Thermotolerance of human body louse, *Pediculus humanus corporis*

I. Treatment of adults and eggs by hot water

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Introduction

Human pediculosis still persists in most parts of the world despite highly improved public health and hygiene, particularly in developed countries. In Japan, the incidence of human pediculosis recently increased, with 1,862 cases reported in 1989 and about 7,500 cases in 1992. The statistical data of the Ministry of Health and Welfare in Japan showed that above 87.5% of reported cases of head lice occurred in kindergartens, nursery schools and elementary schools (Yamada, 1992). Tongu (1994) also reported that pediculosis was found in 30.9% of public institutions including nursery schools, kindergartens and elementary schools in Okayama City, Japan. After World War II, DDT and BHC have been used to eradicate both human body and head lice, but resistance to both compounds developed after 10 years of continuous use (Yasutomi, 1953; Maunder, 1971). It is unclear whether the recent increase of louse infestation in Japan is linked to the level of insecticide susceptibility or not. Juranek (1977) reported that 59% of the infested children had at least one other infested household member. The risk of infestation in household members may be caused by sharing a bed, clothing or towels. Following therapy of the infested children by the treatments of dusting powder or shampoo supplemented with insecticides, clothing, towels and bed linens of infested children should be treated at high temperature. But the treatment of large volume of such materials by boiled water is not easy for individual families. If it were proved that human lice can be killed by treatment of hot water for a short time, this treatment would be a very valuable way to kill lice in linens and clothing. Several reports suggested that lice cannot survive high temperature (Tokunaga, 1948; Hopkins, 1949; Busvine, 1977) but systematic studies on thermotolerance in human body and head lice have not been carried out. We further evaluated thermotolerance in head and body lice in order to improve techniques for blocking transmission between household members.

Materials and methods

Human body lice, *Pediculus humanus corporis* reared in our laboratory were used. The lice were collected at Sapporo City, Japan at 1953 and colonized in our laboratory. The lice were allowed to feed to full satiety on our arms daily except on Saturday and Sunday in every week. Thirty adult lice of both sexes, which had been fed 1 day before, were treated at each temperature and period of exposure. Adult lice clinging to nylon mesh (0.3 mm mesh 2.5 cm²) were dipped in hot water (at 35, 40, 45, 50, 55 and 60°C) in test tubes for 5, 15, 30 and 60 min. After dipping, the lice were dried with a kimwipe®, maintained in an incubator at 30°C and mortality was checked 24 hr after treatment. Louse eggs (100–200 per nylon mesh) deposited 4 days before were treated in the same manner as adults. The treated eggs were maintained in a same incubator at 30°C and the hatching rate was checked 8 to 10 days after treatment.

Results and discussion

In the hot water at 35°C almost all adult
lice survived at all times of treatment (Table 1). The lice treated at 40°C for 15 or 30 min did not show any mortality. The treatment at 45°C for 30 and 60 min showed a severe effect on the survival of adult lice. Present results show that the treatment of 55°C is extremely effective to kill adult lice in a short period (5 min). The body color of almost all adult lice killed by hot water at high temperature (55 or 60°C) changed drastically to a reddish color, following rupture of the midgut. This phenomenon may be related to weakening of the midgut wall. The eggs treated at 45°C for 5, 15, 30 min, hatched at a rate comparable to all treatments at 35°C, although treatment for 60 min showed mortally damage (Table 2). When the eggs were treated at 50°C for 5, 15, and 30 min, 62 to 86% of eggs could hatch normally. It is suggested that the thermotolerance of louse eggs is slightly higher than adult lice in the treatment at 50°C for various periods. The present results showed that the temperature of 55°C for over 5 min is effective to kill louse eggs.

Hopkins (1949) observed that adult body lice incubated at 41-42°C for several hours appeared to be mortally damaged. Tokunaga (1948) reported that the optimal temperature for development of body lice is 34°C and the maximum possible temperature for development was just below 40°C. A temperature above 38°C completely blocked the hatching of the eggs (Lesson, 1941). Busvive (1977) also reported that 50°C for 30 min, 53.5°C for 5 min and 60°C for 10 min killed all eggs. Our results agreed with previous studies but the critical temperature of mortality was not calculated because the mortality was almost 100% at high temperature or almost 0% at lower temperature (Tables 1, 2). As the level of hygiene began to rise particularly in developed countries, it is seemed that body and/ or head louse infestations became associated with certain segment of society. However, the present status of human louse infestation in Japan does not seem to be linked to socioeconomic problems. There have not been epidemiological and entomological investigations focusing on lower grades of elementary schools in Japan. The present studies show that hot water (above 55°C) is able to kill adult body lice and their eggs in a short period (5 min). If this simple control method can be applied to eliminate head lice, large volume of linens and clothing could be treated with hot water in a bath tub within homes which have infested household members. This treatment will reduce the transmission of lice in individual families drastically. In the near future, the insecticide resistance of lice will be a crucial problem in developed and developing countries. These situations will require us to develop effective, non-chemical control methods of head and body lice.

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References


要約

コロモジラミの熱耐性

I. 成虫および卵の温水処理

シラミは重要な疾病媒介昆虫として古くから研究されているにもかかわらず、シラミの高温耐性に関して詳しい実験報告は見当たらなかった。このため、今回コロモジラミの成虫および卵を用いて耐熱性に関する実験を行った。30°Cから5°Cとまで各温度の水に成虫または卵を一定時間浸せきし、その後30°Cで飼育し死亡率および孵化率を調べた。その結果、55°C、5分間の処理によって成虫および卵ともに卵個体が死亡することが確認された。成虫の死亡個体は中腸の破裂により赤色に変化していた。また各温度においての死亡率はほとんど0かあるいはほとんど100%というall or none的な死に方を示した。