Studies on Genetic Resistance to Infectious Diseases of Small Ruminants in Southeast Asia

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ABSTRACT

Disease caused by helminths is a constraint on production of sheep and goats in Southeast Asia. Lost production and increasing resistance to anthelmintics have resulted in the initiation of several research programs, in Indonesia, Thailand and the Philippines, to investigate breeding approaches to helminth control. These programs are focussing on differences in worm numbers between breeds and on the potential for humoral and cellular immune responses to be used as alternative selection criteria. The major problems encountered in this work are firstly, the reluctance of scientists to accept that breeding has a role in worm control and secondly, in assembling the relatively large flocks required for genetic studies.

Southeast Asia, including China, with a human population of about 1.6 billion has 120 million sheep and 114 million goats (Table 1) (FAO 1992). The region possesses various indigenous breeds of small ruminants. Several exotic breeds have been imported for improving the local stock. Disease resistance has not been included in breeding programs and few reports on disease

Table 1 Sheep and goat (in thousands) and human population (in millions) in Southeast Asian countries (FAO 1992).

Country	Sheep	Goat	Human
Philippines	30	2132	62
Indonesia	5900	11250	184
Malaysia	206	332	17
Thailand	162	121	54
Cambodia	NA	NA	8
Laos	NA	139	4
Vietnam	NA	413	66
Burma (Myanmar)	276	1036	41
China	113508	98313	1153
Total	120082	113736	1589
% of world population	10.1%	19.1%	30%

NA=Not available.

resistance in small ruminants in Southeast Asia exist. Recently, some work has been initiated in Malaysia, Indonesia, Thailand and the Philippines to study aspects of general resistance, or resistance to specific disease agents, of small ruminants. This paper reports some of the activities of these programs. Most of the research is targeted towards helminths as they cause major problems in the hot humid climate of the region.

Malaysia

A research program to develop a synthetic hair sheep by crossbreeding wool sheep with hair sheep started in Malaysia in 1990. The hair sheep used is the 'Cameroon', which belongs to Djallonke breed of West Africa. Preliminary studies indicate that cross-breeds perform better and have some reproductive advantage over local wool sheep (Horst et al. 1992). Disease resistance is one aspect of this program.

Effect of breed on natural infections with nematodes and coccidia

Gastrointestinal nematodes, mainly *Haemonchus contortus*, are major constraints in all age groups of sheep. In young animals, especially those in a zero grazing system, coccidia are also common but their real impact on health and production has not been investigated in detail.

Weaned lambs of local longtail wool sheep and their crosses with Cameroon were monitored for nematode eggs and coccidia oocysts in faeces over a period of 9 months (Pandey and Sivaraj 1992). Analysis of data showed that crossbreds were more resistant to *H. contortus*, the predominant nematode species present, than the local wool sheep lambs. However, oocyst counts in crossbred sheep were higher than in local sheep. Coccidia is a self-limiting infection and within a few weeks their numbers were reduced to a very low level of insignificant importance. Further studies are under way to confirm these preliminary findings.

Immune response of different breeds/genotypes of sheep

Phenotypic markers of general disease resistance have proved useful in a selection index to breed pigs for disease resistance (Mallard et al. 1993). Humoral and cellular immune responses and complement have been studied in different breeds/genotypes of sheep in Malaysia to assess their suitability as markers for disease resistance.

Humoral immune response

Humoral immune responsiveness of three genotypes of sheep, namely local longtail wool sheep (LL), Cameroon (C) and C × LL, was assessed by measuring the haemagglutinating antibodies after two intravenous injection of

chicken red blood cells (CRBC), on day 0 and day 14. Although the titres of antibodies of three genotypes were not significantly different, there were big variations in the titres of individuals within a genotype. This suggests genetic variation in the response to CRBC.

Cellular immune response

Five genotypes of sheep were examined for *in vivo* response to the mitogen, phytohaemagglutinin-P (PHA-P) by intradermal injection and measurement of double skinfold thickness before and 24 hours after injection. The effect of genotype on skin thickness was highly significant ($p<0.001$). The genotypes could be classified in ascending order of response as follows (Pandey and Sivaraj 1992): local longtail (LL), Cameroon × LL, Cameroon (C), Dorsimal (DM) (a cross of Poll Dorset Horn × Malaysian indigenous sheep), C × DM.

Complement

Complement is a non specific element in the defence mechanism against infections and therefore is of interest in disease resistance studies. Complement levels measured by classical pathway (CPW), alternative pathway (Pandey and Sivaraj 1993) and C_3 molecules, as well as C_3 activity, were examined from 12 genotypes of sheep in Malaysia. There were significant differences ($0.005<P<0.05$) between genotypes. The significance of such differences needs to be evaluated in relation to disease resistance. It may be postulated that animals with higher levels of complement would be able to respond better to infections.

The practical implications of the differences in immune response or complement level in breeding for disease resistance merit investigation through selection and challenge infections.

Indonesia

Javanese thin-tailed sheep were experimentally infected with *Fasciola gigantica* and their response studied for up to 16 weeks post infection by Wiedosari and Copeman (1990). Based on the susceptibility to infection, as indicated by percentage take of metacercaria, and the severity of pathological changes, these authors concluded that Javanese thin-tailed sheep have a higher innate resistance to *F. gigantica* than other breeds studied elsewhere such as Merino, Corriedale, Sudanese desert sheep and African dwarf sheep.

Recently, a research program has been initiated in Sumatra, Indonesia in which breeding of sheep for disease resistance is one of the objectives. Sumatra (a breed similar to Malaysian indigenous breed), Java fat-tail and

two exotic hair sheep, Virgin Island (St. Croix) and Barbados Blackbelly are being used. Some of the results obtained so far are presented in this monograph (Gatenby, this volume).

Thailand and the Philippines

As gastrointestinal nematodes are one of the major constraints in small ruminant production in Southeast Asia, a study was initiated in 1993 to evaluate the breeds or genotypes of goats in the Philippines and Thailand.

In southern Thailand, local indigenous goats and their crosses with Anglo Nubian goats with 25%, 50% and 75% Anglo Nubian blood, are initially being studied under natural infection on pastures. These studies would permit comparison of different genotypes and the identification of individuals with high or low susceptibility to nematodes. At a later stage, it is hoped to establish lines of resistant and susceptible goats since this would allow the detailed study of mechanisms involved in helminth resistance; and the subjective breeding of goats resistant to helminths.

In northern Philippines, studies with objectives similar to those of Thailand are being made on local, indigenous goats.

General Remarks

The main difficulty in such studies is the availability of large numbers of animals for initial studies from which nucleus flocks of resistant or susceptible animals can be created. Furthermore, such breeding studies require a relatively long time frame, which implies the creation of suitable infrastructure and qualified manpower committed to these programs for long periods. Another problem is the reluctance of the scientific community and decision makers to invest in long term activities for breeding of genetic resistance to diseases. Recently, anthelmintic resistance in sheep and goats has been recognised to be a serious problem in Malaysia (Pandey and Sivaraj 1993, 1994; Sivaraj et al. 1993, 1994; Dorny et al. 1993; Sivaraj and Pandey 1994). Similar problems may be encountered in other Southeast Asian countries especially in the hot, humid climates prevailing in the region. Research on breeding for disease resistance needs to be encouraged. Vigorous scientific and public relations activities need to be undertaken with regional and international collaboration.

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