



PAKISTAN JOURNAL OF LIVESTOCK SCIENCES (PAKJLSC) Vol–XVII, No.17-2025

Volume-XVII

December-2025

No.17

ISSN-2077-933X

SIS-ID-7465

# PAKISTAN JOURNAL OF LIVESTOCK SCIENCES

Established  
2008

ONLINE – ISSN-2521-8697  
URL-<http://www.pakjisc.org/publications>

First Published  
2009

Seventeenth Published 2025



Islamabad – Pakistan

[www.pakjisc.org](http://www.pakjisc.org)

PUBLISHERS:

**LIVESTOCK DEVELOPMENT FOUNDATION® (LDF)**

H.No.17, St. No.06, Muslim Town, Bhara Kahu, Islamabad

Cell: 0345-9727722 Email: [drmhafeez1949@gmail.com](mailto:drmhafeez1949@gmail.com)

---

PAKISTAN JOURNAL OF LIVESTOCK SCIENCES (Pak.jlsc.) ISLAMABAD



© Copy Right Title:	All rights reserved with the Chief Editor Pakistan Journal of Livestock Sciences (Pak.JLSc) Established in 2008, First Published in 2009
ISSN (Regd.) No.	2077-933X-Print
ISSN-On-Line	2521-8697-On-Line
HEC Recognition	Formal recognition awaited (in-final stages)
International Indexing	The Journal (PJLSc) with abbreviated title Pak.JLSc and with Website <a href="http://www.pakjlsc.org">www.pakjlsc.org</a> has been indexed in <ol style="list-style-type: none"> <li>i. Directory of Research Journal Indexing (DRJI)</li> <li>ii. Scientific Indexing Services (SIS)-ID-7465</li> <li>iii. Google Scholar</li> <li>iv. Academic Resource Index (ARI)</li> <li>v. Directory of Open Access Scholarly Resources (ROAD)</li> </ol>
Abstracting & Indexing In Pakistan ISSN Regd. No. (NIABS) Present Publication No. LDF approved document No.	Regularly indexed with National Indexing and Abstracting Services (NIABS), Pakistan, Islamabad, since 2013. 2521-5647 Vol (XVII), No.17, December, 2025 No.LDF-PJLSc/17/2025
Chief Editor	Dr. Muhammad Hafeez B.V. Sc, B.Sc. AH, M.Sc(Hons) AH, M.Sc.Vety Sciences, USA President Livestock Development Foundation® (LDF), Regd. Islamabad
Co-Editors:	1. Uzma Kanwal M.Sc. Sociology, B.Ed. M.Ed. M.Phil (Education)  2. Nadia Hafeez, BSCS, M.Ed., M.Phil (Education)
No. of Research Articles Pages (PP) No. of copies published	(No. 157-168) 1300-1373 100
Website	<a href="http://www.pakjlsc.org">www.pakjlsc.org</a>



Ad: Subscription Rates:	Full page – Inside (With prepared Ads:-)	Rs.15,000/-
	Full page – outer title	Rs.20,000/-
	Full page – inner title	Rs.15,000/-
	Half page – inside	Rs.10,000/-

Rates Inland (per copy)	Rs.500/- Institutions/Departments/NGOs
Student Rate	Rs.300/-
International Rates	US Dollars 20 each
UK: Pound Sterlings	10 each with cast of mailing
Canadian Dollar	15 each
Australian Dollar	20 each
FF	30 each
EUR	20 each

- |   |  |
|---|--|
| 1. Computer IT Consultant               | Muhammad Waqar (MSCS-Pak)  |
| 2. Research Associate                   | Muhammad Salman Hafeez   |
| 3. Composing, Compilation, & Formatting | Uzma Kanwal<br>Farsalan Consultancy Services (FCS) ph:0345-9727722 |
| 4. Graphic Work etc.                    | Muhammad Usman Hafeez, Bhara Kahu, ICT, Islamabad. Ph.0305-5888686 |



## EDITORIAL

Alhamdulillah with the approval of Editroial Board of (pakjpsc) Volume XVII, No -17,2025 is now ready in hand and Online with title more devotion specifically the articles of various research sections and veterinary Disease diagnostic Laboratories of Veterinary Research Institute ,Peshawer (VRIP) Based on their Technical Annual Reports of 2023-24.

The present issue comprises a total of eleven research articles, one of which is reviewed ,one on a recently written Text Book entitled “ A Concise and Practical Approach of Veterinary Microbiology -2025” and one update on Livestock products (recent picture –surveyed from Southern and Central Punjab local markets ) while rest of nine articles pertain to efforts made by researchers of VRI Peshawer ,a work done worth presentable hence the EB of pakjpsc dedicated this volume in hand as VRIP –highlighted issue, with appreciation and their confidence in our journal .

The presentation of pakjpsc Vol-XVI,No-16 (2024) was presented at VRIP, in August 2025 and the format was demonstrated in the gathering of researchers (ROs , SROs, and PROs/Directors) by the Chief Editor pakjpsc , with editing support to their effort on Journal of Animal Health and Production (JAHP) be published in Dec- 2005, to which ours is on Barter Exchange with other 12 Journals , in the century .

It is hoped that with the publishing of work done at VRIP will be an updated and useful information for other Veterinary Research Institutes in the country and abroad.

Suggestions , comments and publications in pakjpsc will further improve our coordinated efforts , amongst veterinary sciences sector of our country and abroad .

Dr Muhammad Hafeez  
Chief Editor

**CHIEF EDITOR**

**Dr. Muhammad Hafeez**

B.V.Sc, B.Sc AH, M.Sc (Hons) AH, M.Sc. Veterinary Sciences, U.S.A

**MEMBERS EDITORIAL BOARD**

- |    |  |   |
|----|--|---|
| 01 | <b>Dr. Qurban Ali – Ph.D</b><br>Ex-Director, National Veterinary Laboratories,<br>M/O Food Securities and Research, NARC,<br>Islamabad | <b>Editor</b><br>Microbiology and Quality<br>Assurance        |
| 02 | <b>Dr. M. Fatahullah Khan – Ph.D</b><br>Ex-Director, ASI,<br>NARC, Islamabad   | <b>Editor</b><br>Small Ruminants                              |
| 03 | <b>Prof. Dr. Subhan Qureshi – Ph.D</b><br>Ex-Dean F/o Veterinary Sciences<br>Agricultural University, Peshawar                         | <b>Editor</b><br>Livestock Management and<br>Dairy Production |
| 04 | <b>Dr. Tanveer Ahmed – Ph.D</b><br>Associate Professor/Chairman,<br>Faculty of Veterinary Sciences<br>PMAS-UAA-Rawalpindi              | <b>Editor</b><br>Academics, Syllabi and Animal<br>Nutrition   |
| 05 | <b>Dr. Khizar Hayat – Ph.D</b><br>Ex-Director, Agriculture Research (KPK)  | <b>Editor</b><br>Agriculture Sciences                         |
| 06 | <b>Dr. Tabinda Khawaja – Ph.D</b><br>Ex- Assistant Professor,<br>Manager PM, Backyard poultry program.                                 | <b>Editor</b><br>Poultry Sciences                             |
| 07 | <b>Dr. Amtul Hafeez – Ph.D</b><br>Associate Professor Education AIOU,<br>Islamabad   | <b>Editor</b><br>Education                                    |
| 08 | <b>Dr. Hina Fatima, Ph.D,</b><br>Associate Professor (Environment),<br>AIOU, Islamabad   | <b>Editor</b><br>Environmental Sciences                       |
| 09 | <b>Dr. Muhammad Tariq Tunio – Ph.D</b><br>Assistant Professor, AIOU, Islamabad   | <b>Editor</b><br>Microbiology and Livestock<br>Management     |
| 10 | <b>Dr. Hamid Irshad – Ph.D</b><br>Senior Scientific Officer,<br>NARC, Islamabad  | <b>Editor</b><br>Virology and Molecular Biology               |
| 11 | <b>Dr. Hajira, Ph.D</b><br>Associate Professor, HoD<br>Home & Health Sciences, AIOU, Islamabad.  | <b>Editor</b><br>Food and Nutritional Sciences                |
| 12 | <b>Dr. Shakira Ghazanfar Ph.D.</b><br>Senior Scientific Officer,<br>Plant Genetics Research Institute,<br>NARC, Islamabad              | <b>Editor</b><br>Bio-Technology                               |

## QUICK SURVEY REPORT OF LIVESTOCK PRODUCTS IN CENTRAL AND SOUTHERN PUNJAB , PAKISTAN (FEB-MARCH) – 2025

Salman Hafeez and Uzma Kanwal

### ABSTRACT

This article based on the Quick Survey Report (QSR) of the research team of LDF (Livestock Developmental Foundation) and Farsalan Consultancy Services (FCS) carried out in Central and Southern Punjab area, providing average (Av.) rate of fresh milk (Rs/ liter) and green fodder (Rs /per kg) from deras, nearest towns and Distt. Sale points, from six survey areas, namely (a) Dunya pur, (b) Deepal pur, (c) Haasil pur, (d) Arif wala, (e) Kabir wala and (f) Khanewal. The fresh milk rate per litre (Rs) from deras was recorded (av) as Rs 125 /-litre and Rs 131.66, in the nearest town markets while this was recorded in the Town markets and in main Distt with Average rate of Rs 136.66 and Rs.142.166 respectively. The green fodder rate at Deras Rs per 40 kgs averaged as Rs 146.66 and 152.50 while this rate averaged in the newest town and Distts as Rs 153.33 and 159.166 respectively. As most of the milk is transported upstream to Rwp-Isbd twin cities, getting good sale price both at whole sale and retail Farmers are advised for keeping on this dedicated effort, with positive recommendations.

**Keywords :** fresh milk prices, central and Southern Punjab, Green fodder prices

**Article received :** March -2025 **Article accepted :** July -2025 **Article published :** December 2025

### INTRODUCTION

Livestock population is slowly and steadily increasing when the recent data /pertaining to the year of 2023-24 of cattle, buffaloes, sheep and goats, (numbering in million) as 57.55, 46.66, 33.50, and 86.33, as compared to the previous year 2022-23 as 55.50, 45.00, 32.30 and 84.70, based on the 3.89 growth rate (PESR 2023-24). The livestock main products (milk and meat) as well as by-products have also showing similar trends of growth. The poultry birds (both domestic and commercial) together with Day Old Chicks (DOC) and eggs have shown at least 7-8% growth rate.

The recent update on poultry sector stood (in million Nos) as (i) poultry birds =1920, (ii) Eggs (both hatching and table)=2400 and (iii) poultry meat as 2.36 million tons, as per PESR (2024-25).

As the livestock rearing /keeping is a traditional and cultural economic activity in the central and Southern Punjab and elsewhere in the country, due to vast agricultural land and plenty of irrigation water availability supported with quick growing seasonal green fodder and health care services, both the fresh milk and green fodder are far cheaper than the bigger cities, upstream, such as Rawalpindi and Islamabad, (RWP and Isbd both cities).

Same is the case with live dairy animals (cows and buffaloes), as these fetch better prices; together with the larger adults, male cattle calves (Dondas and Chogas) produced for the sacrificial purpose, are also transported to bigger town and fetch better prices, as documented

- Research Assit –LDF-ISBD
- Research Associate-LDF-ISBD

earlier in previous efforts by Uzma Kanwal et al (2024) Muhammad Hafeez (2024) and others .

Not only the milk production ,meat production , as well as livestock by products are locally used but the export potential also exists as already updated in a comprehensive write up, as an endeavour of Animal Quarantine Deptt (AQD) Karachi , Subjected to animal health inspection ,prior to exports ,Zargham Nawaz et al (2024) forwarding data of 2022-2023 indicated to demanded livestock related items by the friendly countries and brotherly muslim countries from Pakistan .Dairy Farmers Association in Karachi and Punjab Province at a mediocre to larger level ,are working hard sustainably ,in producing good dairy animals (cow and buffaloes) , comparatively better milk production and feasibility based male cattle for sacrificial purposes , in Punjab province specially have recorded eleven percent (11%) growth rate in 2024-25 (media reports in March-2025), U-Tube videos 2022, 2024 and Kisan News(2024-25) .

## MATERIAL AND METHODS

The information was collected by the research associates of LDF and FCS , Islamabad ,on tour for this assignment ,and has been gathered in tabulation form for areas (i) thru ,(vi) and results compiled in simple  $\sum x$  and  $\bar{x}$  and presented below.

## RESULTS AND DISCUSSION

### RESULTS

1. The milk rate/ prices in Rs/per litre , collected , were averaged  $\bar{x}$  in the areas (i) thru, (vi) as Rs 125/- at Deras and Rs 131.66 in the local markets near the Deras ,villages as presented in the table No.01.
2. The fresh milk rates per litre in the same areas (i) thru, (vi) the nearest towns was recorded as Rs 136.66 while the rate of nearest cities appeared averaged Rs 142.16, as detailed in the table no.02.
3. The green fodder per 40kgs (Rs) was recorded in the study areas averaged to 146.66 close to deras and Rs 152.50 in the nearest town sale points ,as detailed in the table No.03.
4. The same green fodder when transported to nearest city sale points , the rate per 40 kgs was recorded as 153.33 (un-cut) while the chopped one averaged to Rs 159.16 as available in table No.04.

### SHORT DISCUSSION

Cost of live dairy animals (cows and buffaloes) is still not very high in rural areas , especially in Punjab province where livestock keeping and production being a culture and economic activity , the cost of fresh milk is comparatively very less what we see in the bigger cities e.g Rawalpindi and Islamabad ,twin cities and other metropolitan cities of the country. Documented reports are available from the recent years 2022-23 and 2023-24

in which the rate of milk has been recorded to the tune of Rs 210/- 220/- , at retail shops while the whole sale was recorded as Rs185/- to 190 .while some of the retailers went up to Rs 225/- to 230/- per litre in 2024 (as per prevailing market rates of 2024). Which has been seen as little bit contained in 2025.

Rural areas , where green fodder is available , with a low price per 40 kgs , the rates of fresh milk thus recorded in Feb-March -2025, show a reasonable price per litre. The farmers are still working hard to maintain their milch animals and also involved in the production of live animals ,fresh milk and adult calf production for the sacrificial purpose, every year .

Table No.01 Quick survey Report of Fresh milk in Dunya Pur , Deepal Pur and Hassil Pur , Punjab February (2022)

area	Cost of fresh milk (per liter ) in deras	Cost of fresh milk (per litre- in local markets)
i Dunya Pur	120/-	130/-
ii Deepal Pur	125/-	135/-
iii Hasil Pur	120/-	125/-
iv Arifwala	130/-	135/-
v Kabirwala	125/-	130/-
vi Khanewal	130/-	135/-
<b>Σx</b>	<b>750</b>	<b>790</b>
<b><math>\bar{x}</math></b>	<b>125</b>	<b>131.66</b>

Table No.03 Quick Survey Report of Green Fodder in Dunya Pur ,Deepal Pur and Hasil Pur . Punjab (Feb 2025)

area	Cost per 40 kgs in deras	Cost per 40 kgs – in local markets
i Dunya Pur	140/-	145/-
ii Deepal Pur	145/-	150/-
iii Hasil Pur	140/-	150/-
iv Arifwala	150/-	160/-
v Kabirwala	140/-	145/-
vi Khanewal	160/-	165/-
<b>Σx</b>	<b>880</b>	<b>915</b>
<b><math>\bar{x}</math></b>	<b>146.66</b>	<b>152.50</b>

Table No.03 Quick Survey Report of Retail sale Prices (Rs) in main Towns of nearest cities of the area

area	Cost of fresh milk (per liter ) in Town	Cost of fresh milk (per litre – in nearest cities
i Dunya Pur	135/-	140/-
ii Deepal Pur	140/-	138/-
iii Hasil Pur	130/-	145/-
iv Arifwala	140/-	145/-
v Kabirwala	135/-	140/-
vi Khanewal	140/-	145/-
<b>Σx</b>	<b>820</b>	<b>853</b>
<b><math>\bar{x}</math></b>	<b>136.66</b>	<b>142.166</b>

Table No.04 Quick Survey Report of Green Fodder Cost Rs in the nearest Town and cities of the area Punjab

area	UN-cut	Cut/Toka
i Dunya Pur	150/-	160/-
ii Deepal Pur	155/-	160/-
iii Hasil Pur	145/-	150/-
iv Arifwala	160/-	165/-
v Kabirwala	145/-	150/-
vi Khanewal	165/-	180/-
$\Sigma x$	<b>920</b>	<b>955</b>
$\bar{x}$	<b>153.33</b>	<b>159.166</b>

## CONCLUSIONS

With an overview of the QSR, based on the work carried out in Southern and central Punjab (limited area) it can be concluded that (i) the cost of fresh milk per litre in the surveyed area is cheaper than the bigger cities, (ii) the cost of retailers close to farmers in the villages /deras is also not increased but 2-3% per litre and (iii) the cost of fresh milk in the nearest towns and cities is also not increased but 2-3% per litre and is being sold easily per day. (iv) the cost of green fodder per 40 kgs is also cheaper as compared to bigger cities and the farmers are carrying out this economic activity on a sustainable basis where many people are involved in this process.

## RECOMMENDATIONS

Establishing large size dairy animals farm involves million of rupees subject to availability of agricultural land, dairy sheds, the feed and fodder but running this business at a smaller scale 6-7 animals unit, is easier to manage hence farmers are recommended to continue this national and cultural activity with mediocre income.

