KEYNOTE ADDRESS

ON EMERGING PROBLEMS IN FOOD-BORNE PARASITIC ZOONOSIS: IMPACT ON AGRICULTURE AND PUBLIC HEALTH

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INTRODUCTION

Food-borne diseases can cause both direct and indirect economic losses. The provision of clean food through enforceable food safety requirements affects many areas of human economic and social activity. including agriculture, food manufacturing and processing, animal husbandry and the practice of veterinary medicine (Waites and Arbuthnott, 1990). Unsafe and unclean foods may have to be withdrawn from sale and destroyed, having a direct economic impact on the food industry. Indirect economic distress occurs through a reduction or loss of income by those suffering from a food-borne illness.

At present, the emphasis on food-borne diseases is mainly confined to foods contaminated with microbial organisms or their toxins, but there has been little emphasis on food-borne parasitic zoonoses or diseases acquired through the eating of animals which harbor these parasites. Northern Thailand is highly endemic area for a large number of animal parasitic infections that can be transmitted to man. Except for a few, the clinical aspects and treatment of these diseases have not been well documented and their epidemiology is not completely known. There is little general knowledge on many aspects of these parasitoses in Thailand and in other endemic areas of Southeast Asia.

Indeed problems appear to be increasing. Behavior of communities in endemic areas, in particular their awareness of the disease, their eating habits, and changes in diet are critical factors. The impact of parasitic zoonosis on agriculture is of concern, including inadequate inspection of meats; the need for tougher standards of hygiene in the food processing industry; and finally the appropriate application of food science and technology in food manufacture and processing as well as in agricultural practices.

In this overview, the public health aspects of food-borne parasitic zoonoses, especially in Thailand, will be reviewed. These parasitoses will have many features of scientific interest for those from other countries.

FOOD-BORNE PARASITIC ZOONOTIC DISEASES IN THAILAND

These diseases can be categorized by their etiological agents into four main groups, namely, protozoan, nematode, trematode, and cestode infections.

PROTOZOAN INFECTIONS

Toxoplasmosis

Northern Thais are fond of eating raw meat, such as "lahb" and "nahm" — raw pork or beef; however, toxoplasmosis is rarely reported. Although congenital toxoplasmosis has not been recorded, acquired toxoplasmosis has been diagnosed clinically.

Serologic evidence of *Toxoplasma gondii* in blood donors from Chiang Mai University Hospital revealed a prevalence of 4.6% by indirect hemagglutination test (IHA) and 1.2% by indirect fluorescent antibody test (IFA), while in pregnant woman, 2.8% were positive by IHA (Morakote *et al*, 1984). A survey of 60 cats in Chiang Mai yielded 18.4% positive by the Sabin-Feldman dye test (Maleewong *et al*, 1984).

Intestinal sarcosporidiosis

A stool survey conducted in Nakhon Nayok, Phitsanulok and Kalasin, representing the central, northern and northeastern regions of Thailand, yielded a prevalence of *Sarcocystis hominis* sporocysts of 3.76%, 1.1% and 2.97%, respectively. (Ektasaeng *et al,* 1987). Six patients, four from the northeast and two from the north were admitted to Ramathibodhi Hospital in Bangkok with a diagnosis of acute enteritis. Histopathological diagnosis was reported as either segmental eosinophilic enteritis or segmental necrotizing enteritis. Merozoite, microgamete, macrogamete, sporocyst and oocyst of *Sarcocystis* species were observed in tissue sections. Because of the presence of *Sarcocystis* cysts in the local beef and the habit of eating meat raw, it was postulated that the causative agent was *Sarcocystis bovihominis* (Bunyaratvej *et al,* 1982).

It another study, 99% of cardiac muscle of cattle from markets in Chiang Mai contained *Sarcocystis* cysts of unknown species. (S Pan-In, 1989, personal communication).

Cryptosporidiosis

Reports of the cryptosporidiosis in the past have been rare, but with the global spread of HIV (human immunodeficiency virus) infection, cases are now reported. A prevalence of 9.26% was reported among orphans from the "Home for Boys" in Chiang Mai who were suffering from diarrhea (Morakote *et al,* 1990).

