SHORT COMMUNICATION

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Effect of parasitism on respiration rates of adults of different Artemia strains from Spain

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Abstract The effect of cestode parasitism on the respiration rate (Mo2) of different strains of Artemia from wild populations of Spain was studied. Respiration rates (Mo2) of adults from each strain were not affected by the presence of cysticercoids of Flamingolepis liguloides or Hymenolepis stellorae (Cestode, Hymenolepididae). This finding could be related to the absence of reproductive activity (parasite castration) in parasitized females.

Introduction

The brine shrimp Artemia (Crustacea, Branchiopoda, Anostraca), is an intermediate host of several cyclophylldian tapeworms (Cestoda, Hymenolepididae) that are final and specific parasites of water birds such as gulls, flamingos, avocets and grebes (Amat et al. 1991a, b; Anderson 1975; Condreau and Condreau-Balcescu 1978; Gabrion and McDonald 1980; Jarecka 1984; Maksimova 1973, 1974, 1976; Robert and Gabrion 1991).

The presence of cestode cysticercoids in Artemia is manifested as a bright red colour. Cysticercoids also provoke a severe degree of castration in Artemia (Amat et al. 1991b). This is a frequent syndrome that has been documented for many other cestodes (Kennedy 1972; Sekutowicz 1934). Furthermore, parasitism increases longevity in parasitized specimens in comparison with unparasitized individuals, favouring the infection of the final host (Courtney and Christensen 1987).

Little research has been done to determine how wide the influence of these parasites on the host’s metabolism might be (Kennedy 1972). Oxygen consumption appears to be a good measure of the complex interaction between the parasite and its host (Klekowski and Guttowa 1968). As far as we are aware, the respiration rate of Artemia parasitized by cestode cysticercoids has not previously been investigated. The primary aim of this work was to study the effect of the parasitism caused by cysticercoids of Flamingolepis liguloides and Hymenolepis stellorae (Cestode, Hymenolepididae) on the respiration rates (Mo2) of adults of different wild Artemia strains from Spain.

Materials and methods

Experiments were carried out on wild specimens of Artemia salina (bisexual strain LmPB) from La Mata (Torrevieja, Alicante, Spain) and A. parthenogenetica (diploid strain LmPd) from the same location and from Bonnati (BmPd; Santa Pola, Alicante, Spain). The samples were collected and processed as described elsewhere (Amat et al. 1991a, b). It was found that the bisexual and the parthenogenetic Artemia strains from La Mata were parasitized by cysticercoids of Flamingolepis liguloides (Cestoda, Hymenolepididae), whereas the parthenogenetic Artemia strain from Bonnati was parasitized by cysticercoids of Hymenolepis stellorae (Cestoda, Hymenolepididae). After light narcosis, undeveloped specimens (nauplii and metanauplii) were discarded and parasitized and unparasitized ones were separated and placed in separate 2-l glass flasks filled with saline water [salinity (S) = 90 parts per thousand (ppt)] at 20 ± 0.5 °C for the bisexual Artemia strain and 24 ± 0.5 °C for the parthenogenetic ones under a 12-h:12-h light:dark regime. The animals were fed regularly ad libitum on the alga Dunaliella sp. and the medium was changed twice a week.

Prior to the measurements of oxygen consumption (Gilson differential respirometer; Gilson Medical Electronics, Wisconsin, USA) the animals were starved for 24 h at 24 ± 0.5 °C. Rates of oxygen consumption were determined only in parasitized and unparasitized adult females because there were not enough parasitized males in the bisexual population. The parasitized females used did not display reproductive activity and bore only one cysticercoid, whereas the unparasitized females showed reproductive activity (embryos, cysts or nauplii, filling the ovisac). One or two individuals were placed into a series of 15-ml flasks in 3 ml of filtered saline water (S = 90 ppt) and were left at 24 ± 0.5 °C for 30 min,
during which time the flasks were continuously shaken at the minimal speed available (45 oscillations per min). After this time the oxygen consumption was measured every 45–60 min over a period of 3.45–4.8 h. At the end of each experiment, individuals were removed from the flasks, their total length was measured and the total dry weight was determined after oven-drying.