## REFERENCES

- PESR (2022-23) Livestock population data, Pak. Economic Survey Reports, Finance Division, M/o Finance, economic advisors Wing, GoP, Islamabad
- PESR (2023-24) Livestock population data, Pak. Economic Survey Reports, Finance Division, M/o Finance, economic advisors Wing, GoP, Islamabad
- PESR(2024-25) Livestock population data, Pak. Economic Survey Reports, Finance Division, M/o Finance, economic advisors Wing, GoP, Islamabad
- Zargham Nawaz Butt ; Maqbool Ahmad and Livestock Expert Potentials of Pakistan, AQD Karachi, PakJlsc, Vol-XVI, No-16, 2024

## BOOK REVIEW: A CONCISE AND PRACTICAL APPROACH IN VETERINARY MICROBIOLOGY

Muhammad Shahid

### ABSTRACT

This review has been conducted to critically examine the content wise ingredients of this recently written Manuscript, by the Author, Dr. M. Hafeez, in a summarized presentation to be easily digested by under grads and graduate students, for academic, training and future lab diagnostic work endeavours. Chapter wise reviewed frank and critical evaluation is presented below:-

This book in hand entitled, **“A Concise and Practical Approach in Veterinary Microbiology” -2025**, has been attempted to provide a summarized content of the subject, as most of the Text -Books on the subject are 1000-1200 pages and with sufficient details and accurately referenced. Students, mostly the graduates and under-graduates (under-grads.), have been observed unable to purchase such highly priced books worth thousands of rupees in Pakistan and elsewhere. Even in US, only the Libraries have such reference books eg. i) Topley and Wilson’-“Text book of Microbiology Virology and Immunology”(1985 and 2005), ii) Stites text book of Microbiology and Immunity (1984) and iii) Cruikshank’s Medical Microbiology (1980’ the recent eddition of which has been published in 2005), the text books we used to study in our college life at College of Veterinary Sciences (CVS) Lahore, Punjab University 1966-1972 (now known as University of Veterinary and Animal Sciences (UVAS)- Lahore. The Text book of that time one was known as Gaiger and Davies Text book of Veterinary Pathology and Microbiology (1956). In US, when the author was a graduate student, at Tuskegee University, Alabama, the text book studied in Microbiology was Dulbaco’s Microbiology (1970) and the Veterinary Virology was written by Mohanty and Dutta (1983) published in US but in early (2000) Banes Diagnostic Microbiology was, and is, still being used by Teacher and students.

- 
- Senior Research Officer, Vety Research Institute -Peshawer

Different individual lecture material on various aspects of microbes is available on U-Tube social media, described in simplified and understandable manner but still we need to provide a concise textbook, easily be taught and studied at home as well as abroad, with major threshold on indigenous information of endemic importance in livestock, (cattle, buffaloes, sheep, goats and poultry) together with diagnostic work in human beings (touches of Medical Microbiology), comprising twelve chapters. The chapter-wise brief Introduction is presented as a preamble of this book Chapter -One describes the history and very earlier (1780-1822) inventors of microbes, spread over 10-12 pages the year in which Luis Pasteur and Robert Koch invented mycobacteria (1878-1922) and Jenner (1880-1930) the father of Soil Microbiology and others including earlier stages of pasteurization aspects, surgery and bacterial work of these eminent scientists. Furthermore, this chapter includes eminent work. Each chapter is supported by Self-Assessment Questions with correct answers, colored plates and references of Microbiology (various development and the production of penicillin sodium from fungus (*Aspergillus fumigatus*) and some related historic work.

Chapter two encompasses the actual domains of different classes of Microbiology, comprising 10-12 pages, this includes micro-biological areas of Agricultural, Veterinary, Medical, Pharmaceutical, Industrial and diagnostic sectors in human and veterinary side including various institutions involved in Vety. Microbiology and doing related work, so that to apprise our students to become a practical and competent in diagnosing various morbid material to be examined. This chapter also includes the understanding of microscope(s) (m/scopes) different parts and uses in diagnostic work. The chapter ends with self-Assessment Questions and correct answers, as a format of the book as well as colored plates as per format of the book to better understand the things.

Chapter three pertain to General and Systemic study of microbes, starting with various systems of the body, affected by streptococci, staphylococci, various bacilli (Anthrax, Tetani, Mycobacteria, Clostridia, the Salmonellae and E-coli (curved/comma shaped organisms). Most of the systems, such as, digestive, respiratory, cardio-vascular, uro-genital and reproductive including brain and nervous system as well as skeletal system. The organisms involved are narrated accordingly. Furthermore in this part of the book, it has been an added effort to jot down some specific symptoms of such infections to differentiate one from the other. Lastly this

chapter shows prominent and salient points of diagnosis of some of the important organisms and morbid material in the laboratory. The chapter ends with the self-Assessment Questions and correct answers, as per format of this book, as well as colored plates, as per format of the book, to demonstrate the things clearly to the readers and students. Lastly some of the recent References are also added.

Chapter four describes the real schematic study of microbes in the form of morphological and sequential manners. In the preamble, as per format of the book, desired by the author (and on the text -book Pattern of Allama Iqbal Open University (AIU) and Higher Education Commission (HEC) approaches, in the 2011 format of monogram series, in the country. The main purpose and objectives of each chapter as pre-fix. The schematic study starts from streptococci and main contamination/infection in human beings, as well as livestock and biotypes of diplococci, micrococci, staphylococci with bacilli *B.anthraxis*, *B.malei*, mycobacteria, Clostridia, brucellae, salmonellae and other with bio-types and sub bio-types are described. This also includes most of the important symptoms of infections and causes. In this chapter spiral bacteria, the flagellats (the trypanosomes etc.), and spirochaetes namely *Borelia*, *Leptospira* and *Treponema* have been discussed. Lastly this chapter also includes protozoa (including plasmodia, babesia, the piro-plasms, amoebas, paramecia and spermatozoa etc.) with distinguished characteristics and microscopic appearances, as a diagnostic tool for laboratory evidence. The chapter ends, as usual, with self-Assessment Questions including correct answers, color plate for guidance and references for interested Readers/students.

Chapter five has particularly spared for viruses, the virology as a subject but squeezed to a single chapter, spread over 12-14 pages, briefly describes the morphology, the architecture of these organisms, various shapes, occurring in the atmosphere/environment and their prevalence, affecting livestock and human beings. The two main domains of RNA-Viruses and DNA Viruses in this chapter also includes the diagnostic approach, as these infect the victims and produce symptoms of various diseases. In the diagnostic aspect Antigen ↔ Antibody reactions, the viral Antigens (used), the Immunoglobulins (Igs.) involved, in the tests meant for lab: diagnosis, as well as various techniques involved in today's virological evidences, namely i) sero-agglutination, ii) Polymerase Chain Reaction (PCRs), the diagnostic kits etc. In the same part of this chapter viral Diseases of veterinary importance have also been discussed briefly: namely, a)

Endemic Viral Diseases of cattle (Foot and Mouth Disease -FMD), Rinder Pest, Bovine Viral Diarrhea (BVD) and Bovine Viral Exanthema (BVE), b) sheep/goat viral diseases (Pest De Petit Ruminale (PPR), c) Bovine and Ovine Pox and d) viral diseases of poultry (New Castle Disease-NCD) Infectious Brusal Disease (IBD), Fowl Pox , Infectious Layringeo-Tracheitis (ILT) and Bird Flu/Avian Influenza etc. Some aspects of slightly touching the human viral diseases, namely the cow-pox, the influenza, the measles, polio, AIDS, cancerous diseases and specifically the CO-VID-19, (as was experienced in the World-2019-2022), including Pakistan. This chapter has been strengthened lastly to add viral vaccines, anti-viral drugs and immunological products/by-products used in therapy. The chapter ends with self-assessments questions and correct answers with color plates and references, as per format of the book.

Chapter six, spread over 15-16 Pages, as per format of the book, starts with its purpose and objectives pertaining to the important component of microbiology, **The Immunology**, which must be an asset to all students/readers and teachers alike. This part of the book describes its preamble and general immunology involving very basic units of a) glands, b) cells, c) immunoglobulins (Igs), d) antigens (Ags), antibodies (Abs) and their interaction within the body of human beings and animals. This chapter also describes various diagnostic tests proposed for various diseases through blood sera, namely the sero-agglutination tests, (tube test, plate test, haemagglutination test), Electrophoresis, The Enzyme Linked Immuno-Sorbent Assay (ELISA) and Poly-Acrylamide Gel Electrophoresis (PAGE), as well as Polymerase Chain Reaction (PCR) etc. Lastly in this chapter, various immunological, biochemical and bio-immunological products, namely vaccines, immunogens and antigens (from bacterial, viral, protozoal and fungal origin) are described for broadening the horizons of students to make them genre-competent in this field. The chapter ends, as per format of the book, with self-assessment questions and correct answers supported with colored plates and some important reference. Chapter seven describes the important aspects of hypersensitivity/allergies and grafts/transplants, starting with its importance, the write-up describes four different types of hyper sensitivity, its grades/types I, II, III and IV. The write up encompasses the body immune response, to non-self “the foreign body” (Antigens, the invasion of various organisms, namely bacteria, virus, parasites and fungi (and related infections) release of immunoglobulins (Igs) Ig-A, Ig-G, Ig-D and Ig-E, in different situation of responses, of the body defense mechanism. This part of the book also includes compatibility and non compatibilities in Ag. and Ab. reactions, in grafts/transplants, in term of hair, tissue and

organ transplants (body tissues, skins, cornea, kidneys, pancreas and plastic surgeries) including blood transfusion in human beings. This chapter is also of importance in sting-bite cases, reptile bites, skin allergies, (mange, eczemas and external parasitic infestation of ticks, mites, lice and fleas etc. as well as, internal helminthic infestations (nematodes, tremetodes and cestodes), resulting in allergic/hypersensitivity conditions. The last portion of the chapter describes therapeutic/medication approach in hypersensitivity, specially the antibiotics, antiviral, antifungal, antiparasitic, fusidic acid, steroids and antihistaminics including immunogens of various stages of infection. The chapter ends with self-assessment questions and correct answers, with colored plates for evidence of academic, practicals and relevant references.

Chapter eight of the book has been attempted, as part of microbiology, the endemic, pandemic and trans-boundary diseases, with-out breaks in livestock and human health. Starting with its importance, the students/readers have been apprised with the importance and graveness of the subjects namely endemic bacterial, viral, parasitic, fungal and metabolic diseases in large animals (cattle, buffaloes) small ruminants (sheep/goats), canines (dogs/cats) and poultry. A specific part of this chapter is attempted to inform our stake-holders the role of International Organisations such as FAO, WHO, OIE in disease reporting, the 200 plus countries, members of UN, their responsibilities and obligations, mediated through Animal Quarantine Department (AQDs) for sanitary inspections of live animals and livestock products, for clearance or otherwise (destroying) to avoid spread of health hazardous items, with special references to international health card for travellers and international Animals Health Certificates issued, after sanitary clearance by AQ department, as an international document travelling with each consignment up to its destination. Lastly this chapter includes zoonotic diseases/communicable diseases and control and eradication program by the Ministries of human health and nutrition including EPI program of children protecting from five major endemic diseases as well as MNFS and R programs on transboundry diseases with mass vaccination program of livestock and poultry by the Provincial b.dd department for protection. This chapter ends, as per format of the book, will self-assessment questions and correct answers, colored plates and references.

Chapter nine of the book, spread over 15 pages, describes briefly the important part, the haematology, the study and information of blood in human beings and in animal body, comprising content wise, the Preamble/importance and various ingredients of blood, namely

cells (the RBCs, WBCs, the platelets etc.), the plasma and serum, linked with microbiology and immunology. The diagnostic importance of serum, its Immunoglobins (Igs) and agglutinations, as well as blood complete picture (Blood C/P). The blood as diagnosed in the laboratory for ESRs, the centrifuged Packed Cell Volume (PCV), blood glucose (sugar test, blood urea, kreatinin and various cell counts (differential WBCs, differential shaped RBCs, with isolation of different bacteria, as obtained from the sediment. Last but not the least, the diagnosed result declared with competence, using various protocols of manuals of UK, US and other International labs: affiliated with Pakistani labs, with particular example of Islamabad Diagnostic Centre (IDC Bhara kahu), using Tietz (1980) format/manual of microbial-biochemical assay: The fundamentals of clinical chemistry and Molecular diagnosis, Vol-2, Seventh Edition, as well as professor Tiffany Martin (1980), (1996), (2015-16) lecture material on U-Tube, for ready reference. Email @professortiffanymartin786, on-line. The chapter ends, as per format of the Authors books, with self-assessment questions, correct answers, colored plates and salient references.

Chapter ten, as per format of the book, is spread over 01-09 aspects, endeavored on specifically “A Microbiology lab: practical work, inside it”. Starting briefly with a Pre-ambule and importance of any laboratory and classifications of various Labs: namely bacterial, viral, parasitological, bio chemistry, bio-chemical, Food Technology, Biology, chemistry, physics, Public Health, Biotech and Pharmacology etc. etc. but in this write-up and the content of this book, microbiology lab: is going to be the main focus. This chapter also includes various, morbid material to be examined namely blood, pus, sputum, urine, different discharges (nasal, oral, lacrimal, ear, anal, vaginal), milk, semen, tubercles and various tissues etc. The reader(s)/student(s) are also made abreast with the very basics, called A.B.C.D. of a lab: with equipment, lab ware, glass-ware and items needed in daily work. Also main practical aspect of sterilization, asepsis, hot and wet sterilization, fumigation of main lab: and the culture-room/culture hood (for delicate microbial work). This chapter also includes the stains and staining (techniques and procedure) and lastly weekly 10 12 practical labs: assignments for teachers and students, to maintain a Laboratory Work Practical Note-Book (LWPNB), daily signed by the teachers on each practical. Special attention is paid to apprise the readers/students with sample collection, Slaughter-House (S/H) visits and transport of material from farm to labs:

and/or from field to labs, to be examined. The chapter ends with self assessment questions and correct answers as well as colored plates for interest and supported with recent references.

Chapter eleven, being the second last component of this Endeavor which pertain to production of biologicals (vaccines, antigens and other immunological products) of academic and practical importance. To summarize this part, present bacterial vaccines, viral, protozoal and fungal origin together with production of antibiotics, anti-viral and anti-fungal drugs/medicines, by various pharmaceutical firms/companies. Although not in very much detail but brief touches are narrated and enumerated. This part of the book includes cellular bio-products (27-28) used in infections, immunological disorder/syndrome and also products obtained from tissues of glandular origin (lymph glands, pancreas, thymus, adrenals, splenic cells and bone marrow). Some of the bio products from non-immunological important namely i) stomach (from which rennin/and rennet enzymes are biotechnical biotechnologically obtained), these are used in curdling milk in bulk quantity for cheese production, ii) adrenals (from which epinephrine is produced, that is used for medicinal purposes while iii) from pancreas, the insulin is obtained and is being used for the treatment of sugar patients. In the last few pages bio products from Protozoa and fungi are enumerated. The chapter ends, as per format of the book, the self-assessment questions with correct answers, colored plates and references Chapter twelve, the last effort of this book, provides additional study material as this endeavor was to keep the subject matter, the technical and Professional Academy knowledge as to be concise (not an in depth, research based details, otherwise the book might have become a voluminous textbook. This part of the book indicates for interested students/readers various textbooks (various volumes, as well as recent ones) the on-line lectures, videos, presentations on veterinary microbiology, with some important parts of medical microbiology (as 70-80%) of the microbes are common in human beings and livestock. In addition, various documents/reports (annual reports) of both i) International organisations namely WHO, FAO, WDR, OIE and ii) Local National and Provincial Institutions namely VRIs at Peshawar, Lahore, Quetta, NVL-Islamabad, PRI-Rawalpindi, VRI Sindh (Karachi) and NIH Islamabad including CVDRL Tandojam and PDVC (Karachi) including ASI, AHI, of NARC and PARC Islamabad. This part also includes AQDs efforts on livestock, products (imports and exports data, available in their yearly annual working report) the most recent one 2022-2023, published in P.JLSc Vol XVI, No- 16 2024. The annual reports of VRIs (Peshawar, Lahore, Quetta and Sindh) are also mentioned. In addition the annual reports are also

available in each HQ of LDDDs. Lastly work on livestock diseases pertaining to Research and Development (R&D), written documents (as annual reports of each University/Department and thesis of graduate students (at MSc (Hons) and Ph.D levels, are available in the respective University libraries of UVAS, AUF, AAU, Rawalpindi AU Peshawar and elsewhere. This chapter ends with its format of the book, as usual, the self assessment questions, colored plates and references. The very last part of this book is the Bibliography so as to make abreast the students, the really interested students, going to graduate research work as guidance and updates. Bibliography comprises 14-15 pages recent references (170-172) and appended with the book with color plates of various important chapters .

## INVESTMENT OPPORTUNITIES IN LIVESTOCK BY-PRODUCTS IN PAKISTAN, EVIDENCED THROUGH EXPORTS

Muhammad Hafeez<sup>1</sup> and Uzma Kanwal<sup>2</sup>

### ABSTRACT

This article highlights the attractive open venues of livestock products and by-products investment therein, based on the factual data of exported items of livestock namely (i) live animals, (ii) poultry related items, (iii) meat related items, (iv) milk related and (v) animal feed /fodder including other by-products. Quantified and tabulated in the millions. Interested investors can obtain such data from the published information, duly referenced just for a single year-2021-22 and 2022-23. The exported quantity of (a) live animals was 1464, honey bees 20706 boxes, poultry birds 5.445 million, eggs=605.278 million, Day Old Chicks (DOC) 19.115 million, hatching eggs =38.878 million while meat =721121.220 metric tons and animal feed =1382.577 metric tons respectively. Other items are also included which can attract investors. The article ends with positive recommendations for investors in this sector.

