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SELECTION FOR DISEASE RESISTANCE IN GOATS

Remya John V.[1] and Raghavan K.C.[2]
Centre for Advanced Studies in Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Thrissur

Introduction

Goat rearing plays a major role in the rural economy of India. In India, during the last 40 years, the goat population rose by 140% and goat emerged as a major livestock species. Diseases have always been a major problem in goats, limiting returns from goat rearing. Diseases causing heavy losses in goats include PPR, foot and mouth disease, goat pox, enterotoxaemia, contagious caprine pleuropneumonia, anthrax and fascioliasis. The losses due to diseases in goats scaled at national level were estimated at Rs. 11,720 million per annum (Kumar et al., 2003).Therefore, preventive measures to control disease incidence in goats are essential. The purpose of this paper is to discuss the selection methods for improving genetic resistance to diseases in goats.

Need for selection for disease resistance

Eradication is the ideal solution for any disease. But eradication is not practical for all diseases and many pathogens, can not be completely eradicated. So, the chief defenses employed against pathogens are: vaccination, management measures and use of pharmaceuticals. The first two of these measures are highly beneficial with many advantages, although they are not effective against all pathogens. In contrast, the use of pharmaceuticals which is currently the dominant method of preventing and treating disease carries several major disadvantages such as high cost of treatment and food safety and food quality issues due to drug residues. Development of drug resistant strains and evolution of new drugs with more potential requires extensive research, which impose great economic burden. Use of pharmaceuticals reduces the selective advantage of natural resistance of animals creating generations of animals with deceased immunity and increased susceptibility. Hence, we need to focus attention on selection for disease resistance ie selection of animals immune to diseases. Before going in for selection for disease resistance we should have an idea about the immune mechanisms in the body which protect animals from diseases.

Immunity to diseases

Immunity to disease is conferred by two types of immunity ie innate and acquired immunity. Innate immune response is the first line of defense against pathogens. It includes skin, mucus and acidic secretions, lysozyme in tear and sweat etc. This immunity is non-specific in nature and control the susceptibility or resistance of an animal to acquisition of an infection. Acquired immunity is governed by the interaction of three sets of receptors viz., major histocompatibility antigen, T cell receptors and B cell receptors.

Antigens which enter mammalian body are exposed to a variety of degrading processes which are called antigen processing. After this, the antigen attach to receptors present on the antigen presenting cells such as macrophages, dendritic cells etc. Major histocompatibility molecule is such a receptor present on the antigen presenting cells. The attachment of the antigen to this receptor is essential to present the antigen to T cells and this, inturn is required to activate T cell receptor and production of immunity to that antigen.

Selective breeding to increase disease resistance

Selection for disease resistance can be done in two ways that include selection based on performance and selection based on indirect approaches.

a) Selection based on performance

Selection based on performance can be done under normal environment or under challenging environment or by using index method.

- *Selection under normal environment*: It is the simplest method of selection for disease

1. P.G.Scholar, 2. Professor

resistance. Here we select animals that are not expressing disease under normal production conditions. This method would have no negative effects on production of breeding stock as they are not exposed to disease challenge. But, it probably would not be informative, because absence of disease may not be entirely due to genetic resistance but good hygiene and management might have played an important role. In that case expression of disease resistance would be questionable. More over, the calculation of breeding value may be biased due to incomplete recording of disease incidence. Also it is difficult to attain uniformity for selection as the disease might be caused by different factors in different environments.

♦ *Selection under challenging environment*: This is done either by exposing the breeding stock or the sibs/ progeny to disease causing agents and then selecting the resistant animals. Accuracy of selection would be limited unless sufficient number of sibs or progeny is tested. The main drawback of this method is that it cannot be used if death results from a particular disease. Here, the production of animals could be adversely affected. Another problem is the difficulty in standardization of the level of exposure to a particular disease. This method will be a failure in the economic point of view if there is negative correlation between production traits and disease resistance traits.

♦ *Index method*: Here, production as well as disease resistance traits are considered simultaneously, weighted by their relative economic values. The relative economic value of disease resistance is calculated from the economic loss due to diseases which includes reduced yield, milk discarded due to antibiotic treatment, premature loss of animals, cost of drugs and veterinary services and reduced genetic gain.

b) Selection using indirect approaches

Indirect approaches include, using marker traits or by using physiological markers or using molecular markers.

