The hitherto existing selection of domestic animals for increased production has resulted in some serious disease problems in the herds. As a consequence attempts of breeding domestic animals that can withstand ordinary levels of exposure to infectious diseases have been renewed. The knowledge that the biological fitness of domestic animals to cope with their environment, including infectious diseases, can be greatly increased by selective breeding, is not new. The basis for previous selection experiments on disease resistance, however, has always been the infection experiment: animals surviving natural or artificial infection formed the basis for selection. Stimulated by the results obtained with small laboratory animals (BIOZZI et al. 1979, BUSCHMANN and MEYER 1981) we started to investigate the use of immunological parameters that can be easily measured in living animals as basis for future selection experiments on disease resistance in pigs.

Institut für Med. Mikrobiologie, Infektions- und Seuchenmedizin, Tierärztl, Fakultät, Universität München, D-8000 München 22
The resistance against infectious diseases is regulated by several gene systems in mammals. Most important are gene clusters associated with the major histocompatibility locus, the gene products of which are manifested as transplantation antigens and immune-associated antigens (Ia antigens). Also the function of the complement system is regulated by these genes. Other immune response genes (Ir) are determining the structure of the immunoglobulins (allotype, idiotype) and are found even on the X-chromosome of the mouse.

If immunological parameters should serve as basis for selection at first the genetically determined variation of the parameters in question must be studied. In previous studies (BUSCHMANN, KRAUSSLICH, RADZIKOWSKI, ALTSTÄDTEN 1974) we found significant breed differences in the activation of the glucose metabolism during phagocytosis of particles (killed bacteria and Latex particles) in the blood leucocytes of 254 male pigs from 9 different breeds. The ranking of the breeds correlated highly with the ranking of the same breeds according to their immune response to sheep erythrocytes (BUSCHMANN, JUNGE, KRAUSSLICH and RADZIKOWSKI 1974).

Breed differences were also seen in pigs when the immune response to dinitrophenylated bovine serum albumin (DNP-BSA) was measured (BUSCHMANN, RADZIKOWSKI, KRAUSSLICH, SCHMID and CWIK 1975). The genetic determination of the anti-DNP response in pigs could be verified in a selection experiment over 5 generations.

The main results of this selection experiment were:

- the antibody response to DNP hapten in pigs is determined by many genes;
- by selecting on DNP response also a correlated selection response in the antibody production against another, non related antigen (T4 phages) was observed;
- several parameters of the cellular immunity (Phagocytic capacity of PMN, stimulation of lymphocytes by mitogens, percentage of rosette-forming cells in the blood) remained unaltered;

352
- a possible correlation between the anti-DNP antibody forming capacity and the distribution pattern of serologically determined lymphocyte antigens was found.

The results of the selection experiment are in favor of the hypothesis, that the immunological parameters are regulated by several gene systems and that different gene systems are regulating the antibody-forming capacity and the parameters of cellular immunology studied. Practical animal breeding, however, is mainly interested in an overall, the whole immune system comprising increase of resistance to infectious diseases, including manifold causes of the infection, i.e. viruses, bacteria, fungi and parasites. So we started to develop an immunocompetence profile for pigs, which can be established by single tests in blood samples from the living animal and which will give as much information on the immune status as possible. This scheme may form a future basis for index selection.

By using this scheme we can determine:
- the number of leucocytes and percentage of lymphocytes in the blood
- the percentage of B and T lymphocytes in the blood (rosette formation, detection of surface immunoglobulins on lymphocytes)
- phagocytic capacity of blood granulocytes
- reactivity of the cellular immune system (stimulation of lymphocytes by mitogens)
- primary and secondary antibody forming capacity

It is most important that the sample collection and cell separation methods are standardized.
Blood sample (30 ml) is taken, following immunization with antigens (150 units tetanus toxoid and 5 mg ovalbumin + IPA).

Separation of lymphocytes (Ficoll-Isopaque)

- 1 ml = 2 x 10^6 lymphocytes
- 1 ml 5-10 x 10^6 lymphocytes
- 10 ml (3-5 x 10^6 lymphocytes per ml)

- Determination of percentage of E and EAC rosettes
- Stimulation of lymphocytes by mitogens
  - PHA, Con A, PWM, LPS
- Percentage of cells with surface immunoglobulins (fluorescence test)

- 5 ml heparinized whole blood

Measurement of the glucose-1^14C oxidation rate in leucocytes during phagocytosis of killed Staphylococcus

- Total number of lymphocytes in technique
- Serum levels of IgM against tetanus and ovalbumin

Reimmunization with the same antigens w/o adjuv.

SUMMARY

Due to their high genetic determination immunological parameters are suitable as selection criteria for breeding animals resistant to infectious diseases. Selection on one immunological parameter alone, however, will be of limited value only due to the existence of a network of cellular and humoral factors influencing host resistance and due to the multiplicity of invading microorganisms. So we tried to develop an immunocompetence profile for domestic animals, which can be established by simple immunological tests and which should provide as much information on the immune status as possible. Such an immunocompetence profile may be of value for future...
selection experiments on disease resistance in domestic animals.

RESUMEN

Debido a su elevada determinación genética, los parámetros inmunológicos son apropiados para los criterios de selección con respecto a los animales mejorados resistentes a las enfermedades infecciosas. La selección sobre un parámetro inmunológico sólo, no obstante, será de limitado valor debido a que existe una amplia gama de factores celulares y humorales que ejercen su influencia sobre la resistencia del huésped, y también a la multiplicidad de microorganismos invasores. Los autores han tratado de desarrollar un perfil de inmunocompetencia para animales domésticos, que puede establecerse por simples pruebas inmunológicas y que proporcionarán bastante información sobre el estado de inmunidad en la medida de lo posible. Tal perfil de inmunocompetencia puede ser valioso para experimentos futuros de selección frente a la resistencia a las enfermedades de los animales domésticos.

Literature


Buschmann, H., H. Kräußlich, A. Radzikowski and W. Altstädten. 1974. Variation of the phagocytic activity as measured by the 14C glucose oxidation rate in whole blood of pigs from several breeds. Z. Immunforsch. 147, 148.