**Keywords :** livestock by-products, investment opportunities, Pakistan

**Article received :** July -2025 **Article accepted:** Sept-2025 **Article published :** Dec-2025

### INTRODUCTION

The by-products obtained from larger remnants (cattle, buffaloes and camels) small ruminants (sheep and goats) and poultry are not the neglected ones when the data of such products of recent years is overviewed. These products of the year 2022-23 have shown increasing trends over the data of the year 2021-22. This article will remain limited to by-products only and not to discuss the main products of the milk and meat (Zaigham Nawaz Butt et al-2024)

As understood the byproducts namely hides from large animals and skins from the small remnants, together with the wool (from sheep) hair from goat, edible offals (from both large and small remnants) Guts (from large remnants) and casing (from small ruminants) with horns and hooves, together with bones products (from both large and small ruminants) trotters from head and feet (four feet) have witnessed in million Nos. 20.717 hides, 10.90 skins, 0.49 wool 0.032 hairs, 0.49 (edible offals) 64.857, (casings 22.009 guts, 0.072 (horns and hooves) and 1084.3 (bones), 0.34 (fats) as documented by Zargham Nawaz Butt et al (2024). The fresh information on the livestock (documented) in 2023-24 Reports of PSER indicative has shown, 3.9% growth rate, over the previous years data of 2022-23, also available in the "Brief on livestock" of livestock wing Ministry of National Food Security and Research (MNFS and R), GoP -2023-24.

The last year's (2022-23) data on livestock by product indicated the number of processing

- CEO, FCS-Isbd
- Research Associates -LDF and FCS -Isbd

plants of hides and skins as 725 mainly in Distt :Kasur ,03 in Lahore and o2 in Mureed key area in Punjab Province while the bone and bone products processing plants were mainly in Karachi 30 ,Wazirabad 09, one each in Pabbi (KPK) , Multan , Sukkar , while the guts and casing processing units were in Karachi (28) , Lahore (04) , with data of their output increased in 2023-24 ,as compared to the previous years , as documented in the Annual Working Report . (AWR) of Animal quarantine Department (AQD) Karachi , Published by Zirgham Nawaz Butt et al (2024) .

The livestock products and by products are not only being used locally (in the country) but also exported to different friendly country ,as well as brotherly muslim countries and are a specific area of investment with good returns ,Zaigham Nawaz Butt et al (2024).

Investment in this area of Livestock sector is a promising open venue , as there are incentives in the livestock policy of the country together .with financial supportive packages by the State Banks overall Farmers supportive programs , implemented by commercial Banks of the country as we as small scale financial institutions etc , as SPP-2023-24 and evidenced in the PESR (2023-24) and (2022-23) respectively .

Investment opportunities in Livestock , products and by products was earlier advocated in the Book, “Investment in Livestock Sector : A real Business in Pakistan ”.By Muhammad Hafeez (2009). And sustainably highlighted in various publications of Pakjlsc , Volumes , XI, XII, XIII and XV of 2015, 2016, 2017 and 2023,respectively . With the passage of time , not only live animal prices are increasing year after year , the products (milk and meat ) and by products are not the exceptions .

Livestock Development foundation (LDFs) Annual Quick Survey Reports (QSRs) of previous years are the documented evidence for the last one and half decade (2009-2024) as published from time to time , including the recent work of 2025 ,invited the investors to the become the part of this economic activity and their share in the overall economy of the nation . This effort in the for them of the research cum investigative approach provides an updated information on the subject .

## **MATERIAL AND METHODS**

This write up has been based on the followings documents / reports as a potential source for developing this article :-

(i) Pak Economic Survey Reports (PESRs) 2023-24.

(ii) Pakistan Bureau of Statistical Reports (PBS) 2022-23 2023-24 and 2024-25.

(iii) Livestock Development Foundation (LDF) 's Quick Survey Reports (QSR), 2022-23, 2023-24 and 2024-25.

(iv) Annual Working Reports (AWRs) of Animal Quarantine Department (AQDeptt) Karachi, GoP 2022-23, 2023-24.

(v) Previous published data in different journals and specifically in Pak.journal of livestock sciences (Pakjlsc) , various volumes , (recent ones)

## RESULTS AND DISCUSSIONS

The results obtained from documents , cumulatively , gathered and inferences drawn are displayed as under :-

- a. Live animals (i) cow and calves were exported to the tune of 2049 Nos:- (ii) poultry birds + Day Old Chicks (DOCHs) and hatching eggs (05 items) numbering 659.913 million, as detailed in table No-02.
- b. Meat and meat products were exported in the quantity (Qty) of 108.732 metric tons while chilled products were exported to the tune of 15029.795 metric tons
- c. Milk and milk products exported were 21605.35 metric tons while finished leather and sheep skin etc with 10 pieces ( pcs) Qty=10922.548 metric tons .
- d. Miscellaneous , products/ by-products, items related to livestock (12 items ) were exported ,Qty=808,687.972 metric tons as detailed in the same table No-02
- e. All such items are splitted and itemized detailed in table No-02.
- f. All such items are splitted and itemized further detailed in table No-03, for interested and all stake holders .

Table No.01, Livestock Population of the country in 2022-23 and 2023-24 (million)

	Livestock type	2022-23	2023-24
i	Cattle	55.50	57.50
ii	Buffaloes	45.00	46.50
iii	Sheep	32.30	32.70
iv	Goats	84.70	87.00
v	Camel	01.10	01.20
vi	Horses	0.40	0.40
vii	Asses	5.80	5.90
viii	Mules	0.20	0.20

Table No.02 Exported items of the livestock products (QUANTUM) during 2022-23

	Livestock related exported	Nos/Qty (millions)	Revenue generated (milliom PKRs)
i	Live animals	2949	0.569
ii	Poultry related (p/birds /Dochicks and eggs )	659.913	10.7755
iii	Meat (mutton and camel )	108.732 m.tons	206.964
iv	Chilled products (organ and frozen )	15029.795 m.tons	0.889
v	Finished leather	0922.548 m.tons	0.579
vi	Bone and bone products	40.358 m.tons	0.579
vii	Milk and milk products	21,605.35	1.173
viii	Miscellaneous ,byproducts	808,687.972 m.tons	0.579

Source –AQD's AWR-2022-23- MT=metric tons

Table No .03 Splitted items exported in Livestock, poultry and by products (2022-23)

<b>A.</b>	<b>Livestock (live animals )</b>	<b>Nos/Qty</b>	<b>Details</b>
I	Pet animals	739	Dogs and cats
ii	camel	145	Both males and females
Iii	Cattles	350	Young bulls
Iv	Cows (female )	100	Adults
V	Cows with calves	130	Both adult /young calves
Vi	Honey bees	1464	
<b>B</b>	<b>Poultry birds</b>	<b>Nos/ Qty (million)</b>	<b>Details</b>
I	Breeders ,layers and broilers	5.184	Adult /healthy
ii	Other birds	0.2614	Adult /healthy
Iii	Cockrals	5.445	Adults
iv	Table eggs	605.278	Fresh
v	Pasteurized liquid ,whole eggs	0.608	Fresh
vi	Day old chicks .1 million	19.115	Live –healthy
Vii	Hatching eggs (fertile )	38.878	Fertile
<b>C</b>	Meat snd meat products	721121.227-	
	. chilled mutton	19. tons	
	.beef		
	.organs		
	.frozen meat		
	.various meal products		
<b>D</b>	Animal feed	1382.577	
	.pet	M.tons	
	.feed additives		
	.poultry feed		
	.Meat and bone meal		

## LITTLE DISCUSSION

It can be easily concluded that based on the exported items only , in ONE YEAR’S EXPORT as quantified by the AQDeptt, Karachi , forwarded by Zargham Nawaz Butt et al (2024) venues and items targeted in livestock by products attract investors to explore specified chosen areas , most suited the beginners and /or already involved in livestock production .In addition livestock products and by products namely (i) meat products namely ready to eat (RTE) ,or precooked items namely Ready To Cook (RTC) .(iii) oils and fats (tallow) from boiled bones , (iii) organic fertilizers , bone by products namely gelatine (edible and pharmaceutical grades) . Di –Calcium Phosphate (DCP) and other products are the areas where investors can jump –in and can become part of this trade (both imports and exports ) as livestock industry in an open venue as an industry (N Hafeez - 2011)

## CONCLUSIONS

Based on a few items exported from Pakistan to other countries , just for one year (2021-22) and when compared with data of 2022-23 , it can be concluded that positive evidences are sufficient for investment in various areas of livestock products and by products business in Pakistan .

## REFERENCES

- Zargham Nawaz Butt ;Zainul Abideen and Maqbool Ahmad (2024) .Livestock by products exports from Pakistan , during the year 2022-23, Pak.Jlsc ,Vol-XVI,No-16,147-pp1215-1225
- PESR (2022-23) Livestock and poultry sector update: Agriculture chapter-Pak Economic Survey Report, Economic Advisors wing , M/o Finance , GoP, Isbd.
- AWR, AQD –(2022-23) Livestock import and export data ,Annual Working Report of Animal Quarantine Deptt (GoP) , Karachi
- Muhammad Hafeez (2009) , (2016),Investment in Livestock Sector : A Real Business in Pakistan and Pakjlsc Vol XI,XIII and XV various volumes
- Muhammad Hafeez (2023) Livestock and its allied Industries of Pakistan –Book 2023 ,FCS Publication , Isbd .

## PARASITOLOGICAL AND POULTRY DIAGNOSTIC WORK CONDUCT AT THE VETERINARY RESEARCH INSTITUTE, PESHAWAR

Hamza Khan<sup>1</sup>, Sajid khan<sup>2</sup>, Anwar Mahmood<sup>3</sup>, Muhammad Irshad<sup>4</sup>, Barakat Khan<sup>5</sup> and Tariq Ali<sup>6</sup>

### ABSTRACT

This article describes the diagnostic work carried out at the Centre of Parasitology and Poultry (CPP), Veterinary Research Institute, Peshawar, during 2023–24. A total of 3,760 samples were examined, including 1,955 blood samples and 1,584 fecal samples. Of these, 46 samples were processed through PCR for haemoparasites detection, while an additional 46 blood/fecal samples were submitted from government farms or collected during outbreaks. In addition, 129 fecal samples from Markhors at VRDIC Chitral were diagnosed. Farmers and stakeholders were provided diagnostic results along with recommended anthelmintics. Traditionally, microscopy was the only diagnostic method for haemoparasitic and gastrointestinal parasites. Recently, however, PCR has been introduced commercially for the detection of *Anaplasma*, *Theileria*, and *Babesia*. In a comparative study of 150 blood samples, microscopy detected *Theileria* in 29 cases (19.3%), whereas PCR detected 37 cases (24.6%). The Poultry Husbandry Section of CPP also produced 237,087 fertile eggs during 2023–24 for the use in Newcastle Disease (ND) vaccine production. The article concludes with a recommendation to restore the research allowance and enhance future allocations for research support.

**Keywords:** Helminthology, Protozoology, haemoparasites, *Anaplasma*

Article Received : July 2025    Article Accepted : Aug 2025    Article Published : Dec 2025

### INTRODUCTION

Parasitic infections have existed for centuries, and their remedial and symptomatic treatments were traditionally managed through herbal medicines, both in livestock and in human beings. In addition to clinical signs, practical observations of ectoparasites—such as mites, ticks, lice, fleas, and dermatophytes—as well as internal parasites (namely helminths, often evidenced by their oozing out in feces) were commonly used for diagnosis and subsequent treatment. Historical references, including early records from Machin (1910, 1929) and various Ayurvedic texts, highlight these early diagnostic and treatment practices.

<sup>1</sup> Research Officer, Center of Parasitology and Poultry, Veterinary Research Institute, Peshawar, Pakistan

<sup>2</sup> Senior Research Officer, Center of Parasitology and Poultry, Veterinary Research Institute, Peshawar, Pakistan

<sup>3</sup> Principal Research Officer, Center of Parasitology and Poultry, Veterinary Research Institute, Peshawar, Pakistan

The diagnostic work of internal parasites in fecal and blood samples advanced significantly with the invention of the stereoscope (1886) and the microscope (1890), as documented by Wilson & Miles (1929) (2005) and Mönnig's Parasitology (1830) and (1960). These developments laid the foundation for parasitological diagnostics. In the 20th century, the advent of Polymerase Chain Reaction (PCR) technology—based on the detection of specific antigens—further revolutionized diagnostic accuracy. Recent evidence from parasitology centers, including EDC Attamtoiga (2020) for *Anaplasma* and *Theileria* species, as well as studies by Barbosa (2020), CVL (2020), and NADC (2022), has validated PCR protocols for Haemoparasitic diseases. Responding to farmers' demand, the Parasitology Centre has initiated PCR-based diagnostic services on commercial basis since May 2023, representing a promising approach for generating Non-Tax Revenue (NTR).

In addition, the Centre of Parasitology has been engaged in advanced research projects, including:

- i) Development of Loop-Mediated Isothermal Amplification (LAMP) for the detection of important Haemoparasitic diseases of bovines.
- ii) Development of an *in vitro* culture facility for *Theileria annulata*. Both projects have been approved by the National Science Foundation of Pakistan (NSFP) and reflect ongoing efforts to enhance diagnostic capacity and research excellence in veterinary parasitology
- iii) A project entitled “Proteomic analysis of *Haemonchus contortus* for identification of vaccine candidates and selection of recombinant proteins for vaccine production” has been initiated under the Agriculture Linkage Program (ALP). This project aims to identify potential vaccine targets and develop recombinant proteins that may be used in vaccine production against *H. contortus*, one of the most economically important helminths in small ruminants.

In addition, comparative efficacy studies were conducted on the diagnosis of haemoparasitic infections. A total of 150 blood samples were examined for *Theileria* species. Of these, 29 samples (19.3%) were found positive by conventional microscopy, while 30 samples (24.6%) were confirmed positive through PCR. Detailed results of this

comparative diagnostic evaluation are available in the Annual Reports of VRI Peshawar (2023–24).

This improvement in diagnostic accuracy has been largely attributed to the availability of modern equipment, including microscopes, stereoscopes, and PCR technology. Although molecular methodologies are relatively costly, they represent the most precise diagnostic option. As a result, the previously common diagnostic category of “doubtful” cases is no longer required, thereby strengthening the reliability of laboratory reports.

This report presents a recent account of parasitological diagnostic work—including helminthology, entomology, and protozoology—conducted during the year 2023–24, along with activities .

The Poultry Husbandry Section was transferred from VRI Peshawar Headquarters to Poultry Research Institute (PRI) , Jaba, Mansehra, due to environmental considerations. From this facility, local crossbred poultry birds are produced and distributed to farming communities, while fertile eggs are supplied to the Viral Vaccines Section for Newcastle Disease (ND) vaccine production throughout the year as per demand.

## MATERIAL AND METHODS

This article is based on the following documents and record reproduced from various sections of Centre of Parasitology and Poultry Husbandry (CPPH), of VRI Peshawar .

- (i) Work carried out in Helminthology and Protozoology section for the period 2022-23.
- (ii) Practical work done in hide and skin, and entomology section in the period under report.
- (iii) Task completed in the poultry husbandry section during the period July 2023 to June 2024.
- (iv) Reports of research projects carried out during the period 2023-24.

## RESULTS AND DISCUSSION

### RESULTS

#### I. Helminthology and Protozoology section

During the reported period, a total of 3,760 samples were subjected to diagnostic work. These included 1,955 blood samples and 1,584 fecal samples submitted by farmers, along with 46 samples processed through PCR for haemoparasites detection. In addition, 46 blood/fecal samples were submitted by government farms or collected during outbreaks. Two separate batches comprising 53 and 76 fecal samples (total 129) from Markhors at VRDIC Chitral were also examined, and results were communicated with recommended anthelmintics.

**Table 01.** Diagnostic samples processed at CPP, VRI Peshawar

S/No.	Type of Samples processed	Quantity (n)
1.	Fecal Samples (Microscopy)	1,584
2.	Blood Samples (Microscopy)	1,955
3.	PCR Samples (Haemoparasites)	46
4.	Markhor Fecal Samples	129
5.	Government Farm Samples	46
6.	Total	3,760

## II. Poultry Husbandry Section

This section is flourishing producing fertile eggs for utilization in ND Vaccine production at VRI Headquarter in viral vaccine section, where a total of 237087 Nos: of fertile eggs were supplied during financial year 2023-24.

## CONCLUSIONS

The Centre of Parasitology and Poultry remains actively engaged in:

1. **Diagnostic services** for haemoparasites and helminthic infections, along with recommending suitable anthelmintics to farmers. Livestock farmers, government departments, and progressive farmers regularly benefit from these expert services.
2. **Entomological work** on ectoparasites
3. **Research and academic collaboration**, as VRI Peshawar continues to receive graduate students for studies in Protozoology, Helminthology, and Haemoparasitology. This reflects the confidence of universities in the institute's equipment, facilities, and research supervision.

## RECOMMENDATION

(i) It is recommended that research grants be increased in the upcoming Khyber Pakhtunkhwa budget allocations, exclusively for the Veterinary Research Institute (VRI) Peshawar. This will not only support graduate students from various universities, but also ensure the availability of essential chemicals, biochemical reagents, antigens, and other consumables. Without adequate funding, such sophisticated research work may be hampered due to shortages.

