

MATERIAL SAFETY DATA SHEET FOR *NECATOR AMERICANUS*

NAME: *Necator americanus* infective larvae

SYNONYM: Human hookworm, necatoriasis

CHARACTERISTICS: Family Ancylostomatidae, subfamily Necatorinae; intestinal nematode parasite, adult male measures 5-9 X 0.30 mm, female 9-11 X 0.35 mm; eggs are 64-76 X 35-40 μm , infective larvae 630-670 X 20-30 μm .

SECTION II - HEALTH HAZARD

PATHOGENICITY: Adults, eggs and rhabditiform larvae of *N. americanus* are not infectious. Only third stage larvae (iL3) are infectious. Infective larvae can penetrate intact skin and mucous membranes and can swim in water including a water film. They will actively seek out a mammalian host, moving up a heat gradient. Once iL3 make contact with the skin, they invade using mechanical and enzymatic mechanisms. iL3 penetrate initially under skin scales and down hair follicles. When iL3 penetrate, a pinpoint itching sensation is felt. The penetration site is marked by a small red spot within several hours that progresses to a red papule and fades within a week.

Infective larvae penetrate the skin, enter into capillaries and undergo a blood-lung migration that involves travel through the right side of the heart to the pulmonary capillaries, escape into the alveoli, passage up the airways, travel down the oesophagus, through the stomach to establish in the small intestine where maturity occurs. If both sexes are present, mating occurs and eggs are produced in faeces usually within 8 weeks.

Hookworms suck blood and initiate an allergic response in the small intestine which commences 3 weeks after penetration. Clinical signs occur at the penetration site (red itchy papules) and during the intestinal establishment phase at 3-8 weeks (abdominal pain and episodic diarrhoea). Passage through the lungs is usually asymptomatic and sub-clinical. Heavy infections may cause anaemia in a person with iron deficiency, but usually infections in people without iron deficiency are sub-clinical.

HOST RANGE: Humans. However, a strain of *Necator americanus* has been adapted to hamsters in the laboratory.

INFECTIOUS DOSE: One iL3 is capable of penetrating intact skin, but at least one male and one female are required for mating and to produce eggs in faeces.

MODE OF TRANSMISSION: Transmission is by penetration of iL3, typically through intact skin, but also through mucous membranes.

COMMUNICABILITY: Not directly transmitted from person-to-person

SECTION III - DISSEMINATION

RESERVOIR: Humans, faeces, with 7 day old faecal cultures being highest risk.

ZOONOSIS: None in nature although a laboratory strain of *Necator americanus* has been adapted to hamsters.

VECTORS: None

SECTION IV - VIABILITY

DRUG SUSCEPTIBILITY: Adult hookworms can be treated with pyrantel, mebendazole, albendazole, levamisole, or nitazoxanide. Albendazole 400 mg orally can kill migrating juveniles of *N. americanus* and could be used in laboratory accidents.

DRUG RESISTANCE: Strains with some resistance to mebendazole and pyrantel have been reported.

SUSCEPTIBILITY OF iL3 TO DISINFECTANTS: Infective larvae can be killed within 10 minutes by 70% ethanol and within 15 minutes by 0.5% Dettol.

PHYSICAL INACTIVATION: Infective larvae can be killed immediately by addition of hot water at near boiling point. Infective larvae also die when the water film they are in disappears due to evaporation.

SURVIVAL OUTSIDE HOST: Infective larvae can survive up to 6 weeks in moist materials at ambient temperatures of 24-30°C.

SECTION V - MEDICAL

SURVEILLANCE: Occurrence of typical papules at penetration site is good evidence of penetration. Monitor for gut symptoms, particularly abdominal pain commencing 3 weeks after infection. If worms of both sexes are present, diagnosis can be confirmed by detection of eggs in faeces 8 weeks after infection.

FIRST AID/TREATMENT: Wash site of contact with 70% ethanol or Dettol. If these chemicals are not quickly available, wash the site immediately with running water and dry the skin to remove all water film. If lesions typical of penetration develop at site within 24 hours, consider treatment with albendazole to kill migrating larvae. Adult and juvenile hookworms in the intestine can be treated with anthelmintic drugs listed above.

IMMUNIZATION: None available

CHEMOPROPHYLAXIS: None available

SECTION VI - LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: None reported to date.

SOURCES/SPECIMENS: High risk specimens are faecal cultures aged 7 days which contain iL3. This would rarely occur in routine aerobic faecal bacterial plates since they are usually disposed of prior to 7 days. High risk with hookworm or *Strongyloides* cultures, particularly agar plate and Harada-Mori cultures.

PRIMARY HAZARDS: Water drops or films containing iL3 coming into contact with skin or mucous membranes.

SPECIAL HAZARDS: None

SECTION VII - RECOMMENDED PRECAUTIONS

CONTAINMENT REQUIREMENTS: Biosafety level 2 practices and containment equipment for all activities involving iL3.

PROTECTIVE CLOTHING: Laboratory coat; gloves should be worn at all times when working with live iL3.

OTHER PRECAUTIONS: Cultures of iL3 should be covered whenever they are not being accessed by researchers and should be labeled as infectious.

SECTION VIII - HANDLING INFORMATION

SPILLS: Allow aerosols to settle. Avoid any contact between liquid and skin or clothing. Wear gloves, carefully apply five times the volume of 70% ethanol. Allow sufficient contact time (20 mins) before clean up. On heat resistant surfaces, another option is to flood with water at near boiling point, leave 5 mins and clean up. Dispose into a sealed container.

DISPOSAL: When working with iL3, protect others against downstream risk. All iL3 should be killed prior to placing in general infectious waste. Infective larvae and material used (microscope slides, pipettes, test tubes, culture vessels) can be made risk free by placing in a larger container and flooding with 70% ethanol or 0.5% Dettol for 15 mins or water at near boiling point. Solid waste should be placed and sealed in airtight containers, and placed in infectious waste container. Disposal after this can be routine.

STORAGE: In sealed containers that have an infection hazard label and specifically labeled as infective larvae of human hookworm.

SECTION IX - MISCELLANEOUS INFORMATION

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