to the infested Batch B having a bottom temperature of 42°C at 1700 hours. The lethal temperature for *D. maculatus* is therefore expected to be found between these temperatures for commercial application of the method.

During 8 h of intensive solar treatment, the fish experienced a weight loss higher than fish kept at ambient temperature for 6 months (Gjerstad, 1986). The extreme high surface temperature of 55 to 60°C caused the exposed fish to become brittle and caused also losses in terms of weight (tissues of fish broke off during transport) and value (the damaged products fetched a lower price than normally treated insect free Labeo). A reduction in time of exposure as indicated from Table 1 and/or a reduced and controllable temperature is therefore regarded as a must if this method is to be considered commercially viable in the area.

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