(ii) A research allowance, previously permissible at the rate of 20% of the initial basic pay of researchers, has since been discontinued. This allowance served as a token of encouragement. Recently, a disparity allowance of 30% has been demanded by all government employees and appears to be adjusted in the proposed new pay scale. It is therefore recommended that the research allowance be resumed to provide due recognition and motivation to research staff.

(iii) The number of samples being received for laboratory examination is steadily increasing. On average, 30–40 samples of blood, feces, and morbid materials (dead birds/chicks) are submitted daily for diagnostic

and post-mortem examination, thus farmers are advised to take benefit from the facilities available , at VRI Pesawar.

## REFERENCES

1. Wilson and Miles (2005). Text book: Topley and Wilsons principles of Bacteriology, Virology and Immunology.
2. Mönnig's (1966), Text book at Helminthology protozoology and entomology, Sand hart publication US.
3. CVL (2020) utilization of PCR technology in haemoparasites, central Vety Laboratory Weybridge Survey UK
4. NADC (1984) (2001) (2021) implication of recent Diagnostic technologies using PCR and other tests in Protozoology and Bacteria, including viruses: National Animal Disease Centre, US Ames, Iowa, UA.
5. CDC (2020), Diagnostic Techniques using PCR and other test in haematology and other microbiology Centre for Disease Control, Atlanta US

## RECENT DISEASE DIAGNOSTIC WORK EVIDENCED AT CENTRE OF MICROBIOLOGY VRI PESHAWAR 2023-24

Hamidullah<sup>1</sup>, Aziz Ullah<sup>2</sup>, Hayaz Uddin<sup>3</sup>, Muhammad Abbas<sup>4</sup>, Muhammad Tufail Ahmed Khan<sup>5</sup>, Najeebullah<sup>6</sup>, Muhammad Nauman Ul Islam<sup>7</sup> and Imtiaz Ali Shah<sup>8</sup>

### ABSTRACT

This article envisages briefly the disease diagnostic quantum of work done in various technical sections of the Centre of Microbiology at VRI Headquarter Peshawar for the period 2023-24 pertaining to the sections namely (i) Brucellosis, (ii) Mastitis, (iii) Pathology and Bacteriology (iv) Animal Reproduction and Genetics, (v) Poultry Pathology, (vi) Tuberculosis, Veterinary Public Health, and lastly (vii) the Virology Section. A total of 1876 cattle serum samples were subjected to RBPT, PA, and MRT; (22 goats; 7 sheep), while 823 human samples (508 and 3150-f) were also subjected to seroagglutination with an experimental oil adjuvant vaccine using Montanide and RB-51 strain used in the experimental stage. In the mastitis section, a total of 540 milk samples were screened for sub-clinical mastitis from cattle (94), buffalo (156), and 10 goat samples. The Pathology and Bacteriology Section processed suspect morbid material for bacterial isolation; the number is available in the detailed annual report of the year. The animal reproduction and genetic lab carried out 400 samples (200 blood + 200 milk) for DNA collection, quantification, PCR amplification, and gel electrophoresis, while 34 sheep blood samples were processed for D-loop and Cox-1 gene analyses from Kutta sheep of Dir. The poultry pathology section carried out Ab-titre of NCD = 111 samples, Avian influenza NCD = 15 HA for ND-Harvest = 66 SPAT for Salmonellosis = 71, while Mycoplasma 114 ELISA for IB-09 ELISA for ND = 36, respectively. In the Tuberculosis & Path section, 172 samples were diagnosed for AFB and fecal samples for cryptosporidium, etc. In the virology section, 129 FMDV samples were subjected to ELISA, with 75 negative and 56 positives. In addition, the virology section analyzed 718 samples through PCR including Canine Distemper = 217, LSD = 210, BVD = 57, IB = 54, NP = 33, FMD = 19, PPR = 06, Mycoplasma = 66 + 08 MCCP = 4, and Clostridia = 44, respectively. Lastly, the CMB provided facilities for postgraduate research of university students and helped assist internees together with farmer's advisory services.

**Keywords:** Disease diagnosis bacterial, viral, fungal, MB Center, VRI-Peshawar, Pakistan

Article Received: July 2025, Article Accepted: Sept 2025 Article Published: Dec 2025

### INTRODUCTION

Veterinary Research Institutions are working in the country at Peshawar, Lahore, Quetta, Tando Jam, Islamabad, and Divisional Disease Investigation Labs (DDLs) have been providing services to livestock and poultry farmers for the last 6-7 decades. Approximately 2-3% of dead poultry birds/young chicks benefit from such institutions where professionally qualified personnel and facilities are available.

With overall blessings of Almighty Allah (SWT), both veterinarians and farmers are concerned with Animal Healthcare Services (AHCSS) of live animals and poultry in

- 
- Research Officer, VRI, Peshawar
  - Senior Research Officer, VRI, Peshawar
  - Principal Research Officer, VRI, Peshawar
  - Corresponding Author: youngdr66@gmail.com

a coordinated atmosphere, and a mutual trust has developed whereby farmers collect their dead birds (poultry and young chicks) early in the morning from their sheds and rush to the nearest diagnostic centers.

This article is limited to Veterinary Research Institute (VRI) Peshawar. The recent work done on disease investigation will be targeted only, alongside a glance at the national overview of the livestock sector.

The National herd of livestock comprised cattle = 57.50 million, buffaloes = 46.30 million, sheep = 32.70 million, goats = 87 million, and camels 1.20 million during the year 2023-24 (PESR). The poultry birds domestic = 95.50 million and commercial = 1968.7 million.

The livestock sector growth rate was recorded as 3.9%, while the poultry sector (birds, ducks, eggs, etc.) showed a composite growth rate of 7.3% (details are available in the above-mentioned report of PESR-2023-24). The Khyber Pakhtunkhwa Livestock survey conducted in 2020 provided an update of livestock population in millions: cattle = 8.840, buffalo = 3.402 (locating cows = 2.498 and lactating buffalo = 0.747), sheep = 4.219, and goats = 10.04, respectively (KPK 2020). The total poultry birds were recorded as = 19.130 million, while other detailed information on number of farmers, etc., is available in the same survey reported in 2020.

As we discuss the current status of disease diagnostic efforts at VRI Peshawar, in the Centre of Microbiology and Bio-Technology (CNB), first of all, the estimated/pre-emptive livestock population as of 2023-24 be records as cattle = 9.406 million, buffalo = 3.54 million, sheep = 4.54 million, and goats = 10.80 million, considering the National animal growth factor of 3.9% respectively (LDF/information Livestock, 2024).

The CMB at VRI Headquarter Peshawar has been performing its routine obligatory tasks as per its objective and in line with the overall mandate of the organization in helping farmers for disease diagnosis in each of the sections namely: (i) Brucellosis, (ii) Mastitis, (iii) Pathology and Bacteriology, (iv) Animal Reproduction and Genetics, (v) Poultry Pathology, (vi) Tuberculosis and Public Health, and lastly (vii) The Virology Section. The work carried out in these sections is briefly presented herein on the format of Pakistan Journal of Livestock Sciences (PjLSc - Online pakjsc) to be published in the forthcoming issue of Volume XVII-No-17, 2025, hopefully in Dec 2025, Insha'Allah.

## **MATERIAL AND METHODS**

This effort is based on the following documents/reports taken from the Daily Routine Registers (DRRs) and cumulatively summarized:

1. Annual sectional reports of VRI Headquarter the year under report - 2023-24
2. Final annual progress of VRI Peshawar (2023-24)
3. Individual Research Officer's (RO)'s project reports (2023-24)

4. The article covers the period July 2023 to June 2024 and relevant data of PESR & other documents
5. Recent efforts from the book entitled "A Concise & Practical Approach in Veterinary Microbiology 2025."

## RESULTS AND DISCUSSION

### RESULTS

1. **Brucellosis section:** A total of 1876 serum samples were subjected to Serum Plate Agglutination Test (SPAT), Rose-Bengal Plate Test (RBPT = 943), Milk Ring Test (MRT = 20), Enzyme Linked Immunosorbent Assay (ELISA = 738), and Polymerase Chain Reaction (PCR = 145) from various animal species (cattle = 1846, goats = 22, sheep = 7, and dog = 1) collected/received from 10 districts. In addition, 823 human serum samples were subjected to serological tests: RBPT = 262, i-ELISA = 210, and PCR = 18. Details of area, sex, age, and fractional age (M and G) are given in the detailed report (2023-24). In addition, a trial of Brucella abortus strain R-B-51 oil vaccine was conducted using Montanide TM oil-ISA-50 in 20 cattle for immunization which gave very little response.
2. **Mastitis Section:** Routine mastitis testing of milk samples was carried out. During the period, 540 such samples were subjected to California Mastitis Test (CMT) from cows = 394, buffaloes = 136, and goats = 10. Overall, 71.10% samples showed sub-clinical mastitis. In addition, 40 out of 540 samples (7.40%) showed clinical mastitis, while 27 out of 540 (5%) showed blood in milk. Area-wise and species-wise details are available in the final annual report of VRI Peshawar 2013-24.
3. **Pathology and Bacteriology Section:** During the reported period, a total of 540 suspected subclinical milk samples were examined for mastitis (cows = 394; 73.1% positive), buffaloes = 136 (67.7%), and goats out of 10, positive samples. Clinical mastitis was recorded as 31 out of 394 = 7.9% positive in cows, 6.6% in buffaloes, while goats were all negative. Blood in milk was recorded in 25 cows (6.4%) and 2 buffaloes (1.5%). The distribution of these samples area-wise is also displayed in the detailed report 2023-24.
4. **Pathology and Bacteriology Section:** Being the main section of VRI Peshawar, in addition to its research obligations, the diagnosis of various suspected samples was subjected to bacterial isolation (Details available in the animal report of VRI Peshawar).
5. **Animal Reproduction and Genetic Lab:** In addition to its routine work, the facility detected beta casein gene variant under which 200 blood and 200 milk samples were subjected to DNA collection, quantification, PCR amplification

of cattle genetic resources and phylogenetic and diversity analysis in Kuta sheep (LR&DS-Dir), involving 34 sheep, all successfully completed.

6. **Poultry Pathology Section :** Daily post-mortem work of dead birds brought to this section by farmers was conducted; the work carried out indicated Ab-titre for NCD = 111, Avian influenza = 15, HA for ND-hardest form, VV section for IB = 09, ELISA for AI = 12, and ELISA for ND = 36 samples respectively.
7. **Tuberculosis and Veterinary Public Health Section:** In addition to obligatory functions, detection of AFB in milk, fecal samples and PPD tuberculosis tests were carried out. A total of 172 samples (5 milk, 145 fecal, and 11 cryptosporidium) were examined.
8. **Virology Section:** The virology section analysed 131 samples of FMDV (serotype O = 29, A = 10, Asia-1 = 15) subjected to ELISA testing, with 75 positive (57.25%) and 56 negative (42.77%). Samples collected for suspected tests of Peste des Petits Ruminants (PPR) numbered 30 and were subjected to ELISA with negative results. The area distribution was: Nowshera = 13, Khyber = 3, and Peshawar = 14, respectively. Furthermore, 718 samples were referred for PCR testing, including Canine Distemper Virus = 217, Lumpy Skin Disease = 210, Bovine Viral Diarrhea = 57, Newcastle Disease = 33, FMD (Serotype O) = 19, PPR Virus = 6, Mycoplasma gallisepticum = 66, Mycoplasma bovis = 8, MCCP = 4, and Clostridium perfringens types B and D = 44. RNA and DNA extractions and cDNA syntheses were performed on 192, 123, and 136 samples, respectively. Additionally, 192 samples were subjected to gel electrophoresis for research purposes during 2023-24.
9. **Miscellaneous Tasks Undertaken:**
  - The following miscellaneous tasks were undertaken
    - a) Graduate students were supervised for their thesis research work across various universities in the country.
    - b) Internees were acquainted with the workings of the centre.
    - c) Farmers' advisory services continued.
    - d) Animal health Care Services (AHCSS) were provided to L&DD (Extension), KPK Wildlife, Pak Army, and Governor House Livestock units.
    - e) Outbreak investigation work was conducted as required.

## DISCUSSION

This centre, being the main diagnostic and research-oriented entity, was as usual heavily involved in its mandated obligations. The research team, headed by a Senior Research Officer (SRO), 1-2 Research Officers (ROs), and supported by technical para-research staff (Lab.Techs, Lab.Assistants, and Lab Attendants), remained actively engaged as per the annual approved work plan starting July

2023 and successfully completed its targets. Hardly one or two such institutions perform this detailed work hence other organizations and universities send their personnel for training and thesis research at VRI Peshawar.

According to a comparison of two VRI reports (2020-21) published in Pak-JLSc by Pervez Shah 2022, this centre's disease diagnostic quantum sampled 53,682 (in 2019-20) and 54,450 (in 2020-21) respectively. To avoid long paragraphs, most details are available in the annual report of VRI Peshawar (2023-24).

It is ascertained that this centre continues its function of assisting livestock farmers for disease investigation, supervising graduate students for their thesis research, supporting internees, and maximizing utilization of facilities (equipment, personnel, and chemicals) made available for this sacred task in line with national and international commitments under the OIE guidelines and WTO Sanitary and Phytosanitary (SPS) agreements of 2001-2005 and 2012 respectively.

## REFERENCES

- Pervez Shah, Muhammad Ijaz, and Mirza Ali Khan (2022). A Brief overview of comparison of two annual reports of VRI Peshawar. P.JLSC Vol-XIV No.-14, pp. 1136-1144.
- Directorate General L&DD (Extn) (2020) Livestock survey of Khyber PK.
- PESR (2022-23), (2023-24), (2024-25) Livestock and poultry sector update, agriculture chapter - Pakistan Economy Survey Reports, Economic Advisors Wing, Finance Division, Ministry of Finance, GOP Islamabad.
- VRI Peshawar (2023-24), (2024-25) Annual Reports of Veterinary Research Institute, Peshawar, Khyber Pakhtunkhwa.
- OIE (2005), (2008), (2013) updates of Office International des Epizooties, obligations and commitments in Animal Disease Reporting from 202 Member Countries. WTO (2001), (2006) - SPS Agreement on Sanitary & Phytosanitary Conditions, agreements and commitments, UN.
- Muhammad Hafeez (2025), Diagnostic approaches using various equipment in microorganisms: A concise and practical approach in Veterinary Microbiology, 2025, ISBN Regd. FCS Publications Islamabad.

## EFFECT OF FETAL BOVINE SERUM VS HORSE SERUM ON REVIVAL , PROLIFIRATION OF BHK-21 CELL LINE FOR FMD VACCINE PRODUCTION

Shahid Khan<sup>1</sup>, Dost Muhammad Khan<sup>2</sup>, Hammad Ullah<sup>2</sup>, Sania Subhan Qureshi<sup>2</sup>, Hameed Ullah<sup>2</sup>,  
Arooba Akhter<sup>2</sup>, and Faiza Ashraf<sup>2</sup>

### ABSTRACT

A study was conducted to analyze growth-promoting effect of serum type and concentration on Baby Hamster Kidney- 21 cell line (BHK-21) including Fetal Bovine Serum (FBS) and Horse serum (HS). Different concentrations of FBS and HS serum were used including 5%, 10%, 15% and 20%. Automated cell counter was used to check cell growth. For this purpose, cells were cultured over cell culture flask. Equal cells were distributed among cell culture flasks after adding growth media of respective serum concentration. Experiment was performed in triplicate. More growth of BHK- 21 cells was observed in 10% FBS which was  $3.35 \times 10^4$  /ml. A 10% FBS was followed by 5% FBS having cell growth i.e.,  $2.89 \times 10^4$  /ml. As far as Horse serum is concerned, more growth was found in 15% FBS i.e.,  $1.501 \times 10^4$  /ml which was even less than 5% FBS. Cell morphology was better with use of Fetal Bovine Serum (FBS) as compared to Horse serum. Chi- square method was applied to check the significance of data. The difference between data was found significant statistically as 'p' value was found less than 0.05.

Keywords: BHK- 21 cell line, serum, fetal calf serum, horse serum.

Article Received : August 2025 Article Accepted : Sept 2025 Article Published :Dec2025

### INTRODUCTION

Livestock is an important sector in the economy of Pakistan contributing 62.68% share in agriculture GDP and 14.36 % in overall GDP, (Economic Survey of Pakistan 2022-23). Nearly 8 million rural families are involved in livestock raising directly or indirectly getting more than 35% income. However, inspite of this importance the livestock sector is facing with great challenges of low productivity. One of the reasons of low productivity is the prevalence of various infectious diseases of livestock including Foot and Mouth disease (FMD). This FMD is an economically devastating disease and a major cause of ban on export of livestock and its products to other countries and is causing a huge loss of 6 billion rupees annually in Pakistan (Zulfikar, 2003). New serotypes of FMD are also emerging which is a threat to FMD disease-free countries (Dopazo *et al.*, 1988).

The disease is caused by a non-enveloped single stranded RNA virus of genus Aphthovirus of family Picornaviridae occurring in seven different serotypes such as A O, C, SAT1, SAT2, SAT3 and Asia-1. (Longjam *et al.*,2011).

