DISEASE RESISTANCE IN INDIGENOUS COWS

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The indigenous cows, scientifically called as *Bos indicus* or Zebu cattle, mainly seen in Indian subcontinent. Different hereditary characteristics of breeds and even types within a breed have resulted in difference in reactions to environmental stimuli. These reactions are intimately associated with anatomical-physiological characteristics, which have developed as the result of natural selection. Indigenous breeds, as the name suggests, have been identified with a particular area or people from time immemorial and are thus considered to be adapted to some of the environmental stresses. The degree of successful adaptation of such animals is accurately reflected in their ability to grow, to reproduce regularly and in their production.

Indian breeds of cows are also developed in thousands of years of evolution process and are well adapted in diverse geoclimatic conditions of the country. As a result these breeds are able to survive even in harsh dry and hot environment of Rajasthan on one side and in wet and cold climate of hilly areas of Uttarakhand without much management requirements. In order to understand the resistance of indigenous cattle breeds, it is better to have an idea of immunity/ resistance in animals.

Immunity is the resistance of body against extraneous etiological factors of disease, which is afforded by the interaction of chemical, humoral and cellular reactions in body. This is an integral part of the body without, which one cannot think of life. During the process of evolution, nature has provided this defence mechanism in body of all living creatures particularly of higher animals and man that protects them from physical, chemical and biological insults. It can be classified as natural/paraspecific and acquired/specific immunity.

**Natural/ paraspecific immunity**

There are some species resistant for a particular disease due to presence of natural resistance against them *e.g.* Horse, pig, cat are resistant to canine distemper virus; dogs are resistant to feline panleucopenia virus, chickens are resistant to anthrax. Even within species, there is natural resistance that protects some individuals while others are susceptible *e.g.* Indian Deshi (Zebu) cattle (*Bos indicus*) is quite resistant to piroplasmosis in comparison to *Bos taurus*. Besides, there are the mechanisms or barriers in body provided by nature, which are:

- **Skin and mucous membrane** prevent organisms from gaining entrance in body
- **Mucous** prevents from infections by trapping and keep them away.
- **Saliva, gastric juice and intestinal enzymes** kill bacteria
- **Tears, nasal and GI tract secretions** are bactericidal due to presence of lysozymes.
- **Phagocytic cells** such as neutrophils and macrophages kill bacteria through phagocytosis.
- **Natural antibodies** acts as opsonins and helps in phagocytosis.
- **Interferons** have antimicrobial properties. They are host/species specific and arrest the viral replication.
- **Interleukins, cytotoxins and growth factors** stimulate the immune reactions and inflammation
- **Natural killer cells** kill targets coated with IgG.
Acquired/specific Immunity

Acquired immunity develops in the body as a result of prior stimulation through antigen. It is specific to a particular antigen against which it was developed. It can be restimulated on second or subsequent exposure with antigen and thus, it has memory for a particular antigen. It differs from natural immunity in respect of prior stimulation, specificity and memory. It can be classified as humoral and cell mediated immunity. The immunity present in fluids of body mainly in blood. There are antibodies in serum of blood, which protect body from diseases. It is specific to particular antigen. Antibodies are formed in blood as a result of exposure of the foreign substances including bacteria, virus, parasite and other substances.

Antigen is foreign substance, which is able to stimulate the production of antibodies in body. They may be of high molecular weight protein, polysaccharides, and nucleic acids. Simple chemicals of low molecular weight are not able to induce immunity. However, they may be conjugated with a large molecular weight molecules such as protein then they become antigenic and induce antibody production, such substances are termed as haptens.

Antibodies are protein in nature present in serum and produced as a result of antigen. Antibodies are specific to antigen. Most of the microorganisms have several antigenic determinants and antibodies are produced against each antigenic determinant specifically. The antibody response to antigen can be enhanced if the antigen is released slowly in body. There are several substances like oils, waxes, alum, aluminium hydroxide, which may be added with antigen so that it is released slowly in body to increase the antibody production. Such substances are known as adjuvants. Antibodies are also known as immunoglobulins as they are the part of globulins.

Immune response

The antigen when enters in body of animal is trapped, processed and eliminated by several cells including macrophages, dendritic cells and B-cells. There are two types of antigen in body i.e. exogenous and endogenous. The exogenous or extra cellular antigens are present freely in circulation and are readily available for antigen processing cells.