NEMATODE INFECTIONS

Trichinellosis

Trichinellosis is widespread in northern Thailand. The first outbreak of the infection was recorded in Mae Sariang district in June 1962 (Boonthanom and Nawarat, 1963). To date, there have been 118 outbreaks, affecting some 5400 patients, 95 of whom have died (Chumkasian, 1990). Patients usually acquire the infection by eating raw pork dishes called "lahb" and "nahm", which are frequently served at traditional celebrations.

The transmission cycle of *Trichinella spiralis* appears to be of the sylvatic type with larvae often found in hill tribe pigs, which are allowed to forage in the open, and in wild boar. The larvae are rarely found in domestic pigs (Khamboonruang *et al,* 1978). The parasite appears to be *Trichinella spiralis* rather than other species (Pozio and Khamboonruang, 1989).

Capillariasis

Human intestinal capillariasis *(Capillaria philippinensis)* causing chromic diarrhea has been reported from several regions of Thailand. Man acquires the infection from eating a raw fish dish called "koi-pla". Fresh-water fish were experimentally infected with the larvae (Bhaibulaya *et al,* 1979).

Gnathostomiasis

Human gnathostomiasis caused by *Gnathostoma spinigerum* is commonly reported in Thailand. Third-stage larvae of the worm are commonly found in freshwater fishes, frogs and eels. Consumption of undercooked or raw flesh of second-intermediate hosts and paratenic hosts is the major mode of transmission to humans.

Subcutaneous migratory swelling is the most common clinical feature, with worms also recovered from the mucous membranes, conjunctiva, soft palate, respiratory tract, eyeball, intra-abdominal organs, and the central nervous system. Fatal gnathostomiasis occurs when worms invade the central nervous system (Daengsvang, 1980).

Diagnosis of gnathostomiasis is based on clinical signs, peripheral eosinophilia, and immunological tests. More sensitive and specific serological tests for diagnosis are needed. Specific drugs for treatment are also needed.

Angiostrongyliasis

Angiostrongyliasis or eosinophilic meningitis is widely distributed in Thailand. Between 1965-1968, 484 cases were reported (Punyagupta *et al,* 1970). The disease occurs in all age groups, with a higher prevalence in the second and third decades. Male farmers are at greatest risk. Infection occurs by eating raw or partially cooked *Pila* spp. snails. *Pila* are usually eaten by people of lower socioeconomic levels, since it is an inexpensive source of protein. They are also eaten while drinking alcoholic beverages. Twenty percent of *Pila* snails in an endemic area were found infected with third-stage larvae of *Angiostrongylus cantonensis.*

Twelve percent of rats were reported infected with adult worms. Sensitive and specific serological tests are needed to support the clinical diagnosis.

TREMATODE INFECTIONS

Liver fluke infections

Opisthorchiasis

Thailand is now recognized as having the highest prevalence of human liver fluke infections in the world. In the northeastern Thailand the overall prevalence rate is about 35%, involving about 7 million persons (Preukraj, 1984). The habit of eating raw fish, called "koi-pla", and salted fish called "pla-ra", is the source of infection. The infection is found in young people and increases with age. Immigration of infected people from northeast to the north impacts on prevalences. In Chiang Mai Province, the prevalence was reported to be as high as 37% (Yamaguchi *et al,* 1982). The northerners acquire the infection from eating raw-fish dishes call "lahb-pla" and "pla-som".

Snails of the genus *Bithynia* are the major first-intermediate host of *Opisthorchis viverrini.* These snails are found predominantly in rice fields in the north and the northeast. Many species of cyprinoid fishes serve as second-intermediate hosts. In some endemic localities, fish were found to have infection rates of 94% to 97%. Dogs and cats are the major reservoir hosts.

The clinical picture of opisthorchiasis varies. The mild cases have symptoms of dull abdominal pain and abdominal discomfort, eg, anorexia and flatulence. Liver and gallbladder enlargement is infrequently found. Hematological parameters and clinical chemistry are within normal limits, except that some persons show peripheral eosinophilia (Wykoff *et al,* 1966). Severe disease, with symptoms and signs of obstructive cholangitis, is rare. Cholangiocarcinoma associated with *O. viverrini* infection has been reported. In the Udon Thani Provincial Hospital in an endemic area, 8 out of 11 cases of opisthorchiasis found in an autopsy had coexistent cholangiocarcinoma (Sonakul *et al,* 1978). Serum bile acids, alpha-fetoproteins, etc, are tumor markers for the early detection of cholangiocarcinoma caused by *O. viverrini* (Changbumrung *et al,* 1989). In Thailand, opisthorchiasis appears to have an immense public health and social and economic impact on the population.