- Senior Research Officer (FMDVRC, VRI, Peshawar)
- Research Officer (FMDVRC,VRI, Peshawar)

FMD exists throughout the world, except in some countries included European regions, North America, New Zealand and Australia. (Kitching *et al.*, 2007). Three of serotypes A, O and Asia 1 are endemic in Asia including Central and South East Asia (Pacheco *et al.*, 2016). Most antigenically serotype of FMD virus is serotype A. (Knowles. *et al*, 2003). This is more stable at a pH between 7.4 and 7.6 and there is fast destruction upon changing its pH (Fraser, 1991). It can remain below 4°C and may be stored under freezing temperature for long time. There are 7 serovars of FMDV. Serovar O and A were first reported by Vallée and Carree. *et al* (1922). They noted that recovered cattles from FMD virus of France again showed signs and symptoms when mingled with animals affected from FMD virus originated in Germany. According to place of origin, serovar O was named after Department of Oise in France and A for Allemagne (French word which means Germany). Another serotype C was reported by Waldmann and Trautwein (Waldmann *et al*, 1926), while SAT 1, 2 and 3 were detected from FMDV in South African Territories and named after them. (Brooksby, 1958). The Seventh serovar Asia-1 was reported in Okara, Punjab, Pakistan in 1954 (Brooksby *et al*, 1950). The virus exists as seven distinct serotypes (O, A, C, Asia1 and Southern African Territories (SAT) 1-3 with multiple subtypes in each serotype (Muhammad K. *et al.*, 2012). Out of these, only “A”, “O” and “Asia-1” types of FMD virus are prevailing in Pakistan (Khuwaja *et al.*, 2009).

As FMD is contagious and is usually transmitted by direct contact between infected and healthy animals, Cases of indirect contact are also observed via people, wild animals, birds, vehicles, fomites and animal products including milk and meat. Wind borne transmission is also possible but is it not common as it requires particular climatic and epidemiological conditions. (Alexandersen S., *et al*, 2002). Virus is primarily found in oropharyngeal fluid but presence of virus in blood in and nasal fluid indicates that disease is in its preclinical state. (Chase-topping., *et al*, 2013). Serotype O can be easily transmitted to both cattle and swine under controlled conditions regardless of donor species. In contrast A is only transmitted to swine and its transmissible to steer is less severe. Pigs had severe, rapid and contagious disease when infected with serotype A by direct inoculation or contact exposure by infecting with inoculum of bovine derived virus. (Pacheco *et al*, 2016)

Clinical signs of FMD include massive erosions on tongue and inner side of buccal cavity leads to excessive salivation and vesicles on legs, hence animal is unable to walk or stand. (Blood *et al*, 1989). There is high fever in this disease reaching to 104-106 °F and Susceptible animals include cattle, sheep goat, other cloven footed animals and pig. The morbidity is as high as 100 % and its mortality is high in young animals in one locality due to lack of

milk from infected dam and myocarditis. . The primary sign in 54% of dairy animals is appearance of vesicles on teat. (Yoon *et al*, 2012).

For prevention and control of FMD, regular vaccination against it may be reasonable strategy by using good quality FMD vaccine. For FMD vaccine production contamination free cell culture is of utmost importance. Cell culture is use for the isolation and propagation of viruses (Butler, 2003; Zhang *et al.*, 2013) and is categorize as primary cell culture and cell lines. Primary cells offer a method of choice for the isolation of viruses from the clinical specimen while cell lines are routinely use for achieving high biological titer of animal viruses (Castillo *et al.*, 1991). A number of cell lines of mammalian origin i.e., BHK-21, MDCK, MDBK, HeLa, and Vero are employed in the animal virology laboratories. All of the cell lines vary in their spectrum and degree of sensitivity for the virus growth (Freshney, 1998). The cell lines which yield a high titer virus are preferred for the mass propagation of the viruses (Kretzmer, 2002).

Baby Hamster Kidney cells are adhesive and cancerous fibroblast, derived from kidney of a hamster (Macpherson and Stoker, 1962). Adherent BHK-21 cells are commonly cultured on flasks (glass, plastics), roller drums, multilayer dishes, and roller bottles or Roux flasks (Ryan, 1979).

Not all cells have the same requirements for growth and survival. For successful growth, maintenance and expression of animal cells in vitro, either primary cultures or continuous cell lines, appropriate culture conditions are required that mimic the physiological conditions in vivo and situ.

Serum is frequently added to the medium as a source of nutritional and macromolecular growth factors essential for cell growth. A number of synthetic media have been prepared serum continues to be used in cell culture. The best supplementation to a basal medium is fetal bovine serum (FBS) that is most frequently use for all types of cell cultures. However, due to its high cost and uncertain supply an alternative is sought. Commercially available horse serum is often explored due to its lower cost and suitability for supporting the growth of various cell lines.

As BHK-21 remains the most preferable cell line for FMDV routine laboratory isolation and vaccine production (L. M. Swaney, 1988). The BHK-21 cell line was established in 1961 from the kidneys of 5 Syrian hamsters from litter number 21. Since this time, this cell line has been a laboratory standard for the growth of countless viruses and the study of many biological process (Hernandez *et al*, 2010). To overcome FMD, there is a dire need to develop vaccine containing local isolates of FMDV which will be adopted on BHK-21 cell line. This procedure will need maintenance of BHK-21 cell line. There are

multiple steps such as growth, harvesting, storage and revival for persistent cultivation and maintenance of adherent BHK-21 cell line in Cell Culture Laboratories. (Rahman. *et al*, 2007).

The main aim of the present study is to investigate the influence of horse serum in comparison to Fetal Bovine Serum on BHK-21 cell line viability, morphology and cell proliferation.

## **MATERIAL AND METHODS:**

### **Growth and Maintenance of BHK-21 Cells**

1. The BHK-21 cells were procured from the frozen cell repository of the Cell Culture Section of Foot & Mouth Disease Vaccine Research Center (FMDVRC) of Veterinary Research Institute, Peshawar. The cryopreserved cells was revived using standard procedure (Rehman *et al.*, 2007).
2. Glasgow's minimum essential media (GMEM) Media was used for the purpose of growth of cells.
3. Propagation of Glasgow's minimum essential media (GMEM) Media The GMEM was prepared as per manufacturer's instructions and was used for the revival and propagation of cells supplemented with penicillin (1000 IU/ml), streptomycin (200 µg/ml), and Amphotericin B (5 µg/ml).
4. A one sachet of GMEM was dissolved in 01 liter double distilled water. Then Sodium bicarbonate was added to maintain pH at 7.2 to 7.6. After that the Media was filtered via filtration assembly. Ten ml of media was collected in falcon tube and tested for sterility.
5. Revival of BHK-21 cells from cells repository was done as per ATCC Animal Cell Culture guide. 25 ml of growth media was taken T-75. Cryovails containing frozen cells were thawed and poured in 15 ml falcon tube containing 9ml media. Tube was centrifuged at 2000 rpm for 10 minutes. After that supernatant was discarded and 3 ml growth media was added in falcon tube and vortexed for few seconds. Growth media containing cells were poured in T-25 plate and incubated for 24 hours. All the procedures were performed in Biosafety Cabinet-II/Class A2.
6. Preparing 25 square cm flasks for each serum concentration: A 75 square cm cell culture was confluent after 24 hours. Total of eight 25 square cm were prepared containing growth media 5%, 10%, 15% and 20% of (FBS) and Hrse Serum respectively. A sterilized 75 square cm flask was trypsinised and equal amount of cells were cultured in that eight 25 square cm flasks for routine Production of a single Batch ..

After 24 hours cell growth was checked with help of Automated Cell Counter (ACC). Procedure described in Sceptor Handheld Automated Cell Counter User Guide and was followed. Each 25 square

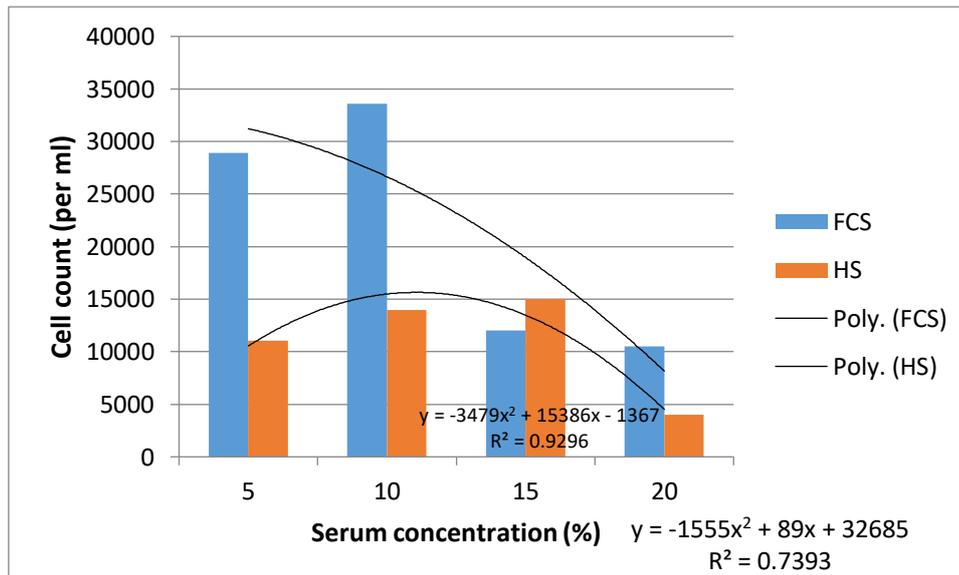
cm flask was trypsinised, 100 ul of cells and 400ul/ of GMEM added in respective Eppendorf tube. After that sensor of Cell Counter was attached and counting was performed as per instructions.

## RESULTS AND DISCUSSION

### RESULTS:

Highest cell count was observed in 10% FBS which was  $3.35 \times 10^4$  / ml followed by 5% FBS ( $2.89 \times 10^4$  / ml), then 15% ( $1.200 \times 10^4$  / ml). Least cell count was observed in 20% FBS which was  $1.048 \times 10^4$  / ml.

As far as horse serum is concerned, greatest cell count was observed in 15% HS but that was even less than 5% FBS. It was followed by 10% i.e.,  $1.396 \times 10^4$  / ml then 5% i.e.,  $1.105 \times 10^4$  / ml and least cell count was observed in 20% HS ( $4.004 \times 10^3$  / ml).



As Horse serum showed less cell count, it was not recommended for adaptation purpose. P value was found (less than 0.001) which showed that analyzed is highly significant.

### DISCUSSION:

Different types of cell lines can be used for adaptation of FMD virus. These cell lines include bovine kidney cell line, calf thyroid, Baby Hamster Kidney-21 cell line and LFBK cell line etc. Serum is frequently used as growth promoter in cell culturing. In this study, fetal bovine serum was compared with horse serum. Different percentages of fetal bovine serum and horse serum were used including 5%, 10%, 15% and 20%. The 10% fetal bovine serum showed best result. A previous study showed that FCS as best for BHK 21 cell growth

and its concentration should be 5-7.5 % for desired effect (Rahman *et al.*, 2006). This study goes parallel with our findings. In another study, goat serum was compared with fetal bovine serum (FBS). The best among all serum was FBS. As FBS is costly so we need to search for alternative sources. Commercially available sera from goat, human, sheep, new born calf and horse blood were compared. The serum of goat was found appropriate for most of primary cultures and cell lines (Paranjape 2004). FCS has a growth stimulating effect and 5 -10% serum level being the best for of cell line maintenance (Rabbani *et al.*, 2007). These findings coincides with our study which showed that FBS as best for growth of BHK-21 cells.

Appropriate serum quantity is required to give maximum cell count of BHK-21 cells. For BHK-21 cell culturing, 5 -10% fetal calf serum gives more appropriate result. For detachment of BHK-21 cells 0.25% trypsin (EDTA-free) is found best (Rabbani *et al.*, 2007). In contrast to previous study, 10% fetal bovine serum was used and 0.25% EDTA added trypsin was used due to their easily availability. For filtration of media 0.2  $\mu$ m syringe filter was used (Rabbani *et al.*, 2007) same filter size used in this study.

#### REFERENCES:

- Alexandersen S., I. Brotherhood, and A. I. Donaldson (2002). Natural aerosol transmission of foot-and-mouth disease virus to pigs: minimal infectious dose for strain O 1 lausanne. *Epidemiology & Infection*, 128(2), 301-312.
- Butler, M., 2003. In: *Animal Cell Culture and Technology*, 2nd edition, pp: 10–27. Internl, T.J. (ed.). Padstow, Cornwall, UK.
- Blood D.C., O.M. Radostits, C.C. Gray. 1989. Disease caused by virus, *Veterinary Medicine*, 7th edition, pp. 824-831.
- Brooksby J.B., and J. Rogers (1950–55). Methods used in typing the virus of Foot-and-mouth disease at Pirbright. *Methods of typing and cultivation of foot-and-mouth disease virus: Project No. 208*. 1957, Paris: European Productivity Agency of the Organization of European Cooperation (OEEC).
- Brooksby, J. (1958). The virus of foot-and-mouth disease. *Adv Virus Res*, 5(1), 37.
- Castillo, A.A., L.D. Morier, F.V. Perez and M.C. Durruthy, 1991. Use of goat serum as substitute for calf serum for growing various primary cultures from vertebrates. *Rev. Cubana. Med. Trop.*, 43: 89–92.
- Chase-Topping M. E., I. Handel, B. M. Bankowski, N. D. Juleff, D. Gibson, S. J. Cox, & P. V. Barnett (2013). Understanding foot-and-mouth disease virus transmission biology: identification of the indicators of infectiousness. *Veterinary research*, 44(1), 46.

- Dopazo J., F. Sobrino, E. L. Palma, E. Domingo, & A. Moya (1988). Gene encoding capsid protein VP1 of foot-and-mouth disease virus: a quasispecies model of molecular evolution. *Proceedings of the National Academy of Sciences*, 85(18), 6811-6815.
- Freshney, R.I., 1998. In: *Culture of Animal Cells: A Manual of Basic Technique*, 2nd edition, pp: 1–3. Alan, R. (ed.). LISS, Inc., New York, USA.
- Fraser C.M. (1991). *The Merck veterinary manual* (ed. NJ Rahway), 7th edition, Merck Co., pp. 338-340.
- Hernandez R., & D. T. Brown (2010). Growth and maintenance of baby hamster kidney (BHK) cells. *Current protocols in microbiology*, 17(1), A-4H.
- Kitching P., J. Hammond, M. Jeggo, B. Charleston, D. Paton, L. Rodriguez, and R. Heckert (2007). Global FMD control—is it an option?. *Vaccine*, 25(30), 5660-5664.
- Khawaja, R. M., K. Muhammad, W. Shahzad, I Hussain, Z. I. Choudhry, F. N. Awan, A. Bukhari, I. Altaf and A. Hanif (2009). Isolation, adaptation and sero-typing of local strains of foot and mouth disease virus Pakistan J. Zool., Suppl. S# 9: (Part II): 173-177.
- Sutmoller, P. (2003). Control and eradication of FMDV, *Virus Res.*, 91: 101-144.
- Knowles N. J., and A. R. Samuel (2003). Molecular epidemiology of foot-and-mouth disease virus. *Virus research*, 91(1), 65-80.
- Kretzmer, G., 2002. *Industrial processes with animal cells* Published online: 11 June 2002. Springer Verlag, Germany.
- Longjam N., R. Deb, A. K. Sarmah, T. Tayo, V. B. Awachat, and V. K. Saxena (2011). A brief review on diagnosis of foot-and-mouth disease of livestock: conventional to molecular tools. *Veterinary medicine international*, 2011. Article ID 905768, 17 pages. doi:10.4061/2011/905768
- Muhammad, K. (2012). Augmentation of combined oil based Foot and Mouth Virus ('O', 'A' and 'Asia-1') and Hemorrhagic Septicemia vaccine production potential and immunoprophylaxis of buffalo and cattle against the diseases. Final technical and financial report, Department of Microbiology, University of Veterinary and Animal Sciences, Lahore (LUMS) .
- Macpherson, I. and M. Stoker, 1962. Baby Hamster Kidney Fibroblast Cells (BHK-21). *Virology*, 16: 147–15.
- Pacheco J. M., K. N. Lee, M. Eschbaumer, E. A. Bishop, E. J. Hartwig, S. J. Pauszek, & H. S. Lee (2016). Evaluation of infectivity, virulence and transmission of FDMV field strains of serotypes O and A isolated in 2010 from outbreaks in the Republic of Korea. *PloS one*, 11(1), e0146445.

- Rahman, Sadeeq-ur., M. Rabbani, Sahidullah, K. Muhammad and Z. Iqbal. (2007). Studies on In Vitro Culture Characteristics of Adherent Baby Hamster Kidney-21 (BHK-21) Cell Line. *International Journal of Agriculture & Biology* 1560–8530/2007/09–6–821–826
- Ryan, J.M., 1979. Effect of different fetal bovine serum concentrations on the replicative life span of cultured chick cells. *In Vitro*, 15: 895–899.
- Swaney L. M. (1988). A continuous bovine kidney cell line for routine assays of foot-and-mouth disease virus. *Veterinary microbiology*, 18(1), 1-14.
- Vallée H., & H. Carré (1922). Sur la pluralité du virus aphteux. *CR Acad. Sci. Paris*, 174, 1498-1500.
- Waldmann O., and T. Zimmermann (1955). Preparation of foot and mouth disease vaccine according to Waldmann and Köbe using calves as the antigen source. *Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene. 1. Abt. Medizinisch-hygienische Bakteriologie, Virusforschung und Parasitologie. Originale*, 163(4), 239-244.
- Yoon H., S. S. Yoon, S. H. Wee, Y. J. Kim, and B. Kim (2012). Clinical manifestations of foot-and-mouth disease during the 2010/2011 epidemic in the Republic of Korea. *Transboundary and emerging diseases*, 59(6), 517-525.
- Zulfiqar M. (2003). Draft report for development of National disease control policy for Foot and Mouth disease in Pakistan, under FAO project “Support for emergency prevention and control of main trans-boundary animal diseases in Pakistan Rinderpest. FMD and PPR”, 90.