The endogenous or intracellular antigens are not free and are always inside the cells such as viruses. But when these viruses synthesize new viral proteins using biosynthetic process of the host cells, these proteins also act as antigen and are termed as endogenous or intracellular antigens.

The processing of antigen by macrophages is comparatively less efficient as most of the antigen is destroyed by the lysosomal proteases. An alternate pathway of antigen processing involves antigen uptake by a specialized population of mononuclear cells known as dendritic cells located throughout the body specially in lymphoid organs. Such dendritic cells have many long filamentous cytoplasmic processes called dendrits and lobulated nuclei with clear cytoplasm containing characteristic granules.

Antigen presenting cells process the exogenous antigen and convert into fragments to bind with MHC class II molecules. Such processed antigen along with MHC class II molecule and certain cytokines such as IL-1 is presented to antigen recognizing cells (T-helper cells). Macrophages also regulate the dose of antigen to prevent inappropriate development of tolerance and provide a small dose of antigen to T-helper cells. However, if the antigen is presented to T-Cells without MHC class II molecule, the T cells are turned off resulting into tolerance. On an average, an antigen presenting cell possesses about $2 \times 10^5$ MHC class II molecules. A T-cell require activation by 200-300 peptide- MHC class II molecules to trigger an immune response.

Thus, it is estimated that an antigen-presenting cell may present several epitopes simultaneously to T-helper cells. A counterpart of T-helper cells also exists and known as suppressor T-cells (T_s cell) which suppresses the immune response. The viral encoded
proteins, endogenous antigens are handled in a different manner from exogenous antigens. Such antigens are bound to MHC class Ia molecules and transported to the cell surface. Such antigen and MHC class Ia molecule complex triggers a lymphocytic response i.e. T-cytotoxic cells (Tc-cells). These cytotoxic T-cells recognize and destroy virus infected cells. However, there is some cross priming leading to cell mediated immune response by exogenous antigens and humoral immune response by endogenous antigens. Some lymphocytes also function as memory cells to initiate secondary immune response. On antigen exposure, there is a latent period of about four to six days and only after that serum antibodies are detectable. The peak of antibody titre is estimated around 2 weeks after exposure to antigen and then declines after about 3 weeks. During this primary immune response, majority antibodies are of IgM type whereas in secondary immune response, it is always predominated by IgG.

**Disease resistance in Indian cattle**

In the world, India is the only nation in which most of the natural environmental conditions are available within the same region. The Indian cattle breeds developed and adapted themselves under various natural circumstances. In the past, the agricultural activities were good but there was huge taxation on the farmers due to which they could not rise properly and didn't maintain themselves. Under such circumstances, the cattle could avail coolers and air conditioners in the summer or heater in the cold. There was pressure on the cattle to work in the natural geoclimatic conditions. That's why the Indian cattle breeds develop resistance against diseases, natural calamities as well as the variable environmental conditions.

Some of the disease resistance features reported in literature or experienced by author are summarized in the following Table.

