

Symposium 9

Status of pathogenic sarcoptic and demodectic mites

9.1. ORIGIN, VARIABILITY AND ADAPTABILITY OF *SARCOPTES SCABIEI*

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INTRODUCTRION

Scabies has been known since antiquity, however the causative agent of the disease was only discovered in the seventeenth century by Bonomo (in 1687) who succeeded to remove the parasite from the burrow of an itchy patient (Parish 1977). Sarcoptic scabies remains widespread and a common disease of man and domestic animals.

Since about 1963 there has been an increase in scabies in many parts of the world, to epidemic proportions in some areas (Orkin et al. 1977). At the same time the number of infested people has increased, scabies lost its classical aspect and became more atypical and therefore more difficult to recognize. One of the most frequent of these atypical forms is the "scabies of the cultivated" which is observed in well kept homes, nursing homes and hospitals! It appears to have evolved with a minimum of symptoms and the burrows are frequently lacking. However, in spite of its mild aspect this form is contagious. Another atypical aspect of scabies is the "nodular form" characterized by the occurrence of reddish brown pruriginous nodules. These nodules may persist for several months. They rarely contain mites (Orkin 1975).

The causes of the resurgence of scabies are probably multiple. One of the most important seems to be the relaxation of standards of personal hygiene and the mass gatherings of disaffected individuals. Other causes are increased travel, importation of itinerant workers and migration of people from infested countries. Some authors surmise that scabies has a 15-year cycle and that the resurgence of the disease is in relation with the periodic loss of immunity in man (Orkin et al. 1977).

VARIABILITY OF *SARCOPTES SCABIEI*

More than 30 species or subspecies have been described in the genus *Sarcoptes*. According to Fain (1968), all these "species" are based on variable morphological characters without taxonomic value and there is only one valid, but variable species, *Sarcoptes scabiei*. Variability becomes evident if one examines a series of about 20 specimens obtained from a human or an animal strain of scabies.

Variability is more marked in the female mites than in the males or the immatures. It does not involve all the morphological characters but only some of them. The most important variable characters in the female are the following: the extent and the size of the cuticular scales on the dorsum and on the ventrolateral regions of the body, the shape of the anterodorsal shield, the size of the body and the length of the dorsal hairs. The dorsal field of scales is either complete or presents a bare area.

Among all these characters the most useful in the estimation of the variability is the extent of the cuticular scales on the dorsum and on the ventrolateral regions of the body. By using this character one may divide all the known strains of *S. scabiei* into 3 main groups (Fain 1968, 1978):

In the first group the bare area in the dorsal field of scales is present in most or in all the specimens of the strain. This group contains strains without ventrolateral scales (all the strains from man, camel, dromedary, peccary, gibbon, etc.) and strains with these ventrolateral scales in all the specimens (strains from domestic and wild pigs) or in some specimen strains from a chimpanzee, *Pan paniscus*, a tapir from Vienna zoo, some African antelopes, a goat from South Africa, horses from the U.S. and South Africa.

The second group includes strains with most of the specimens lacking a bare area in the dorsal scale field. Some of these strains are completely devoid of ventrolateral scales (strains from cattle in Belgium and Holland) while other strains have these ventrolateral scales in all the specimens (all the strains from dogs, ferrets, foxes, mountain dogs, polecats, llamas, sheep and goats from Austria, chamois and red deer) or in almost all the specimens (strains from horses from Mayaguez and from Holland, wombats, chimpanzees, *Pan troglodytes*).

The third group includes strains with characters intermediate between those of the two former groups. They probably are unstable strains in the process of adaptation to a new host (strains from a coatimundi, a tapir from the Washington zoo, rabbits from France).

One may distinguish several types of variability. The different specimens of the same strain may differ greatly by some of their variable characters (individual variability). Variability becomes evident when one compares the strains obtained from two different host species, i.e. man and dog (host variability). Some strains obtained from the same host species but from different countries may be morphologically different in their variable characters (geographical variability).