The oxygen consumption (microliters of O₂ per hour) in each flask was estimated by linear regression analysis of the oxygen decrease as a function of time. The weight-specific rate of oxygen consumption (microliters of O₂ per milligram per hour) was then calculated by division of the total oxygen consumption of each batch of animals by the number of individuals in the flasks and by their mean dry weight. Finally, the weight-specific rates of oxygen consumption were expressed in micromoles of O₂ per milligram per hour (M₀₂).

Results and discussion

Figure 1 shows the mean values recorded for the oxygen consumption rate (M₀₂) of parasitized and unparasitized adult females. All measurements of oxygen consumption were determined for animals of a limited size range to avoid a size effect on the rate of oxygen consumption. The dry weight of the animals ranged from 0.9 to 1.83 mg for the bisexual (Lmb) and parthenogenetic diploid (Lmpd) strains from La Mata and from 0.7 to 1.2 mg for the parthenogenetic diploid strain from Bonmati (Bmpd). One-way analysis of variance (ANOVA) showed that there were significant differences (P ≤ 0.05) among different Artemia strains. Further analysis indicated that the oxygen consumption rate (M₀₂) of parasitized and unparasitized females from the bisexual Artemia strain was significantly lower than the values obtained for parthenogenetic strains, which were not significantly different from each other (P > 0.05). However, the differences in M₀₂ values noted for parasitized versus unparasitized females for each Artemia strain studied did not reach statistical significance (P ≥ 0.05).

Weight-specific rates of oxygen consumption (M₀₂) were not affected by the presence of cysticeroids of Flamingolepis liguloides or Hymenolepis stelllora in the hemocoele of adults of the natural populations of Artemia analysed.

The effect of parasitism on the respiration rate of its hosts has previously been studied in several aquatic organisms (Anderson 1975; Baudoin 1975; Barber et al. 1988; Kennedy 1972; Klekowski and Gutkowa 1968; Walkey and Meakins 1970). The presence of parasites can interfere with the normal physiology of their host, and it might be that this interference would be reflected in an alteration in the respiration rates of the host, but not always in a predictable manner. Indeed, the respiratory response of parasitized organisms shows a great degree of variability (Anderson 1975; Lester 1971; Walkey and Meakins 1970). The lack of effect found for the presence of cysticeroids of F. liguloides or H. stelllora on the respiration rates of the different Artemia strains studied is in agreement with the earlier works of Walkey and Meakins (1970) and Kennedy (1972). These authors reported that the presence of parasites did not alter the respiration rate of different aquatic intermediate hosts, pointing out that this effect could be an adaptation mechanism of the host to the presence of a parasite.

The presence of the parasite can alter the host’s energy budget to increase the amount of the host’s energy potentially available to the parasite. Thus, the parasite can obtain sufficient energy for growth, maintenance and reproduction at the expense of the host (Smith-Trail 1980). If the parasite could reduce the amount of energy the host invests in reproduction by diminishing or annulling the reproductive activity (parasite castration), the amount of energy available to the parasite might be increased. The parasite castration of the host thus seems to constitute an important advantage for the parasite in terms of the increase in available energy from and reduction in death (increase in longevity) of the host (Obrebski 1975).

Amat et al. (1991b) found in females of A. parthenogenetica from Bonmati infected with cysticeroids of F. liguloides a total absence of reproductive activity (parasite castration). During the present study it was noted that uninfected females of the different Artemia strains displayed reproductive activity (embryos or cysts filling the ovisac), in contrast with parasitized ones, which did not. This finding confirms previous works that indicate the effects of castrating parasites on crustaceans (Baudoin 1975) and, in particular, on the brine shrimp Artemia (Amat et al. 1991b; Condreanu and Condreanu-Balcescu 1978). The presence of cysticeroids of F. liguloides and H. stelllora did not produce changes in the respiration rate of infected or uninfected adults of the different Artemia strains studied. This observation could be related to the absence of reproductive activity.