<table>
<thead>
<tr>
<th>Name of disease</th>
<th>Disease Resistance in the Cattle</th>
<th>Cross bred/ Exotic breeds</th>
<th>Indian Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tick resistance</td>
<td>36.5%</td>
<td>73.8%</td>
<td></td>
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<tr>
<td>2. Theileriosis</td>
<td>Highly susceptible</td>
<td>97.84%, Resistant</td>
<td></td>
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<tr>
<td>3. Rinderpest</td>
<td>Highly susceptible</td>
<td>Low susceptibility</td>
<td></td>
</tr>
<tr>
<td>4. Anaplasmosis</td>
<td>Highly susceptible</td>
<td>Resistant</td>
<td></td>
</tr>
<tr>
<td>5. Piroplasmosis</td>
<td>Highly susceptible</td>
<td>Resistant</td>
<td></td>
</tr>
<tr>
<td>6. Heat Resistance</td>
<td>36°C</td>
<td>More resistant, till 40.5°C</td>
<td></td>
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<td></td>
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<td>7.</td>
<td>Cold resistance</td>
<td>Susceptible to diseases in freezing temperature</td>
<td>Resistant upto freezing point</td>
</tr>
<tr>
<td>8.</td>
<td>Solar Radiation Resistant</td>
<td>Highly susceptible</td>
<td>Highly resistant</td>
</tr>
<tr>
<td>9.</td>
<td>Cancer Eye</td>
<td>Susceptible</td>
<td>Resistant</td>
</tr>
<tr>
<td>10.</td>
<td>Trypanosomosis</td>
<td>Less resistant</td>
<td>More resistant</td>
</tr>
<tr>
<td>11.</td>
<td>Hot tropical humid and sub tropical dry conditions</td>
<td>Less resistant</td>
<td>More resistant</td>
</tr>
<tr>
<td>12.</td>
<td>Abortion (Brucellosis)</td>
<td>Frequent</td>
<td>Rare</td>
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<td>13.</td>
<td>Black Quarter</td>
<td>Less Resistant</td>
<td>More Resistant</td>
</tr>
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<td>14.</td>
<td>Foot and Mouth Disease</td>
<td>Less Resistant</td>
<td>More Resistant</td>
</tr>
<tr>
<td>15.</td>
<td>Haemorrhagic Septicaemia</td>
<td>Highly susceptible</td>
<td>More Resistant</td>
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<tr>
<td>16.</td>
<td>Gastro intestinal parasites</td>
<td>Less Resistant</td>
<td>More Resistant</td>
</tr>
<tr>
<td>17.</td>
<td>Babesiosis</td>
<td>Susceptible</td>
<td>More Resistant</td>
</tr>
<tr>
<td>18.</td>
<td>Insect resistance</td>
<td>Susceptible</td>
<td>More Resistant</td>
</tr>
<tr>
<td>19.</td>
<td>Survival Rate under Indian conditions</td>
<td>40%</td>
<td>80-90%</td>
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<tr>
<td>20.</td>
<td>Resistance to BHV-1 Infection (IBR)</td>
<td>27.3%</td>
<td>78.6%</td>
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<tr>
<td>21.</td>
<td>Resistance to Post Parturient Diseases</td>
<td>71.4%</td>
<td>94.1%</td>
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<tr>
<td>22.</td>
<td>Resistance to rotavirus infection in calves</td>
<td>Highly susceptible</td>
<td>Highly resistant</td>
</tr>
<tr>
<td>23.</td>
<td>Retention of Placenta</td>
<td>63.3%</td>
<td>76.7%</td>
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<tr>
<td>24.</td>
<td>Horn Cancer in Bullocks</td>
<td>Susceptible</td>
<td>Susceptible</td>
</tr>
</tbody>
</table>

During their evolution Indian cattle (Bos indicus) have acquired genes that confer thermo-tolerance at the physiological and cellular levels. Indian cattle breeds are better able to regulate body temperature in response to heat stress than are cattle from a variety of B. taurus breeds of European origin. Moreover, exposure to elevated temperature has less deleterious effects on cells from zebu cattle than on cells from European breeds. Superior ability for regulation of body temperature during heat stress is the result of lower metabolic rates as well as increased capacity for heat loss. As compared to European breeds, tissue resistance to heat flow from the body core to the skin is lower in zebu cattle while sweat glands are larger. Properties of the hair coat in zebu cattle enhance conductive and convective heat loss and reduce absorption of solar radiation. At the cellular level, genetic adaptations to resist deleterious effects of elevated temperature result in pre-implantation embryos from zebu being less likely to be inhibited in development by elevated temperature than are embryos from European breeds. Besides, all the above properties, there are some of the common qualities in our pure breeds. Their skin is having sweat and sebacious glands which secrete an oily fluid act as repellent to the insects and mosquitoes. It also decreases the rate of infections. In case of chlamydial abortion, Johne’s disease, babesiosis, tuberculosis, mycoplasma, leptospira, brucella pneumonia and diarrhoea, our native breeds show better resistance. The globulins level in the blood of pure Indian breeds is more while creatinine level is less than that of the cross or exotic breeds.

The antibiotics and/or vaccines show their positive actions. However, if the animal is immunodefficient either due to genetic makeup or as a result of environmental factors, antibacterial drugs do not give full results. As most of the antibacterial drugs are bacteriostatic in nature, they do not kill the bacteria rather they check their growth and bacteria have to be killed by macrophages through phagocytosis. Similarly, vaccines do not mount protective immune response in immunologically weak animals and thus, disease
outbreaks occur inspite of vaccination. As such, even if we have therapeutics and preventables to protect animals from various diseases, the primary requirement of disease prevention remains on the ability of animal’s immunity.

Indigenous cows show resistance to many diseases and under field conditions they are quite refractory to several infectious diseases. On the other hand besides milk, they also provide “Panchgavya” which is utilized as immunomodulator and thus they are much more useful than any other animal under Indian conditions particularly for organic farming.

References


