CROSS INFECTIVITY STUDY OF FOUR SUBSPECIES OF *ONCOMELANIA HUPENSIS* IN FOUR GEOGRAPHICAL STRAINS OF *SCHISTOSOMA JAPONICUM**)

By M. Sudomo**)

ABSTRACT

Four subspecies of *Oncomelania hupensis*, namely, *O.h.lindoensis, O.h.hupensis, O.h.nosophora* and *O.h.quadrasi* were exposed to miracidia of four different geographical strains of *Schistosoma japonicum*, i.e.: the Chinese, Japanese, Philippine and Indonesian strains. Results of this experiments showed that *O.h.lindoensis* from Indonesia and *O.h. hupensis* from China found to be the most susceptible for all geographical strains of *S.japonicum* while *O.h. quadrasi* from the Philippines was the most refractory and could only be infected with the Philippine strain.

SARI

Empat subspecies *Oncomelania hupensis*: *O.h. lindoensis, O.h. hupensis, O.h. nosophora,* dan *O.h. quadrasi* telah dicoba diinfeksikan di dalam laboratorium dengan miracidia dari berbagai strain *Schistosoma japonicum.*

Strain *S. japonicum* yang dipakai untuk menginfeksi keempat subspecies *O.hupensis* tersebut adalah strain Cina, Jepang, Filipina dan Indonesia sendiri.

Hasil percobaan ini menunjukkan bahwa *O.h. lindoensis* dari Indonesia dan *O.h. hupensis* dari Cina ternyata paling rentan terhadap infeksi keempat strain *S. japonicum*, sedangkan *O.h. quadrasi* paling tidak rentan dan hanya dapat diinfeksi oleh *S. japonicum* dari strain Filipina sendiri.

I. INTRODUCTION

The intermediate host of *Schistosoma japonicum* in the Lindu Valley, Central Sulawesi, Indonesia, was discovered in 1971 (Carney *et.al.* 1973) and described as a new subspecies of *Oncomelania*, namely *O.hupensis lindoensis* by Davis and Carney (1973). Subsequent epidemiological surveys deleniated more than 70 snail foci in the lowlands surrounding Lake Lindu (Sudomo and Carney, 1974; Sudomo *et.al.*, 1978) and the natural infection rates of *S. japonicum* in a variety of oncomelanid habitats throughout the valley (Sudomo *et.al.*, 1978). Transmission of Oriental schistosomiasis was only found in two limited areas of

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**) National Institute of Health Research and Development, Jl. Percetakan Negara 1. P.O. Box 226, Jakarta, Indonesia.

Central Sulawesi, the Lindu and Napu valleys (Sudomo and Carney, 1974; Carney *et.al.*, 1977). The evolution and zoogeography of both snails and schistosomes in those isolated areas of Central Sulawesi is discussed in detail elsewhere (Davis 1979; 1980). Several distinct geographical strains of *S. japonicum* and different subspecies of *O.hupensis* occur throughout Asia and information on the degree of genetic relationship between strains and between subspecies can be obtained from cross infection studies. Although there have been several reports of heterologous and homologous experimental infection of *S. japonicum* and *O. hupensis* subspecies (De Witt, 1954; Hunter, Richi and Otori, 1952; Pesigan *et. al.*, 1958; Moose and Williams, 1963, 1964; Hsu Hsu, 1960; Chiu, 1967; Chi *et. al.*, 1971; Davis and Ruff, 1973 and Rachford, 1977), experimental infection utilizing the Indonesian strain so far was done only by Cross (1976).

The purpose of this present cross infection studies of each of the four subspecies of *Oncomelania* snails namely: *O.h. lindoensis, O.h. hupensis, O.h. nosophora* and *O.h. quadrasi* to miracidia of four different geographical strains of *S. japonicum* i.e. the Chinese, Japanese, Philippine and Indonesian were to find out the degrees of susceptibility of these snails subspecies in relation to the various strains of schistosome.

2 MATERIAL AND METHODS

The snails used in these experiments were obtained from laboratory colonies, except for *O.h lindoensis*, which were collected from Lake Lindu area, Indonesia. Field collected *O.h. lindoensis* were checked for cercariae several times at two weeks interval by a shedding technique (Vogel, 1948) and were found negative. Other subspecies of *O.h. hupensis* used in this study: *O.h. hupensis* which had been isolated by Vogel in the province of Chekiang in 1935 (Vogel, 1948), was maintained in breeding colonies kept in the laboratories of Ciba Geigy (Trop. Med. Parasitology Laboratory); *O.h. quadrasi* was obtained from the field (Leyte, the Philippines) by Santos and was set up as a laboratory colony by Striebel in 1963; *O.h. nosophora* isolated by Okabe in 1972 and maintained as a laboratory colony in Sandoz laboratory in Wien.

The Indonesian strain of *S. japonicum* was isolated during this study from infected snails collected in Lindu valley. The Philippine and Japanese strains were obtained from experimentally infected mice from the NAMRU-2 laboratory in Taipei, Taiwan , and the Chinese strain was obtained from the Ciba Geigy laboratory in Basel.

Miracidia of the Philippine and Japanese strains of *S. japonicum* were obtained by a hatching technique (Striebel, pers. comm. 1976), using eggs recovered from

the stool, liver and intestines of mice; the Chinese strain was obtained from the liver and intestines of hamsters; and the Indonesian strain from the stool of a beagle dog.

