CHAPTER 8
Summary and Conclusion

India is gifted with a very large number of cattle and poultry. Livestock is an important source of income and employment in rural areas. They contribute to household income besides assisting crop production. This sector provides full time occupation in some cases at the location itself with better utilization of human resources. It provides balanced nutrition in the form of milk, egg and meat besides farm power. Livestock products also play a main role in export earnings. Livestock sector in Tamilnadu is the single major source of supplementary income for the farming community. The livestock should be protected from some of the important diseases affecting, include Haemorrhagic Septicaemia (HS), Black quarter (BQ), Enterotoxaemia (ET), Brucellosis and Foot and Mouth disease (FMD). The best way to control the above diseases and to have effective 'herd immunity' is by vaccination of all the susceptible livestock.

Vaccination has been one of the most important interventions in disease prevention that has ever been developed. In veterinary medicine, vaccination has also proven to be a boon for animal health. The major goals of veterinary vaccines are to improve the health and welfare of companion animals, increase production of livestock in a cost-effective manner, and prevent animal-to-human transmission from both domestic animals and
wildlife. Vaccination of wildlife is generally considered only with respect to infections that are transmittable to human (zoonotic diseases), although welfare concerns are of increasing importance.

The final successful outcome of vaccine research and development is the generation of a product that will be available in the market place or that will be used in the field to achieve desired outcomes. Successful veterinary vaccines have been produced against viral, bacterial, protozoal, and multicellular pathogens, which in many ways have led the field in the application and adaptation of novel technologies. These veterinary vaccines have had a major impact not only on animal health and production but also on human health through increasing safe food supplies and preventing animal-to-human transmission of infectious diseases. The continued interaction between animals and human researchers and health professionals will be of major importance for adapting new technologies, providing animal models of disease, and confronting new and emerging infectious diseases.

Vaccines are health products that trigger protective immune responses (defense cells in the body) in animals and prepare them to fight future infections from disease causing agents, such as bacteria, viruses, parasites and fungi. Vaccines can lower the severity of future diseases and certain vaccines can even prevent infection altogether. Most experts agree that widespread use of vaccines has prevented death and diseases in millions of animals around the world.
In short, we are exposing the animal’s immune system to a selected antigen (agent that stimulates the immune system) to provide protection against the disease causing virus or bacteria. Because the animal has been pre-exposed, the immune system can build up some immunity and can respond to an invading infectious organism and fight off the disease before it can become established. Our objective should be to use vaccines properly so that the maximum protection which gives animals a better chance of avoiding disease.

Vaccines can fail if they are given to sick animals such as those with a fever, or animals receiving certain drugs, for example steroids, or if given too close together or too far apart. In such situations, the animal’s immune system may not be able to respond well to the vaccine. It is therefore important to administer vaccines only to healthy animals. For that reason, usually prior to vaccinating the animals the veterinarian will ask about the medical history, and then perform a complete clinical examination to find out whether the animal is sick or not. Vaccines also do fail if the vaccine has been improperly handled or stored. To be effective, vaccines must be given at the correct dose and by the correct route of administration (intramuscularly or subcutaneously). The best source of this information is the instructions on the package.
Institute of Veterinary Preventive Medicine (IVPM) is an Institute originally known as Serum Institute was established at Madras (present day Chennai) in 1932 to produce anti-rinderpest serum and bull virus to combat rinderpest which was rampant then, posing serious threat to the livestock population. In 1942, the institute was shifted to Coimbatore Agricultural College Estate as an emergency measure due to World War –II. In March 1948, the institute was shifted to the present campus at Ranipet, facing the National Highway No.4 (Chennai – Bangalore) at a distance of 114 km from Chennai. The Campus with 192 acres (0.78 km²) area was a meat dehydration plant of the army and was acquired by the state government from the army under post war construction scheme. The institute has got vast development over 78 years and it’s now engaged in the production of various vaccines, (Bacterial and Viral Vaccines) against various diseases of livestock and poultry, diagnostic reagents and Pharmaceutical products for treatment of ailing animals. In addition, the institute extends disease investigation service to the field veterinarians.

The thesis was organized as follows:

Chapter one dealt with vaccination. Vaccination is the administration of antigenic material (the vaccine) to produce immunity to a disease. It is considered to be the most effective and cost-effective method of preventing
infectious disease. A vaccine is a biological preparation which is used to establish or improve immunity to a particular disease.

In chapter two animal diseases like bacterial, viral, fungal, parasitic and hereditary diseases were discussed. History of bacteria, classification of bacteria and culture of bacteria, microscopic examination and current research in bacteriology were discussed in detail.

The third chapter dealt with the theory and practice of Fourier Transform Infra Red (FTIR) and UV-Visible spectroscopic techniques. The applications of spectroscopy were also discussed.