## A REVIEW OF OPERATIONAL OUTCOMES AND RESPONSIBILITIES AT ARID ZONE SMALL RUMINANTS RESEARCH INSTITUTE, KOHAT.

Muhammad Idrees<sup>1</sup>, Farman Ullah, and Abdur Raziq<sup>2</sup>

### ABSTRACT

This report as an article summarizes the key operational activities and outcomes of the Arid Zone Small Ruminants Research Institute (AZSRRI), in Kohat. The institute's work focused on providing technical assistance to local goat farmers. In farm management and outputs included the production of 88,400 kg of green fodder and 2,400 kg of wheat grain, with over 5 acres of land prepared for seasonal fodder and other crops. The animal health section conducted extensive diagnostic work, collecting 291 blood samples (243 for routine diagnosis and 48 for a Theileriosis research project) and 96 fecal samples for helminthic analysis. A total of 267 animals and poultry were dewormed. Furthermore, 225 farmers received training and advisory services tailored to specific diseases diagnosed in their herds. A district-level survey recorded theileriosis prevalence as 49.1% in Kohat, 45.0% in Ghumbat, and 38.3% in both Lachi and Dara Adam Khel, areas respectively.

**Keywords:** Small Ruminant Production, Animal Health Diagnostic work, Parasitic Diseases, Theileriosis Prevalence, Agricultural Extension, Kohat Region.

Article received :Aug2025

Article accepted :Sept2025

Article Published :Dec 2025

### INTRODUCTION

The Arid Zone Small Ruminants Research Institute (AZSRRI) in Kohat was established as a developmental project funded by the Provincial Government of Khyber Pakhtunkhwa during 2009-2013. It is located at Ghulam Banda near the Kohat University of Science and Technology (KUST). The institute was founded to address the specific agricultural and economic dynamics of the Kohat region. District Kohat consists mostly of hilly and semi-hilly areas and the farmers are small land holders. Grazing land constitutes about 75% of the total reported land and is classified as subtropical mountain thorn type herbs and shrubs (Habib et al., 2003). The area is about 77% rain and 23% irrigated, hence more suited for rearing sheep and goat (Habib et al, 2013), a sector that plays a vital role in the household economy of the local community.

Historical data from the Livestock Census (2006) underscores the significance of this sector, reporting populations of 64,987 sheep and 355,573 goats in the district. It was

---

• Arid Zone small Ruminants Research Institute, Kohat, KPK

the clear environmental suitability of the region for small ruminants, combined with their established socio-economic importance for the local community, that provided the foundational rationale for creating a dedicated research institute. Consequently, AZSRRRI was initiated to focus exclusively on the advancement, health, and productivity of small ruminants, serving as a central hub for research, development, and farmer support in the arid zones of Khyber Pakhtunkhwa.

## MATERIAL AND METHODS

**STUDY DESIGN :** This study is a retrospective analysis based on the operational records of the Arid Zone Small Ruminants Research and Development Institute (AZSRR&DI), Kohat, for the fiscal year 2023-24..

**Data Collection:** Data were systematically extracted from routine operational records across the institute's core units, encompassing key annual metrics for the 2023-24 period. Which included farm management outputs (fodder production in kg, land area prepared in acres, and livestock culling figures), animal health services (the number of diagnostic blood and fecal samples analyzed, animals dewormed, and Theileriosis prevalence surveys), and agricultural extension activities (the number of farmers trained and provided with tailored advisory services).

**Data Analysis:** The collected data were compiled and analyzed using descriptive statistics. Results are presented as totals, percentages, and, where applicable, prevalence rates to summarize the annual operational outputs and key findings.

## RESULTS AND DISCUSSION

### RESULTS

The operational data for the 2023-24 period demonstrated significant output across all sectors of the institute: the farm management unit produced 88,400 kg of green fodder, 2,400 kg of wheat straw, and 2,500 kg of wheat grain from 250 acres, alongside preparing over 200 canals of land for sowing; the animal health section processed 343 diagnostic samples (291 blood and 52 fecal/milk), dewormed 267 animals, vaccinated 75, and maintained a core herd of 50 sheep and goats .The research project on theileriosis revealed a high prevalence in sheep, with rates of 49.1% in Kohat, 45.0% in Gumbat, 38.3% in Lachi, and 28.9% in Dara Adam Khel

areas and the extension wing successfully provided training and advisory services to 225 farmers.

## DISCUSSION

The findings of this report confirm the pivotal role of the Arid Zone Small Ruminants Research and Development Institute (AZSRR&DI), Kohat, as a hub for livestock development in the region. The Institute's model of integrating farm production, animal health diagnostic work, and farmer's training created a powerful feedback loop where research directly informs extension services. The high prevalence of diseases like Theileriosis, revealed through our research, directly justifies and guides the diagnostic and treatment services provided to farmers. The successful training of 225 farmers, coupled with active collaborations with local veterinary networks and universities, ensured that these research and service outputs are effectively translated into practical benefits for the community, thereby enhancing livestock productivity and farmer livelihoods. Our extensive collaborations with the Veterinary Disease Diagnosis and Research Centre (VDDRC), Kohat, and various veterinary units across The District are essential for amplifying this impact, extending our reach to farmers in Kohat, Hangu, Karak, and surrounding areas.

Furthermore, the institute serves as a critical center for academic capacity building, regularly hosting graduate students from institutions like Kohat University of Science and Technology (KUST) for their research projects. This synergy between research and education fosters the next generation of agricultural scientists. Looking forward, there is a clear need to initiate research projects focused on the phenotypic and genetic characterization of local breeds, such as the Surguli goat and Ghiljio sheep, to secure their certification and conservation. To sustain and enhance these activities, it is recommended that the budget for research supplies be increased. This will ensure consistent support for the growing demands of our diagnostic services, training programs, and vital research initiatives, potentially through a revolving fund allocation from the VRI Headquarters in Peshawar.

## CONCLUSIONS

In conclusion, the institute's operational year demonstrated effective integration of its core functions: the sustained provision of diagnostic services and farmer training successfully addressed critical health and management challenges in small ruminant production; the maintenance of a demonstration flock under Improved Management Practices provided a viable model for genetic conservation and herd improvement; and the strategic scheduling of field visits ensured efficient, farmer-centric service

delivery and sample collection, solidifying the institute's role as a key support hub for the local agricultural community.

### RECOMMENDATIONS

To build upon this success and enhance future impact, the following actions are recommended: actively pursue the publication of research findings in reputable journals such as the Pakistan Journal of Livestock Science to broaden scientific discourse; advocate for the revival of the VRI Peshawar's Journal of Animal Health and Production (JAHP) as a dedicated platform for disseminating regional research; and prioritize securing an increased budget for essential laboratory supplies, potentially sourced from the VRI revolving fund, to reliably support the growing demands of diagnostic, training, and research activities.

### REFERENCES

- VRI Peshawar (2008) establishing arid Zone Small Ruminants Research and Development institute (AZSRR and D.I) Kohat VRI Peshawar animal Report.
- Habib, G., M. Siddiqui and S.M. Suhail. 2003. Livestock action plan: Livestock Management, Feeding and Health in North West Frontier Province, Pakistan FAO Project (TCP/PAK/0168). The Univ. of Agric. Peshawar – Pakistan.
- Habib. G., M. Saleem and A. Hameed. 2013. Mineral composition of local tree leaves for feeding sheep and goats in Kohat district of Khyber Pakhtunkhwa. *Sarhad J. Agric.* 29(1): 97-103.
- Pakistan Bureau of Statistics. (2008). Pakistan livestock census 2006. Government of Pakistan.

## ADVANCING LIVESTOCK PRODUCTION THROUGH APPLIED RESEARCH: INSIGHT FROM LRDS, SUREZAI PESHAWAR

Faiz ul Hassan<sup>1</sup>, Khisrao kalim<sup>2</sup>, Din Muhammad<sup>3</sup>, Zahid Ullah<sup>3</sup>, Ikram Ullah<sup>4</sup>, Sajjad Khan<sup>5</sup>, Naeem Ullah<sup>6</sup>, Muhammad Fakhar uz zaman<sup>7</sup> and Zabit Ullah<sup>8</sup>

### ABSTRACT

Livestock Research & Development Station, Surezai was established with the financial assistance of Dutch Government in 1978-79 and is located at a distance of 25 km in the South West of Peshawar city. In 1986 it was merged with University of Agriculture Peshawar under the USAID Project Transformation and Integration of Agricultural Network (TIPAN). In 2003 it was demerged from University of Agriculture Peshawar and now working under the administrative control of Directorate of Livestock Research & Development KPK Peshawar. Mandate of the station is to conduct research on various aspects of Animal Production, Reproduction, Breeding, Management, Dairy Technology and Animal Health. Carrying out research on various aspects of Animal Nutrition, Fodder & Forages and provision of practical training to the Organizations, Professionals and Livestock/ Poultry farmers. A total number of 201 cross bred (Achai-Jersey cross) maintained at the station in order to enhance the productivity of the native achai breed of the province by crossing with Jersey breed. The total milk produced was 33178 litres while 16047 litres were sold generating revenue of Rs.1925720 during the reported period 2022-23. The remaining milk produced was fed to calves. The animal health (AH) quantum comprised 100% vaccination of the herd against endemic disease (HS, BQ anthrax ET and others) and 100% Deworming done together with 1130 number of animals treated at the farm against different diseases and metabolic disorders. The agriculture section produced seasonal crops of 485997 kgs green fodder fed to the herd (obtained from 25acres of cultivable land). In addition to routine activities at the station, research activities are carried on different parameters such as reproduction, enhanced milk production, new crop varieties development; embryo transfer technology and training of graduate and undergraduate research students/internees are conducted at the station. Advisory services and awareness sessions among the farmers are conducted regularly inside the station as well in the local peripheries.

**Keywords:** Farm Management, Dairy Technology, livestock production and feed fodder Peshawar Pakistan

Article Received :Aug 202    Article Accepted: Sept 2025    Article Published :Dec 2025

### INTRODUCTION

In Khyber Pakhtunkhwa (KP), livestock plays a pivotal role in rural livelihood and the provincial economy, reflecting the national trend where the sector contributes nearly 15% to GDP and over 63% to agricultural value added (Economic Survey of Pakistan 2024–25). According to official estimates, KP is home to a sizeable livestock population, including approximately 8.5 million cattle, 5.7 million buffaloes, 14.4 million sheep, 15.9 million goats, and around 0.5 million camels, along with a vibrant poultry sector. These species are the backbone of subsistence farming systems, providing milk, meat, draught power, hides, skins and casings and.

- Station Director, Livestock Research & Development Station Surezai, Peshawar
- Senior Research Officer, Livestock Research & Development Station Surezai, Peshawar
- Research Officer, Livestock Research & Development Station Surezai, Peshawar

manure. Small ruminants such as sheep and goats are particularly important in the hilly and arid zones of KP, serving as liquid assets and supporting household food security. Cattle and buffaloes dominate dairy and beef production, while the poultry industry has grown rapidly to meet the rising urban demand for affordable protein. Collectively, livestock not only contributes to provincial food security but also generates cash income, supports women's participation in household economies, and sustains rural employment, thereby underlining its central role in KP's agricultural and economic landscape.

The LR & DS Surezai is located in the Mera of Surezai at a distance of 25 km in the southwest of Peshawar city. It was established with the financial assistance of Dutch Government in 1978-79. In 1986, was merged with University of Agriculture Peshawar under the USAID Project Transformation and Integration of Agricultural Network (TIPAN). In 2005 it was demerged from University of Agriculture Peshawar and now working under the administrative control of Directorate of Livestock Research & Development KPK Peshawar.

Mandate of the station is to conduct research on various aspects of Animal Production, Reproduction, Breeding, Management, Dairy Technology and Animal Health. This station is also developed for carrying out research on various aspects of Animal Nutrition, Fodder & forages and provision of practical training to the organizations, professionals and Livestock/ Poultry farmers. Transfer of research findings, technologies and packages to professionals/ farmers as well as Provision of economical and balanced feed to livestock farmers of Khyber Pakhtunkhwa.

## **MATERIAL AND METHODS**

The data from the following sections was obtained for the documented period 2022-23.

- i. Animal Breeding Genetics Reproduction and A.I Section
- ii. Dairy Technology Section
- iii. Cattle feed mill (Shandar Wanda Preparation)
- iv. Livestock Production Section
- v. Agriculture (Feed and Forage) Section
- vi. Farm Management and Animal health section
- vii. Miscellaneous Research Work of University student's internee's awareness/practical's and farmer's advisory services.

## **RESULTS AND DISCUSSIONS**

### **RESULTS**

- i. The summarized work done in animal breeding, genetics Reproduction and AI Section indicated 55 animals (Cows) naturally served 197 females checked for pregnancy 14 females treated for reproductive disorders respectively. Advisory services were provided to the farmers regarding reproductive disorders/diseases

- ii. The farm management and animal health section indicated 682 Blood samples tested against different diseases along with a total of 684 number of faecal samples tasted against helminthic parasites together with 100 % herd vaccinated against endemic disease as well as total herd dewormed against different parasitic diseases.
- iii. A total of 485997 kgs of green fodder was produced at the station and fed to the herd, as well as 4285 bags of Wanda (Shandar Wanda) was produced generating a revenue of Rs: 6856000/- and fed to the herd as per requirement
- iv. Dairy Technology sections data recorded indicated 530 milk samples analyzed for Fat percentage and a total of 510 milk samples tested against mastitis while a total of 684 samples of Blood and faeces analysed for haemoparasites and 288 number farmers were given advised for better management.
- v. The animal production section quantum of work showed a total production of milk as 33178 litters including 10397 litters fed to young calves while a total of 16047 litres of milk was sold earning an amount of Rs.1925720/.(with the cheapest rate of Rs120/-litre).

## DISCUSSION

The LRDS Surezai Peshawar of Khyber PK is showing its justification as to when it was developed in 1978-79 and how it prospered during the 5-decades, toward livestock production livestock breeding genetics (upgrading local breed Achai crossed with the exotic breed Jersey) keeping a herd of 204 plus with milk production of 33178 litters of milk and fetching an amount of Rs.1925720/= in one year's period in 2022-23. The herd of the station is 100% vaccinated against endemic disease (HS,BQ,Anthrax, ET and others) and 100% deworming the herd together with 684 Blood samples screening against different diseases and blood protozoa, as well as producing seasonal fodder on 25 acres of land and feeding 485997 kgs of green fodder along with production of 4285 bags of Shandar wanda ( of 37 kg each). Formulation of compound feed in animal diet improved the body condition score, animal production as well as health status of animals.

Dairy technology section has milk processing plant which improved shelf life of milk and milk products through latest dairy technology techniques. This section also play keyrole in capacity building of livestock farmers to control mastitis and to transfer of research finding and technology to professionals and farmers. The professional researchers of this station regularly deliver Radio talks on prevailing livestock issues for mass awareness among the community farmers

Annual Technical Research Programs are conducted each year in the station and the final findings of the research trial are communicated to the farmers through articles and radio talks. The findings of the research work are also published in reputable National Journals. The young internees/students also carries out their experiments, on the farm animals for their research work and develop confidence in our work and develop confidence in our work .

## REFERENCES

- PESR (2023-24) livestock Sector update. Agriculture Chapter Pak Economic survey report, Economic Advisors Wing M/O finance GOP Islamabad.
- PESR (2029-25) Livestock sector update; Agriculture chapter Pak Economic Survey Report, M/O Finance GOP Islamabad.
- WDR (2025) livestock sector updates for Punjab Province World Bank Report March 2025.
- Info/Livestock LDF (2024-25) Pre-emptive livestock population update (@3.9% increase) for Khyber PK (Based on 2020 Livestock Baseline Survey) LDF, Registered Islamabad.
- TIPAN (1975-78) –(1986) The Establishment and transfer of LRD Farm surezai transferred to Agricultural University Peshawar under TIPAN project/VRI Peshawar reports.