Fascioliasis

In Thailand, fascioliasis is caused by *Fasciola gigantica* and is enzootic in ruminants, eg, cattle and water buffaloes; the prevalence is about 80% (Bhodhi-ngoen, 1982). Nine human cases, involving *Fasciola hepatica* and *F. gigantica* have been reported (Kachintorn *et al,* 1988). Infections reported from man are mostly found as ectopic fascioliasis, ie, breast abscess. Man acquires the infection by eating metacercariae-infected watercress and water hyacinth.

Lung Fluke Infections

There are at least six species of *Paragonimus* in Thailand: *Paragonimus westermani, P. heterotremus, P. siamensis, P. bangkokensis, P. harinasutai,* and *P. macrorchis.* The natural hosts are felines and rats. Seven adult mature *Paragonimus heterotremus* were recovered from a 40 year old Thai farmer from Nakhon Nayok Province, central Thailand, who coughed up the worm after treatment with praziquantel (Vanijanonta *et al,* 1981).

Human paragonimiasis is prevalent in central, northern and northeastern parts of Thailand. Two endemic areas are in the central region, Saraburi Province (Vajrasthira *et al,* 1958) and Nakhon Nayok Province (Sirisumpun, 1963). In the north, there was one small focal area in Chiang Rai, the northernmost province. However, sporadic cases have been recorded scattered throughout the north and mostly from mountainous villages (C Khamboonruang, unpublished data). Recently, one endemic area has been reported from the north in Phitsanulok Province (Phanarunothai *et al,* 1988). Man usually acquires the infection from eating raw mountain stream crabs (*Potamon* and *Parathelphusa* spp.) containing metacercariae, in a favorite ethnic dish called "pla-poo".

Intestinal Fluke Infections

Intestinal flukes are one of the most important food-borne parasitic zoonoses found in the north,

northeast and central parts of Thailand. Fourteen species have been reported. The distribution depends on the presence of the first and the second intermediate hosts and eating habits of the local people.

Fasciolopsiasis

The endemic area is restricted to central Thailand where approximately 10,000 people are infected with *Fasciolopsis buski.* Pigs appear to be the only reservoir host, *Planorbid* snails the first-intermediate host, and five species of water plants are important second-intermediate hosts. The water plants are caltrops *(Trapa bicornis),* lotus *(Nymphaea lotus),* watercress *(Neptunia oleracea),* morning glory *(Ipomeoae aquatica),* and hyacinth *(Eichhornia speciosa)* (Manning *et al,* 1969). Man acquires the infection from eating metacercariae-laden nuts and vegetables.

Light infection causes diarrhea with a foul smelling feces, and heavy infection may result in malabsorption and intestinal obstruction. Metabolic products of the worms can cause intoxication and death (Daengsvang and Mangalasmaya, 1941).

Echinostomiasis

Human echinostomiasis has been sporadically recorded in Thailand, with infections caused by *Echinostoma malayanum, Hypoderaeum conoideum* (Bhaibulaya *et al,* 1964), *E.revolutum; E.ilocanum* (Radomyos *et al,* 1982, 1984), and *Episthmium caninum* (Radomyos *et al,* 1985). Ducks, rats, and dogs are natural hosts. *Planorbid* snails serve as major first- and second-intermediate hosts. Man acquires the infection from consumption of raw snails, tadpoles and fish containing the metacercariae. The disease is asymptomatic.

Plagiorchiasis

Four cases of plagiorchiasis have been found in northeastern Thailand but the species identification has not been made. In Thailand, *Plagiorchis siamensis* has been recovered from a rat (Yamashita, 1967). The infection may be acquired by eating raw snails. No typical clinical picture has been described.

Heterophyiasis

The prevalence of heterophyid fluke infection in Thailand is masked by opisthorchiasis viverrini because the eggs of the flukes are difficult to differentiate. Four species, *Haplorchis taichui, H. yokogawai* (Manning *et al,* 1971), *H.pumilio* (Rodomyos *et al,* 1984) and *Stellanthchasmus falcatus* (Klicks and Tantachamrun, 1974). have been recovered from Thais. Man acquires the infection from eating raw fresh-water fishes, especially cyprinoids. No definite clinical symptoms and signs have been described.