The snails were exposed singly to 3 to 4 newly hatched miracidia for one hour in a vial of 1.5 × 7 cm. The exposed snails were then kept in an aquaria under controlled laboratory conditions at constant temperature (25° ± 1°C), Rh 75% under "cold" fluorescence light (GRO-Lux 40 watts) during the day. After an interval of five weeks, the snails were checked for infection once weekly for five consecutive weeks by the shedding technique according to Vogel (1948). All snails which were negative after 5 successive shedding were crushed.

3. RESULTS AND DISCUSSION

The cross infection results (Table 1) showed that all the four strains of *S. japonicum* developed in *O.h. lindoensis* with relatively high positive rates. Although *O.h. hupensis* was shown to be susceptible to all four strains of *S. japonicum*, infection rates with the Philippine and Japanese strains of *S. japonicum* were much lower than with the Indonesian and Chinese ones. *Oncomelania h.nosophora* was susceptible to the Philippine and Japanese strains of *S. japonicum* but infection rate with the homologous strains of *S. japonicum* was much lower than with the Philippine strain. *O.h. quadrasi* was only susceptible to its homologous strain of *S. japonicum*.

It has long been established that the survival of geographic strains of schistosome depends on their success to penetrate and develop in snail hosts of very specific genotypes within the species (Basch, 1976; Davis, 1979, 1980; Moose and Williams, 1963; Chiu, 1967 and De Witt, 1954). As an example the Japanese strain of *S. japonicum* will develop in *O.h. nosophora*, in *O.h. hupensis* from Mainland China, and in *O.h. chiui* from Taiwan, but not in *O.h. formosana* from Southern Taiwan nor in the Philippine snail *O.h. quadrasi* (Davis and Ruff, 1973). In the present study, the four strains of *S. japonicum* develop in the Indonesian and Chinese snails (Table 1). The low infection rates of *O.h. hupensis* with the Philippine and Japanese schistosome were in agreement with those of Chi *et.al.* (1971), De Witt (1954) and Hsu Hsu (1960) but with the homologous Chinese schistosome, the present study showed a much higher rate than that of Chi *et. al.* (1971) and De Witt (1954). Cross (1976) exposed *O.h. quadrasi* to the Indonesian schistosome and found it is to be refractory. Chi *et. al.* (1971) showed this snail could be infected by its own parasite, but not with the schistosomes of the Chinese and Japanese strains.

The results of this study (Table 1) and those of Chi *et. al.* (1971), Cross (1976) and De Witt (1954) confirmed that *O.h. quadrasi* is very parasite-specific and

could only be infected by the homologous strain of *S. japonicum* which naturally infect humans.

Table 1. Cross infection between four different geographical strains of *Schistosoma japonicum* in four subspecies of *Oncomelania hupensis.*

Oncomelania hupensis	Strain of *S. japonicum*	No. of snail exposed	Survival ten weeks after exposure (%)	Infection of survivals (%)
lindoensis (Indonesia)	Indonesian	266	72.2	28.6
	Philippine	57	84.2	60.4
	Chinese	196	17.3	41.0
	Japanese	42	45.2	31.6
hupensis (China)	Indonesian	162	84.0	67.0
	Philippine	80	62.5	4.0
	Chinese	320	93.4	50.0
	Japanese	75	93.3	3.0
qudrasi (Philippines)	Indonesian	151	76.8	0
	Philippine	80	93.8	46.7
	Chinese	56	82.1	0
	Japanese	63	82.5	0
nosophora (Japan)	Philippine	25	88.0	36.3
	Japanese	45	80.0	2.7

However, the *O.h.quadrasi* was weakly susceptible to the zoophilic Formosan strain of *S. japonicum* (6.4%) (De Witt, 1954). *O.h. nosophora*, when exposed to the Philippine and Japanese schistosomes, was susceptible to both these strains but the infection rate with homologous strain of *S. japonicum* was very low (2.7%) when compared to the Philippine strain (36.3%). *O.h. nosophora* was not exposed to the other two strains of schistosome in the present study, but Chi *et. al.* (1971) and De witt (1954) in their studies found *O.h. nosophora* refractory to the Chinese strain, but susceptible to *S. japonicum* of the Philippine and Japanese strains (Moose and Williams, 1963; De Witt 1954; Hunter, Ritchi and Otori, 1952; Davis and Ruff, 1973 and Chi *et.al.*, 1971). Moose and Williams (1963) demonstrated that *O.h. formosana* from three different areas of Taiwan when exposed to *S. japonicum* had infection rates ranging from 0% to 95%. The different degrees of infection rates in *O.h. nosophora* with its own parasite of 2.7% in the present findings as compared to 33.3% obtained by Chi *et. al.* (1971) could probably be attributed to the observations made by Moose and Williams (1963), or by the small number of *O.h. nosophora* exposed with the parasite

The survival rates of the various subspecies of oncomelanids exposed to geographical strains of *S. japonicum* were usually more than 60%, however, when *O.h. lindoensis* was exposed to the Chinese strain of *S. japonicum* the mortality was relatively high (82.7%). Similarly high survival rates in cross infection experiments was reported by Cross *et al* (1976) and Chi *et al.* (1971).

SUMMARY

Studies on cross infection between four geographical strains of *S. japonicum* in four subspecies of *O.h. hupensis* had been carried out. Results showed that the Indonesian strain, *O.h. lindoensis*, and the Chinese strain, *O.h. hupensis*, were the most susceptible subspecies to the four strains of *S. japonicum*, i.e. the Chinese, Japanese, Philippine and Indonesian. The Philippine strain, *O.h. quadrasi*, was the most refractory and could only be infected with the homologous strain of *S. japonicum*. While the Japanese subspecies, *O.h. nosophora*, exposed to the Philippine and Japanese only, was found to be susceptible to both strains of *S. Japonium*.

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