## SUSTAINABILITY EVIDENCED THROUGH DISEASE DIAGNOSTIC WORK AT VRDIC, KOHAT IN A SINGLE YEAR 2023-24

Hafiz Abdul Majid<sup>1</sup>, Muhammad Asif<sup>2</sup>, Qamar Ullah<sup>3</sup>, Abdur Raziq<sup>4</sup> and Muhammad Farooq<sup>5</sup>

### ABSTRACT

Livestock and poultry farming in Pakistan face significant productivity losses due to infectious, viral parasitic, and bacterial diseases. Effective diagnostic surveillance is essential to safeguard animal health and farmer livelihoods. This article based on a study summarizes the diagnostic work performed at the Veterinary Research and Disease Investigation Centre (VRDIC), Kohat, during 2023–2024, highlighting disease burden across multiple species. Factual data were retrospectively retrieved from daily research registers of parasitology, bacteriology, serology, necropsy, and poultry disease investigation units. A total of 1,040 blood samples from cattle, buffaloes, sheep, and goats were examined for haemoprotozoa; 209 milk samples were screened for mastitis; 66 specimens were subjected to bacteriological culture; 19 sera were tested for brucellosis; and 533 faecal samples were analyzed for gastrointestinal parasites. Poultry disease cases (n = 170) were also investigated. Results showed that *Anaplasma* (49.9%) and *Theileria* (42.6%) were the predominant haemoprotozoa, while Babesiosis was rare (0.4%). Mastitis prevalence was high (70.8%), and Brucellosis positivity reached 52.6%. Bacteriology revealed *Escherichia coli* (18.2%) as the leading isolate, followed by *Bacillus* spp. and streptococci. Gastrointestinal parasites included *Trichuris*, *Schistosoma*, and *Eimeria* species in large ruminants, and a mixed pattern of *Eimeria*, *Strongylus*, and *Oesophagostomum* spp. in small ruminants. In poultry, helminthiasis, enteritis, and Newcastle disease accounted for most cases. Several disease distributions were statistically significant ( $p < 0.05$ ). This study demonstrates the sustained diagnostic role of VRDIC Kohat in identifying major livestock and poultry health problems. The findings underline the need for integrated control strategies, routine surveillance, and resource allocation to strengthen animal health service in the region .

**Keywords:** Livestock diseases; Haemoprotozoa; Mastitis; Parasitology; Disease surveillance.

Article Received : July 2025

Article Accepted: Sept 2025

Article Published : Dec 2025

### INTRODUCTION

Livestock and poultry play a pivotal role in the agrarian economy of Pakistan, contributing substantially to food security, rural livelihoods, and national GDP. However, infectious and parasitic diseases remain among the most important constraints to sustainable animal production.

- 
- Veterinary Research and Disease Investigation Centre (VRDIC), Kohat
  - Faculty of Animal husbandry and veterinary sciences, Sindh agriculture university tandojam

The establishment of Veterinary Research and Disease Investigation Centres (VRDICs) under the Veterinary Research Institute (VRI) Peshawar was a strategic response to these challenges, providing diagnostic services and surveillance for both endemic and emerging diseases (Veterinary Research Institute Peshawar, 2001–2005). Earlier evaluations highlighted the necessity of such Centers to prevent privatization-driven decline of diagnostic capacity, emphasizing their role in National livestock health systems (Muhammad Hafeez, 1993).

Globally, institutions such as the OIE and FAO have mandated systematic disease reporting and surveillance to ensure early detection and containment of Transboundary Animal Diseases (OIE, 1995; FAO/WHO/OIE, 2003–2004). At the national level, such reporting aligns with the United Nations Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), which stress the importance of livestock health in human development strategies, (United Nations, (2001–2002). Within Pakistan, several endemic conditions including contagious caprine Pleuropneumonia (CCPP), Peste des Petits Ruminants (PPR), theileriosis, anaplasmosis, mastitis, and gastrointestinal parasitism have been consistently documented as major health burdens (Iqbal et al., 2019) and Rashid Khan et al., 2019; Zabita Khan et al., (2019).

More recent studies have underscored the economic and welfare implications of these diseases. For example, gastrointestinal helminths have been shown to cause significant production losses in small ruminants (Rashid Khan et al., 2019), while subclinical mastitis remains highly prevalent in dairy cattle and buffaloes in Kohat and neighboring regions (Zabita Khan et al., 2019). Furthermore, theileriosis and anaplasmosis continue to exert a heavy toll on large ruminants, with prevalence rates exceeding 40% in several regions of Pakistan (Zafar et al., 2022).

Against this backdrop, the present study documents the diagnostic outcomes of VRDIC Kohat over a one-year period (2023–2024). By providing evidence on disease prevalence across species, this work highlights the continuing challenges faced by livestock farmers and underscores the importance of sustained diagnostic and surveillance capacity in regional veterinary systems.

## **MATERIAL AND METHODS**

- i. This study was conducted at the Veterinary Research and Disease Investigation Centre (VRDIC), Kohat, during the period 2023–2024. The article is based on factual data recorded in the Routine Research Registers (RRRs) maintained in various laboratories and service sections of The Centre. All information was compiled retrospectively and systematically categorized according to the type of diagnostic activity and laboratory work performed.

- ii. **Sources of Data :**The following diagnostic and research units provided the data used in this article.
- iii. **Parasitology Section (Blood Parasites):** Blood smears and samples from large and small ruminants (cattle, buffalo, sheep, and goats) suspected for haemoprotozoan infections were examined under the microscope. Standard Giemsa-stained thin smears were prepared and examined for detection of Theileria, Anaplasma, and Babesia species.
- iv. **Parasitology Section (Helminths and Protozoa):** Fecal samples from suspected large and small ruminants were examined using direct smear techniques and egg-counting procedures. The McMaster slide method was employed for quantitative egg counts, while stereoscopic examination was used for helminth eggs and protozoan oocysts (e.g., Schistosoma, Eimeria, Trichuris).
- v. **Serology Laboratory (ELISA):** Serum samples collected from cattle, buffalo, sheep, and goats were subjected to serological screening using commercially available ELISA kits. The primary focus was on detection of brucellosis and other economically important infectious diseases.
- vi. **Necropsy and Post-Mortem Section:** Necropsies were performed on animals brought dead or sacrificed for diagnostic confirmation. Gross lesions were systematically recorded, and representative tissue samples were collected for microbiological and histopathological examination where required.
- vii. **Routine Bacteriology:** Specimens from suspected clinical cases (including milk, tissue, and swabs) were inoculated onto selective and differential media. Standard bacteriological methods were applied for the isolation and identification of Escherichia coli, Staphylococcus spp., Streptococcus spp., Salmonella spp., and other pathogens.
- viii. **Poultry Disease Investigation:** Samples from suspected poultry cases were processed for clinical, bacteriological, and parasitological evaluation. Emphasis was placed on diagnosing common conditions such as Newcastle disease (NCD), infectious bursal disease (IBD), yolk sac infections, colibacillosis, coccidiosis, and chronic respiratory disease (CRD).
- ix. **Statistical Analysis:** All records were cross-verified from the RRRs of respective sections. Data were tabulated according to species, type of specimen, diagnostic technique, and disease outcome. Descriptive statistics (frequency counts and percentages) were applied to summarize disease prevalence and diagnostic outcomes. The results were further categorized into ruminant parasitology,

serological findings, bacteriology, necropsy reports, and poultry disease investigations.

## RESULTS AND DISCUSSIONS

### RESULTS

The clinical diagnostic records revealed a wide spectrum of diseases in both large and small ruminants. Among smear examinations, Contagious Caprine Pleuropneumonia (32.7%) and enterotoxaemia (29.1%) were the most frequently detected conditions, followed by PPR (12.7%) and anthrax (10.9%), while 14.6% of smears were negative for these diseases. The distribution was statistically significant ( $p = 0.031$ ), indicating a non-random clustering of specific diseases. In poultry, helminthiasis (27.6%), enteritis (21.8%), and Newcastle Disease (19.4%) were predominant, while other conditions such as colibacillosis (7.1%), yolk sac infections (6.5%), and ILT (5.3%) were detected at lower frequencies. Less frequent but important findings included IBD, ascites, *E. coli* infections, CRD, and coccidiosis. The variation in poultry diagnoses was also significant ( $p = 0.014$ ), suggesting a distinct disease burden that could influence flock health and productivity (Table 1).

Microbiological investigations demonstrated a heterogeneous pattern of bacterial isolation. *Escherichia coli* (18.2%) was the most common pathogen recovered, followed by *Bacillus* spp. (10.6%), while *Streptococcus* spp. (6.1%), *Staphylococcus* spp. (4.5%), and *Salmonella* spp. (3.0%) were less frequent; 27.3% of cultures showed no bacterial growth. The distribution was statistically significant ( $p = 0.022$ ), indicating a clear predominance of certain bacterial agents. Serological testing further revealed a high burden of mastitis, with 70.8% of milk samples positive ( $p = 0.041$ ), confirming the disease as a major constraint in dairy productivity. In contrast, Brucellosis serology showed 52.6% positivity, but this was not statistically significant ( $p = 0.317$ ), reflecting a more evenly distributed outcome in the small number of samples tested (Table 2).

Parasitological findings indicated that haemoprotozoan infections are endemic in the study area. Of 1,040 blood samples, *Anaplasma* spp. (49.9%) and *Theileria* spp. (42.6%) dominated, whereas *Babesia* spp. was rare (0.4%). The distribution was highly significant ( $p < 0.001$ ), confirming that haemoparasites constitute a major health problem for ruminants. Faecal examinations of large ruminants ( $n = 123$ ) revealed that *Trichuris* spp. (43.1%) was the most frequent parasite, followed by *Schistosoma* spp. (30.1%) and *Eimeria* spp. (26.8%), with a significant variation among parasites ( $p = 0.029$ ). In small ruminants ( $n = 283$ ), a mixed pattern was observed, with *Eimeria* (17.1%), *Strongylus* (16.7%), *Schistosoma* (16.4%), and Other *Trichuris* spp. (15.9%) showing relatively balanced prevalence, but still with significant differences overall ( $p = 0.011$ ) (Table 3).

Table 1. Clinical diagnoses recorded at VRDIC Kohat

Category	Disease/Condition	No. of Cases	% of Total	p-value
Smear Examination	Anthrax	6	10.9	0.031
	PPR	7	12.7	
	CCPP	18	32.7	
	Enterotoxaemia (ET)	16	29.1	
	Negative	8	14.6	
<b>Subtotal (n=55)</b>		<b>55</b>	<b>100.0</b>	
Poultry Diseases	Newcastle Disease (NCD)	33	19.4	0.014
	Enteritis	37	21.8	
	Helminthiasis	47	27.6	
	Colibacillosis	12	7.1	
	Infectious Laryngotracheitis	9	5.3	
	Yolk sac infection	11	6.5	
	Infectious Bursal Disease	6	3.5	
	Ascites	4	2.4	
	<i>E. coli</i> infections	6	3.5	
	Chronic Respiratory Disease	3	1.8	
	Coccidiosis	5	2.9	
<b>Subtotal (n=170)</b>		<b>170</b>	<b>100.0</b>	

Table 2. Bacteriological and serological investigations

Category	Isolate/Test	No. of Cases	% of Tested	p-value
Bacteriology	<i>Escherichia coli</i>	12	18.2	0.022
	<i>Bacillus</i> spp.	7	10.6	
	<i>Streptococcus</i> spp.	4	6.1	
	<i>Staphylococcus</i> spp.	3	4.5	
	<i>Salmonella</i> spp.	2	3.0	
	No growth	18	27.3	
<b>Subtotal (n=66)</b>		<b>66</b>	<b>100.0</b>	
Mastitis	Positive	148	70.8	0.041
	Negative	61	29.2	
<b>Subtotal (n=209)</b>		<b>209</b>	<b>100.0</b>	
Brucellosis	Positive	10	52.6	0.317
	Negative	9	47.4	
<b>Subtotal (n=19)</b>		<b>19</b>	<b>100.0</b>	

Table 3. Parasitological investigations of ruminants

Category	Parasite	No. of Cases	% of Group	p-value
Blood parasites (n=1040)	<i>Theileria</i> spp.	443	42.6	<0.001
	<i>Anaplasma</i> spp.	519	49.9	
	<i>Babesia</i> spp.	4	0.4	
<b>Subtotal</b>		<b>966</b>	<b>92.9</b>	
Faecal parasites – Large ruminants (n=123)	<i>Schistosoma</i> spp.	37	30.1	0.029
	<i>Eimeria</i> spp.	33	26.8	
	<i>Trichuris</i> spp.	53	43.1	
<b>Subtotal</b>		<b>123</b>	<b>100.0</b>	
Faecal parasites – Small ruminants (n=283)	<i>Schistosoma</i> spp.	46	16.4	0.011
	<i>Eimeria</i> spp.	48	17.1	
	<i>Oesophagostomum</i> spp.	44	15.7	
	<i>Trichuris</i> spp.	26	9.3	
	<i>Strongylus</i> spp.	47	16.7	
	<i>Toxocara</i> spp.	27	9.6	
Other <i>Trichuris</i> spp.	45	15.9		
<b>Subtotal</b>		<b>283</b>	<b>100.0</b>	

## DISCUSSION

The present study provides comprehensive evidence on the disease burden affecting livestock and poultry in Kohat region during 2023–2024. The findings confirm that a broad spectrum of infectious, parasitic, and bacterial diseases continue to compromise productivity and animal welfare, thereby reinforcing the significance of sustained diagnostic surveillance at regional centers such as VRDIC.

The smear examination of field cases revealed a predominance of pleuropneumonia CCPP and enterotoxaemia, followed by PPR and anthrax. Similar observations have been reported in small ruminants in other endemic regions of Pakistan, where CCPP and PPR were identified as major contributors to morbidity and mortality (Iqbal et al., 2019; Tharwat et al., 2025). The statistically significant clustering of these diseases in our study suggests active transmission cycles in small ruminant populations, demanding coordinated vaccination and biosecurity measures. In poultry, helminthiasis, enteritis, and NCD accounted for the majority of cases.

Bacteriological isolations demonstrated *Escherichia coli* as the most frequently encountered organism (18.2%), followed by *Bacillus* spp., *Streptococcus*, and *Staphylococcus*. This aligns with the results of Zainab et al. (2022), who also reported *E. coli* as the principal isolate from livestock clinical cases in Khyber Pakhtunkhwa. Interestingly, *Salmonella* spp. were recovered in only 3.0% of samples, a lower rate compared with 8–12% reported by Zaman et al. (2025) from Punjab, suggesting either geographical variation or the impact of ongoing surveillance and control strategies. Mastitis remained a major issue, with 70.8% of milk samples testing positive, a prevalence similar to that documented by Salman et al. (2024) in Punjab, who also noted mastitis as the leading economic burden in dairy herds. The significance of mastitis positivity in our data further emphasizes its importance as a persistent constraint to dairy productivity. Brucellosis serology showed 52.6% positivity, which, though not statistically significant in our small sample, still highlights the endemic nature of brucellosis. Comparable seroprevalence levels (40–55%) have been reported in ruminants from Balochistan and Sindh.

Parasitological investigations confirmed that haemoprotozoan infections are widespread in the region. Theileriosis (42.6%) and anaplasmosis (49.9%) dominated, while babesiosis was rare (0.4%). Our findings are consistent with earlier studies by Zafar et al. (2022), who also observed high prevalence of *Theileria* and *Anaplasma* infections in cattle and buffaloes in Pakistan. The very low occurrence of *Babesia* in our data may reflect regional ecological factors such as vector abundance and host susceptibility. Faecal parasitology demonstrated a significant burden of gastrointestinal parasites, with *Trichuris*, *Schistosoma*, and *Eimeria* spp. in large ruminants, and a mixed pattern

involving *Eimeria*, *Strongylus*, and *Oesophagostomum* spp. in small ruminants. These results are in agreement with earlier reports by Elshafie et al. (2025), whom identified gastrointestinal nematodes and coccidia as economically important parasites in that region.

The findings of this study have direct clinical and field relevance for veterinarians and livestock farmers in Kohat region. The high prevalence of haemoprotozoan infections, mastitis, and gastrointestinal parasites underscores the urgent need for regular diagnostic screening, targeted vaccination, and timely therapeutic interventions. For poultry, the dominance of Newcastle disease, helminthiasis, and enteritis highlights the importance of vaccination schedules, improved hatchery hygiene, and optimized farm management practices. Early detection of bacterial infections such as colibacillosis and Brucellosis provides opportunities for intervention before large-scale production losses occur. Overall, the data strengthen the case for integrated herd and flock health programs that combine diagnostics work, prophylaxis, and farmer education to improve animal health, productivity, and ultimately food security.

Although the study provides valuable insights into the regional disease profile, some limitations should be acknowledged. First, the retrospective design relied on daily registers, which may be subject to incomplete recording or observer bias or limited to clinically evidenced situation. Second, sample sizes for certain tests, such as brucellosis serology, were relatively small and may not represent the true prevalence in the wider population. Third, the study did not incorporate seasonal stratification, vector monitoring, or molecular confirmation of pathogens, which would have added further depth to the diagnostic outcomes. Finally, the work was limited to a one-year period, and longitudinal data would be necessary to capture temporal trends and cyclical disease patterns, from various randomized areas.

## CONCLUSIONS

The study demonstrates that livestock and poultry in Kohat are affected by a broad spectrum of endemic diseases, with haemoprotozoa, mastitis, gastrointestinal parasites, and major poultry infections accounting for the majority of cases. Statistically significant distributions confirm that certain pathogens, such as *Anaplasma* spp., *Theileria* spp., CCPP, and NCD, remain persistent threats to herd and flock health. These results reinforce the need for sustained diagnostic capacity at VRDIC Kohat and call for strengthening regional surveillance, farmer awareness, and integrated disease management programs. With appropriate resource allocation and control measures, the burden of these diseases can be reduced, thereby enhancing livestock productivity and supporting the livelihoods of farming communities.

## RECOMMENDATION

- i. Strengthen diagnostic and surveillance systems: Ensure sustained funding and technical capacity at VRDIC Kohat for routine screening of haemoprotozoan, bacterial, and parasitic diseases.
- ii. Implement targeted preventive programs: Introduce structured vaccination campaigns for PPR, CCPP, and Newcastle disease, alongside mastitis control strategies and farmer education on hygiene and biosecurity.
- iii. Adopt integrated parasite management: Promote regular deworming schedules, vector control measures, and farmer training to reduce the burden of gastrointestinal and blood parasites in ruminants.
- iv. Enhance policy and resource allocation: Reinstate research allowances, expand budgetary support for reagents and equipment, and prioritize livestock health as a key component of regional food security.