Lecithodendriasis

Lecithodendrid flukes *(Phaneropsolus bonnei* and *Prosthodendrium molenkampi)* were recovered from Thais in the northeastern part of the country (Manning *et al,* 1971). Man acquires the infection from eating infected naiads of the dragonfly mixed in chili paste. Rice field crabs are also second-intermediate hosts.

CESTODE INFECTIONS

Taeniasis

Taenia saginata, the beef tapeworm infection is prevalent throughout the country. It is predominantly found in the north and northeast of Thailand where the people are fond of eating raw meat. In contrast, infection due to *Taenia solium,* the pork tapeworm, is seldom found. In Chiang Mai Province, the incidence of taeniasis by stool examination was about 3% (Yamaguchi *et al,* 1982). The reported prevalence is low possibly due to an inappropriate technique used to determine the infection. Flatulence and a gurgling sound in the bowel are major complaints.

Cysticercosis

Cysticercus bovis in cattle is frequently found in slaughterhouses. *Cysticercus cellulosae* in pigs, on the other hand, is not as common as it was in the past. This may be due to the large number of commercially-raised grain-fed pigs being slaughtered. However, *C. cellulosae* is sporadically found in domestically raised pigs, illegally slaughtered in rural communities in the north.

Cysticercosis is common in man in Thailand. The cyst is frequently located in subcutaneous tissue as a small firm nodule. Symptoms and signs of cysticercosis depend on the affected organ. However, neurocysticercosis is a major cause of epileptic convulsions, and increased intracranial pressure, severe headache, nausea, and vomiting. Surgical removal of the cyst is an appropriate

treatment. Praziquantel has been used for the treatment of neurocysticercosis with steroids administered concomitantly (Kanchanapongkul, 1989). Neurocysticercosis can also be diagnosed by computerized tomography (CT scan), and sensitive and specific serological tests.

It is reported that *Taenia* in Thailand may be similar to *Taenia* from Taiwan, Korea, and Indonesia, but different from *T. saginata* and *T. solium* (Fan *et al,* 1990).

Sparganosis

The common Pseudophillidian tapeworm in Thailand is *Spirometra mansoni.* Definitive hosts are dogs and cats, with the pleurocercoid found mostly in water snakes, fishes and frogs. In human sparganosis, the larvae are almost always found in subcutaneous tissue or in tissues around the eye (Jenchitu *et al,* 1989). A case of sparganosis, in which the worm was found free in the peritoneal cavity beneath the appendicial fossa, was reported by a medical student in Chiang Mai (Khamboonruang *et al,* 1974).

Man is believed to acquire the infection from eating raw fish and frogs. Snake meat is commonly used as a poultice in traditional treatment of subcutaneous abscesses and skin ulcers and other wounds. Another possible source of transmission is drinking water containing copepods infected with procercoids.

Acanthocephala infection

Three cases of *Macracanthorhynchus hirudinaceus,* a thorny-headed worm of pigs, were reported from Thailand (Tesana *et al,* 1982). All patients were from the northeast.

Various adult dung beetles and grubs serve as an intermediate host. Man acquires the infection by eating beetles containing the infective stage or cystacanth which have not been thoroughly cooked. The thorny-head of the worm becomes embedded in the intestinal wall, producing local inflammation with eosinophilic infiltration and necrosis. Perforation of the gut at the site of attachment is common.

Pentastomiasis

Six cases of human pentastomiasis have been reported from Thailand. The nymphs were recovered during intra-abdominal surgery (Tesjareon and Loahaphan, 1986). Man may acquire the infection from eating raw snake meat.

CONCLUSION

Thais are exposed to a variety of animal parasites through the eating of animals and animal by-products. Despite the availability of methods for prevention and control, deeply rooted sociocultural practices and traditions often defy any change, even one aimed at improving health and well being.

Lack of adequate information on epidemiology, diagnosis, treatment and prevention and control are important in the control of food-borne parasitic zoonoses. During the days ahead, we will discuss and share our common problems with the purpose to formulate a series of recommendations for research aimed at solving the problems in the food-borne parasitic zoonosis. Our ultimate goal, consistent with the WHO recommendation of "Health for all by the Year 2000", will be to create communities that enjoy a better quality of life.

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