♦ *Marker traits for genetic improvement*: Marker trait is a trait that has high genetic correlation with the disease trait. eg: Somatic cell count for mastitis. An increase in the somatic cell count indicates the high susceptibility to mastitis. Marker trait may be inherited quantitatively or qualitatively. Marker trait will be more useful if it has a higher heritability than the disease trait and it can be measured early in life in both males as well as females. It should also be able to indicate sub clinical variations in disease.

♦ *Physiological markers*: They include measures of immune system function based on laboratory testing of immune cell function in blood samples. The main disadvantage is that variation in the physiological markers can be caused by both genetics and environment.

♦ *Molecular markers*: In the world of goat production, a good method to identify animals by using faster and more reliable methods is of utmost importance in order to obtain accurate selection. Because of the negative effects of indiscriminate crossbreeding programmes, there is urgent need to prevent rapid erosion of animal genetic resources. This is especially true for goat breeds in developing countries where many will be lost without ever having been adequately characterized and studied. However, such breeds may still be a valuable source of major genes for disease resistance.

The most reliable and accurate method of selection for disease resistance is the selection based on molecular marker. A molecular marker is a gene or DNA sequence with a known location on a chromosome and associated with a particular gene or trait. It can be described as a variation, which may arise due to mutation or alteration in the genomic loci that can be observed. These differences may be related to genetic differences in disease resistance traits. Selection based on these molecular markers [Marker Assisted Selection (MAS)] is likely to complement rather than replace the conventional breeding systems, leading to increased rate of genetic improvement through higher selection intensity, reduction of generation interval and increase in the accuracy of prediction.

Advantages of molecular markers

♦ Can be measured on both sexes

♦ Eliminate the need to record disease incidence

♦ Allow identification of disease resistant

animals early in life

♦ Give indication of resistance to many diseases at a time

The association between the markers and the Quantitative Trait Loci (A quantitative trait loci are stretches of DNA that are closely linked to the genes that underlie a trait) for disease resistance is a function of distance between the markers and target traits, type of linkage phase, and degree of linkage disequilibrium. Therefore, a high-density gene map ("Gene mapping" refers to the mapping of genes to specific locations on chromosomes) with closer linkage (Genetic linkage occurs when particular genetic loci for different genes are inherited jointly. Genetic loci on the same chromosome are physically close to one another and tend to stay together during meiosis, and are thus genetically linked) is a pre-requisite for successful implementation of MAS. The most important requirement for molecular biological approach is the identification of genes with the ability to influence disease resistance. The Caprine Major Histocompatibility Complex, called the Caprine Leucocytic Antigen (CLA) is one of these genetic systems with a major influence on individual immuno-competence and therefore of primary importance for such investigations in goats.

'CLA' and disease resistance

Caprine Leucocytic Antigen (CLA) is a highly polymorphic system of genes, products of which function as receptors to present peptide fragments of antigen to T cells, as we discussed earlier. Polymorphism in the 'CLA' genes results in the variation in the shape of the peptide binding groove of the MHC molecule. This variation is associated with change in the processing ability to different antigens, which in turn results in variation in the immunity and differences in the disease resistance among members of a goat population.

Disease associations of 'CLA'

'CLA' is a gene complex which contains several genes viz. DQ, DR, DY etc. In each of these genes, there are alpha (A) and beta (B) divisions. There are several examples in which association has been found between these genes and disease resistance. In goat, internal parasitism is a great problem. Studies have shown that CLA is associated with resistance to internal parasites. Polymorphism (occurrence of more than one form) in DYA and DRB loci of CLA is found associated with variations in faecal egg counts which show that DYA has a role in parasitic resistance. DQA2 locus of MHC with 31 identified alleles (different forms of a gene) has an association with relative risk of contracting foot rot. Susceptibility to Caprine Arthritis Encephalitis is also linked to CLA.

Conclusion

Breeding programme for goat, generally operate within an industry that is based on low levels of resource inputs. In developing countries like India, selective breeding based on performance recording is often absent. In this regard, selection using molecular markers in goats is a great challenge. The basic requirement for selection using molecular markers is the unraveling of the genome map of goats. In the light of these developments, let us hope that selection for disease resistance will be realised in India in the near future.

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