MECHANISM OF ADAPTATION OF *S. SCABIEI* TO VARIOUS HOSTS

From the study of the strains obtained from various hosts and in different countries, one may draw the following conclusions (Fain 1968, 1978):

1. Each strain is a combination of "variants", i.e. specimens that vary slightly from each other by one or several variable characters.
2. The strains parasitizing the different hosts differ from each other by a different proportion of these variants (e.g. the size of the bare area and the presence or the absence of the ventrolateral scales). For example, the human strains differ from the dog strains by the presence in the former of a bare area in the dorsal field of scales and the complete absence of ventrolateral scales. In the dog strains there is no bare area in the dorsal field of scales and the ventrolateral scales are almost always present.
3. Each host group (man, dog, pig, etc.) harbors strains with a definite combination of these variants which is morphologically adapted for these hosts.
4. Each strain of *S. scabiei* is probably able to infest successfully any host group simply by a process of natural selection of its variants, so that it becomes morphologically similar to the strain that normally infests this host species (Fain 1968). This adaptation may require several generations before it is completed and one may surmise that in some cases the mite is rejected before the adaptation has succeeded. Possibly this adaptation is facilitated by some pathological conditions of the host causing a lowering of the immunity (malnutrition, some immunodepressive diseases) or by some immunosuppressive treatments.

INFESTATIONS OF MAN WITH ANIMAL STRAINS OF *S. SCABIEI*

It is well known that man may become infested by *Sarcoptes* from domestic animals. In most of these cases the infestations are self limiting but in some patients, however, the lesions may persist for a long period. The *Sarcoptes* strains that infest man most frequently are those of the dog, but strains from other animals (i.e. camel, dromedary, horse, goat, pig, sheep, chamois, ferret, fox and llama) have also been reported in man but more rarely.

Human scabies caused by the *Sarcoptes* of the dog is sometimes epidemic (Emde 1961, Charlesworth and Johnson 1974). When the infestation is contracted from pet dogs, the eruption is located on the areas that have been in contact with the pet.

All the strains from dogs and other carnivores may easily be recognized from the human strains by the presence of the ventrolateral scales and the absence of a bare area in the dorsal field of scales. It is interesting to note that the few strains that we were able to obtain from patients recently infested by scabies of pet dogs presented all the characters of typical dog scabies strains, which indicates that the morphological adaptation of the mite to a new host, by selection, may take some time (Fain 1968).

VARIABILITY OF THE HUMAN STRAIN OF *S. SCABIEI*

As it has been noted above, the human strains of *S. scabiei* are devoid of ventrolateral scales and they present a bare area in the dorsal field of scales. This bare area may vary in size according to the origin of the strain. In the strains from common scabies this bare area is moderately developed while in the strains from the crusted (Norwegian) scabies this bare area is generally much larger. We have surmised that the development of the scales on the dorsum of the female is in relation to the presence of burrows in the host. The scales probably allow the mite to remain and to progress in its tunnel during the process of burrowing. We may also suppose that they contribute to retention of the mites in the skin during scratching. In the absence of burrows or itching, as is the case in some crusted scabies, the scales are no longer useful and may tend to disappear (Fain 1968).

ORIGIN OF *SARCOPTES SCABIEI*

The wide variability of *S. scabiei* suggests that this species is not yet completely adapted to any of the existing hosts but remains in a continuous process of adaptation (Fain 1968, 1978).

The exact causes of such instability is not known but we have suggested that it is in relation to the great number of hosts that the mite is able to parasitize. Actually more than 40 different hosts belonging to 17 families and 7 orders of mammals have been found infested by this mite.

The unique position of *S. scabiei* among the other parasitic mites may be explained by the phylogeny of this mite. I have shown that the subfamily Sarcoptinae includes the most highly evolved genera of the family Sarcoptidae, i.e. *Prosarcoptes*, *Cosarcoptes* and *Pithesarcoptes* from monkeys, *Trixacarus* from rodents and *Sarcoptes* from man and domestic mammals. I have proposed the hypothesis that *Sarcoptes* has been derived from an ancestral form of one of the three genera parasitic on monkeys. I believe that man is the primary host for *S. scabiei* and that domestic mammals acquired this mite from humans. To adapt to these new hosts the mite developed new morphological characters but these never became sufficient to prevent occasional interbreeding with strains from other animals or man. Probably the frequent interbreeding of the mite in zoologically remote mammals has on the one hand prevented speciation and on the other hand provided new genetic characters which have enhanced the adaptability of the mite to infest other hosts.

An argument in favour of the hypothesis that man is the primary host of *S. scabiei* is the fact that this mite is very rarely found in wild mammals living in their natural habitat. The only exceptions are those of the wild carnivores (foxes, wolves) which may have become infested by preying on domestic animals and those of some wild herbivores, probably contaminated by infested cattle.

The variability of *S. scabiei* might therefore be considered as the result of the continuous interbreeding of strains infesting man and domestic mammals.

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