Chapter four discussed about the study of bacterial animal vaccines. Bacterial vaccines like Anthrax Spore Vaccine (ASV), Haemorrhagic Septicaemia Vaccine (HSV) and Black Leg Disease Vaccine were taken for the study. The effect of Anthrax Spore Vaccine (ASV) on animal using FTIR and UV-Visible spectral analysis were discussed. Effect of Anthrax spore vaccine on sheep, goat and white calf was studied in the Institute of Veterinary Preventive Medicine (IVPM), Ranipet, Vellore District, Tamilnadu. The same vaccine was given to cattle, in the field level. The changes in the chemical component of blood like proteins, lipids and amino acids in the pre and post vaccinated blood samples were observed almost same in all the above cases.
Effect of Haemorrhagic Septicaemia Vaccine (HSV) on cattle in the field level was discussed in the **fifth** chapter. Haemorrhagic Septicaemia Vaccine was administered to cattle in the field level in the village Kaveripakkam, Vellore District. The FTIR and UV-Vis spectral analysis were made for the pre and post vaccinated sera samples. This study also revealed that the variation in the protein and lipid level due to the vaccination.

Effect of Black Quarter Vaccine (BQV) on cattle in the field level was analyzed in the **sixth** chapter. Black Quarter Disease vaccine was administered to cattle in the field level in the village Kaveripakkam, Vellore District. The FTIR and UV-Vis spectral analyses were made for the pre and post vaccinated sera samples. This study also revealed that the variation in the protein and lipid level due to the vaccination.

Chapter **seven** discussed about the study of viral animal vaccines by FTIR analysis. Foot and Mouth Disease Vaccine (FMDV) on cattle and Ranikhet Disease Vaccine (RDV) on chicks by FTIR spectroscopic methods were discussed.

Vaccination is one of the routine procedures adopted to control specific diseases. FMD monovalent vaccine is a liquid preparation containing any one type (O, A, C, ASIA-I) of FMD virus inactivated with formalin and adsorbed on buffered aluminium hydroxide gel. Foot and Mouth Disease Vaccine (FMDV) was administered to cattle in the field level at Kanchipuram. Pre (0 day) and post (21\textsuperscript{st} day) vaccinated sera samples were collected and FTIR spectral analysis were made.
Ranikhet Disease Vaccine K is a suspension of modified living virus (Ranikhet Disease K. Strain) prepared from the experimentally infected chicken embryos and is freeze dried. The dosage of this vaccine is 0.5 ml, to be inoculated subcutaneously or intramuscularly. Optimum age of vaccination is 6 to 8 weeks. It should be performed in healthy flock only. If done perfectly the resulting immunity is for its productive life.

Ranikhet Disease Vaccine K was administered to chicks in the village Kaveripakkam, Vellore District. Pre (0 day) and post (21st day) vaccinated sera samples were collected and FTIR spectral analysis were made.

All the chapters discussed above underscores the fact that the spectroscopic method can be employed to study the variation in the blood components due to the vaccination. Thus starting from the principles and uses of UV-Visible and FTIR spectroscopic techniques, a systematic approach is adopted in the qualitative analysis of the protein and lipid level in the samples. Further, these spectroscopic methods have been exploited to study the effect of the vaccine. The computations, finding and their influences were all presented and discussed for bacterial and viral vaccines. Similar results were observed in both bacterial and viral vaccines studies. The changes occurred in the blood samples of all the animals due to vaccination were observed similar.
In vaccine production centers or institutes, safety and potency test are conducted regularly to test the quality of the vaccine. The animals are procured from approved contractors with unknown history of the animals. This test can be used as a screening test on animals to be vaccinated as well as to assess the potency of vaccine in vaccine production laboratories. All the vaccines produced by the institute will be tested for potency. At present experimental animal (maximum of 5) are vaccinated and control animal (2 No's) which are not vaccinated are taken for test. After 21 days, both experimental and control animals are injected with the virulent bacteria or virus. The entire vaccinated animal (experimental animal) will be alive after this test, but the control animals die. This type of vaccine potency test is costly.

In future spectroscopic method can be standardized still and can be used as in-vitro test instead of this present in-vivo test. Compared to ELISA, spectral analysis is cost effective test besides it requires small amount of sample for analysis. One instrument can analyze infinite number of samples, since it is window based data program-spectrum software. The spectra were baseline corrected and they were normalized to acquire identical area under the curves and the maximum absorbance value of the corresponding characteristics bands was noted. The internal standards among the absorption peaks can be calculated. By studying this, the potency of the vaccine can be assessed.
Vaccine potency is estimated in vaccinated animals either directly, by evaluating their resistance to live virus challenge, or indirectly, by inference from the levels of specific antibody induced by vaccination. The uncertainty of measurement in these tests should be taken into account when interpreting their significance. William H. Natcher Conference Center - National Institutes of Health Bethesda, MD, USA, conducted an “International Workshop on Alternative Methods to Reduce, Refine, and Replace the Use of Animals in Vaccine Potency and Safety Testing: State of the Science and Future Directions” on September 14-16, 2010. Implementation of the recommendations in this workshop is expected to advance the availability of alternative methods for vaccine potency and safety testing while ensuring continued protection of human and animal health.

In recent years, efforts have increased to develop alternative methods that reduce, refine, and replace the use of animals for vaccine potency and safety testing. However, these tests still account for the largest numbers of animals that experience unrelieved pain and distress.

Spectroscopy has been employed as a diagnostic tool in the study of blood. This spectral analysis can be effectively used as an in vitro test to screen the animal and also assessing potency of vaccine. In vivo challenge test can be replaced once this procedure is standardized which can satisfy the CPCSEA-“Committee for the Purpose of Control and Supervision on Experiments on Animal”- which imposes regulations to use animal for experiments,