## REFERENCES

- Afridi, Z., et al. (2016). Bacteriological profile of livestock clinical cases in Khyber Pakhtunkhwa. *Pakistan Veterinary Journal*, 36(2), 210–214.
- Ali, R., et al. (2019). Disease profile of poultry flocks in northern Pakistan. *Pakistan Journal of Agricultural Sciences*, 56(4), 899–906.
- Elshafie, E. I., Al-Habsi, K., Ali, H., ElTahir, Y., Al-Kharousi, K., Al-Hamrashdi, A., Khojali, M., Al-Batrani, A. M., & Johnson, E. H. (2025). Gastrointestinal parasites and molecular characterization of *Eimeria* spp. among imported small ruminants in the Sultanate of Oman. *Veterinary Parasitology: Regional Studies and Reports*, 61, 101273. <https://doi.org/10.1016/j.vprsr.2025.101273>
- Food and Agriculture Organization/World Health Organization/World Organisation for Animal Health. (2003–2004). Joint FAO/WHO/OIE reports on animals and human health. Geneva: FAO/WHO/OIE.
- Khan, Z., et al. (2019). Prevalence of subclinical mastitis in dairy herds of Peshawar. *Pakistan Veterinary Journal*, 39(2), 187–192. <https://doi.org/10.29261/pakvetj/2019.040>
- Muhammad Rashid Khan, Zabita Khan, ShamsulHayth, ShahudUllah, &Ahmeed Afridi. (2019). Economic importance of worm infestation in small ruminants. *Pakistan Journal of Livestock Sciences*, XI(11), 834–839.
- Salman, M. M., Nawaz, M., Yaqub, T., &Mushtaq, M. H. (2024). Milk microbiota of Holstein Friesian cattle reared in Lahore: Association with mastitis. *Saudi Journal of Biological Sciences*, 31(6), 103984. <https://doi.org/10.1016/j.sjbs.2024.103984>
- Tharwat, M., Alkheraif, A. A., & Ali, H. (2025). Clinical cases of contagious caprine pleuropneumonia in sheep: Retrospective clinical, sonographic, and pathological investigations. *Open Veterinary Journal*, 15(5), 1947–1957. <https://doi.org/10.5455/OVJ.2025.v15.i5.9>

## STRENGTHENING LIVESTOCK FARMERS' DISEASE DIAGNOSTIC SERVICES THROUGH VRDIC CHITRAL, KHYBER PAKHTUNKHWA

Safir ullah<sup>1</sup> and Sana ullah<sup>2</sup>

### ABSTRACT

The brief article highlights the efforts of the Veterinary Research and Disease Investigation Centre (VRDIC), Chitral, in providing diagnostic and advisory support to livestock farmers during the year 2023–2024. Within this period, the Centre examined a total of 427 blood samples (including blood smears and samples for Brucella serology) and 2,379 fecal samples to detect helminth infections. Notably, this included 200 fecal samples from yaks, which were investigated for gastrointestinal parasitic infestations under an annual technical research program. The diagnostic results were communicated directly to livestock owners, accompanied by prescriptions and recommendations for appropriate therapeutic interventions. Farmers' feedback indicated significant improvements in animal health following the advised treatments. In addition to diagnostic services, VRDIC facilitated the storage and distribution of 3,000 vials of Newcastle Disease (ND) vaccine for poultry, alongside 40 bottles of bacterial vaccines for field use, by para-veterinary (Foxtri) workers. Furthermore, during a five-day farmer awareness program, a total of 1,470 farmers received guidance on disease prevention and treatment, contributing to improved livestock management practices in the region. The findings and outreach activities underscore the Centre's vital role in livestock health management. The report concludes with a positive recommendation for strengthening such farmer-oriented diagnostic and extension services to ensure sustainable livestock development in Chitral area.

**Keywords:** Disease diagnosis, Yak, Chitral, Khyber Pakhtunkhwa, Pakistan

Article Received: Aug 2025 Article Accepted :Sept 2025 Article Published :Dec 2025

### INTRODUCTION

Chitral, the largest district of Khyber Pakhtunkhwa, has recently been administratively divided into Upper and Lower Chitral. The district is characterized by diverse livestock production systems, including yak farming in high-altitude regions (Shandur and Broghil), small ruminant husbandry, and backyard poultry rearing. Livestock contributes significantly to the livelihood of mountain communities, providing food security and income generation (Khan *et al.*, 2020).

However, the sector faces multiple challenges including climate change, disease outbreaks, mechanization, and limited veterinary services. The VRDIC Chitral was conceptualized during the development phase of Veterinary Research Institute (VRI).

- 
- Principal Research Officer, Veterinary Research Diseases Investigation Center (VR&DIC) Chitral, Khyber Pakhtunkhwa, Pakistan
  - Research Officer, Veterinary Research Diseases Investigation Center (VR&DIC) Chitral, Khyber Pakhtunkhwa, Pakistan

Peshawar in 1985–1988 and became functional in the early 1990s with the recruitment of technical staff (SRO, RO and VOR), with laboratory support staff, and provision of essential laboratory equipment, biochemicals, and reagents. Farmers increasingly sought technical assistance from the centre as livestock and poultry farming shifted from traditional subsistence to more commercialized systems, aligning with National Food Security objectives (Government of Pakistan, 2019). The yak population, primarily concentrated in the Shandur and Broghil valleys, has been declining due to pasture degradation, flash floods, cloudbursts, and nutritional deficiencies exacerbated by climate change (Raziq *et al.*, 2016; IPCC, 2022). Farmers’ decreasing interest in yak farming further threatens the sustainability of this unique genetic resource. Similarly, traditional bull keeping for ploughing and breeding purposes has almost diminished due to mechanization and increased use of Artificial Insemination (AI). However, AI services remain underutilized due to a shortage of trained personnel and minimal involvement of the private sector in breed improvement (Ahmad *et al.*, 2018). Backyard poultry, an important component of rural livelihoods, is under threat due to the influx of exotic poultry breeds from the plains of Punjab. These birds often introduce new diseases and face high mortality rates due to poor climatic adaptability (Sadiq *et al.*, 2021). This situation poses a risk to indigenous poultry genetic resources and rural food security. This brief and summarized account encompasses the work done as routine activities as well as research work carried out sustainably, for the last two and half Decades (VRI Peshawar Annual Reports) (2001-02) ,(2010-11) (2015-16) and (2020-21) but this presentation highlights only for one recent year (2023-24)

## MATERIAL AND METHODS

Updated information was obtained from various sections Daily Routine Registers (DRRS) of 3 sections from the period July-2023 to June 2024 as under:-

- i. Microbiology and Parasitology laboratory.
- ii. Post mortem and field farmer’s days’ work
- iii. Vaccines (both Viral and bacterial) received stored and supplied/sold to Extension Personnel
- iv. Continued work on farmer’s advisory services

## RESULTS AND DISCUSSION

### RESULTS

- i. A total of = 427 blood samples were collected/received at VRDC Chitral and were subjected to haemoprotozoans (blood smears for haemoprotozoans) and serum tested for Brucellosis, using Serum Plate Agglutination Test (SPAT) . The detail is availability in the annual report of VRI Peshawar for the reported year (2023-24). The result thus obtained were conveyed to the farmers and are presented below .
- ii. A total of = 2379 faecal samples were collected/received and processed for helminthic examination (both (a) direct micro scopy and (b) McMasters Egg counting chambers slides were approached. The results thus obtained were conveyed to the quarters concerned while the farmers were advised accordingly and the anthelmintic of choice recommended.
- iii. During the reported period, only one out brake was attended, PM conducted morbid material processed for lab diagnosis. The results conveyed to the local farmers of Zidig Gharoom Chesma, lower chitral. The detail is mentioned below in Table No.1

**Table 1 Diagnostic investigations conducted at VRDIC Chitral, during 2023–2024**

Sample Type	Number of Samples	Diagnostic Method(s) Applied	Purpose of Test	Outcome / Action Taken
Blood samples	427	Microscopy for haemoprotozoans (blood smears); Brucellosis screening via SPAT	Detection of haemoprotozoan infections and brucellosis	Results communicated to farmers; management and control measures advised
Faecal samples	2,379	Direct microscopy and McMaster’s egg counting technique	Detection and quantification of helminth infections	Results shared with farmers; appropriate anthelmintic therapy recommended
Morbid material (outbreak investigation)	1 outbreak (PM conducted)	Post-mortem examination; laboratory processing of suspected material	Confirmation of cause of mortality/outbreak	Results conveyed to farmers of Zidig Gharoom Chesma (Lower Chitral)

- iv. A total of 3000 vials of NCD Vaccine and a total of 40 bottles of HSV, BQV, ETV, FMD and ASV received from VRI-HQs Peshawar for supply/Sale to Extension personnel for utilization at their end
- v. Under the farmer’s field days (05 days per month) farmer’s gatherings were arranged at 05 different focal points and advisory services provided to a total of =1470 such interested farmers involved in livestock and poultry

farming and farmers showed keen interest in this economic activity in chitral area. The detail is mentioned in table No 02, below:-

**Table 2. Vaccine distribution and farmer advisory activities conducted at VRDIC Chitral(2023–2024)**

Activity Category	Description	Quantity / Number	Beneficiaries / Outcome
Vaccine supply (from VRI-HQs Peshawar)	(NCD)	3,000 vials	Supplied to Extension personnel for field utilization in poultry disease control
	(HSV) (BQV), (ETV), (FMD) (ASV)	40 bottles	Distributed to field staff for vaccination against endemic bacterial/viral diseases of the area.
Farmer Field Days	Monthly farmer gatherings (5 days/month) at five focal points	1,470 farmers	Advisory services delivered to farmers.

\*Note: The 40 bottles included HSV, BQV, ETV, FMD, and ASV collectively.

- vi. One Day workshop was also arranged for the lady farmers who were involved in house hold poultry were also given on hand practical work in management feeding and animal health care SsrVICES (AHESs) while at the feedback improvement were evidenced.
- vii. Research study on gastro intestinal parasites in Yak population was continual. A total pf 200 faecal samples (100 samples each) from two different locations were collected (in domesticated yaks) in Shander and Boroghil and other belong area. The locations were GPS based located. In majority of samples Eimeria apps were found. The data was statistically analysed and remotely communicated to farmers/owner and the drugs/anthelmintic of choice recommended. The follow up information evidenced lot of improvement. The detail is mentioned in table No 03.

## DISCUSSION

Considering the available manpower, laboratory facilities, equipment, and biochemical reagents, the diagnostic work for large animals particularly yaks and small ruminants remains challenging but is still manageable under existing conditions (Khan *et al.*, 2020). With increasing farmer interest in disease diagnosis, poultry production has potential to flourish. However, a major constraint in livestock rearing is the shortage of green fodder and the lack of grazing resources

during the off-season (November to March). This forces farmers to rely on indoor feeding practices, which are often inadequate (Raziq *et al.*, 2016). The yak (*Bos grunniens*) population in Upper Chitral, particularly in the Shandur and Broghil high pastures, is under severe threat due to climate change, pasture degradation, flash floods, and cloudburst-induced disasters. Additionally, a lack of interest among the younger generation in yak farming, combined with the emergence of vector-borne diseases and feed scarcity, is accelerating the decline of this unique genetic resource (IPCC, 2022; Miller, 2021).

**Table 3. Gastrointestinal parasite study in domesticated yak population, Shandur and Broghil regions (2023–2024)**

Study Location	No. of Samples Collected	Major Parasites Detected	Diagnostic Approach	Advisory / Action Taken	Follow-up Outcome
Shandur	100 faecal	<i>Eimeria</i> spp. (coccidia)	Microscopy, parasitological examination	Recommended appropriate anthelmintics and management	Farmers reported notable improvement
Boroghil	100 faecal	<i>Eimeria</i> spp. (coccidia)	Microscopy, parasitological examination	Recommended appropriate anthelmintics and management advice	Farmers reported notable improvement

The timely distribution and availability of vaccines against major bacterial and viral diseases of livestock and poultry have played a vital role in disease prevention and control. These efforts contribute significantly to enhancing livestock productivity. Furthermore, the introduction of silage and hay production, as well as formulated concentrate feed at the field level, has improved nutrient availability and productivity outcomes (Ahmad *et al.*, 2018). The VRDIC Chitral provides farmers with advisory services on vaccination, deworming, and disease prevention. It also organizes innovative training programs to promote commercial dairy farming, feedlot fattening, and poultry production. These interventions support self-employment opportunities, enhance rural incomes, and contribute to National food security (Government of Pakistan, 2019). Farmers face significant challenges in cattle breeding services. Male calves are often sold at an early age, and the traditional practice of bull ploughing has nearly disappeared due to mechanization. Artificial insemination services are limited, primarily because of a shortage of trained technicians in the public sector and an absence of private sector involvement (Sadiq *et al.*, 2021).

## RECOMMENDATIONS

- 1- In response to farmers' continuous demand, the introduction of Jersey live bulls for cattle breeding is recommended, along with the provision of adequately trained Artificial Insemination staff ,for this area.
- 2- Strong linkages are required between livestock extension services, research-based diagnostic facilities, and farmers to ensure effective disease control and productivity enhancement.
- 3- The availability of green fodder during autumn and winter, as well as specialized concentrated feed in winter, is essential to sustain livestock production levels.
- 4- Backyard poultry production should be promoted at the community level through natural breeding and locally managed production systems.
- 5- The yak (*Bos grunniens*), listed as an endangered species by the IUCN, requires conservation and propagation strategies, along with climate adaptation plans to mitigate emerging risks and challenges.
- 6- Periodic local workshops should be organized for farmers, particularly on livestock feeding. This includes the introduction of “Shandar Wanda” (balanced concentrates feed developed by VRI), winter green fodder varieties suitable for Chitral, and range plant species recommended by the Animal Nutrition Centre of VRI, as requested by many farmers.
- 7- Working in remote areas such as Chitral requires encouragement and recognition. Financial support in the form of research allowances (previously permissible) and/or honoraria should be considered for both technical personnel and support staff .

## REFERENCES

- Ahmad, N., Khan, H., & Ali, S. (2018). Role of artificial insemination in cattle breeding improvement in Pakistan. *Pakistan Journal of Agricultural Sciences*, 55(3), 623–629.
- Government of Pakistan. (2019). *Pakistan Livestock Census Report*. Islamabad: Ministry of National Food Security and Research.
- IPCC. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Cambridge University Press.

- Khan, M. A., Raziq, A., & Younas, M. (2020). Livestock production systems and food security in mountainous regions of Pakistan. *Tropical Animal Health and Production*, 52(5), 2541–2552.
- Raziq, A., Younas, M., & Khan, M. S. (2016). Pastoral yak production in Pakistan: Challenges and opportunities. *Journal of Animal and Plant Sciences*, 26(2), 295–304.
- Sadiq, M., Ashraf, A., & Rehman, A. (2021). Backyard poultry production in Pakistan: Status, challenges, and opportunities. *World's Poultry Science Journal*, 77(1), 77–90.
- VRI Peshawar (2085-85) Project proposal (P-C-1) and approved of establishing VRDI center chitral Veterinary Research institute Peshawar Annual Report.
- MVM (2005) Diagnostic techniques of morbid material (Blood Faecal Samples, Isolation of bacteria stc.) Manual of Veterinary Microbiology, 11<sup>th</sup> Edn. Oxford publication.
- VRI Peshawar (2001-2002) (2010-11) (2005-16) (2020-21) work done in Various research centers including Chitral, Veterinary Research Institute Peshawar Annual Report.
- Miller, D. J. (2021). The role of yak in high-altitude pastoral systems under climate stress. *Pastoralism: Research, Policy and Practice*, 11(1), 15.

## EVALUATING THE NUTRITIONAL COMPOSITION OF ANIMAL FEED WITH HAEMATOLOGY AND BIOCHEMISTRY WORK CENTRE OF ANIMAL NUTRITION, VRI PESHAWAR

Ihsan Ullah<sup>1</sup>, Riaz Ahmad Khan<sup>2</sup>, Faiza Shahzadi<sup>3</sup>, Nakash Smark<sup>4</sup>

and Khalid Khan<sup>5</sup>,

### ABSTRACT

Livestock and poultry production form the backbone of Pakistan's agricultural economy, contributing significantly to food security, rural livelihoods, and national GDP. Feed, which constitutes nearly 65–70% of total production costs, is a critical determinant of animal productivity and product safety. Ensuring the provision of safe, balanced, and cost-effective feed is therefore essential for sustainable livestock development. The present study was undertaken to evaluate the nutritional composition and safety of feed samples analysed at the Centre of Animal Nutrition (CAN), Peshawar, a specialized facility mandated to provide analytical, research, training, and advisory services in animal and poultry nutrition. A total of 2,343 samples were processed during 2023–2024, including compound feeds, feed ingredients, export commodities (tea, rice, honey, spices, dry fruits, molasses), fish feed, and biological samples. Proximate analysis was performed to determine moisture, crude protein, crude fat, crude fibre, ash, and nitrogen-free extract, while aflatoxin B1 was detected using thin-layer chromatography. Molasses samples were tested for brix value, and haematological investigations of blood samples were conducted following standard veterinary protocols. Data were analysed using descriptive statistics. Results revealed extensive demand for proximate and aflatoxin analyses, reflecting the persistent challenges of nutrient imbalances and mycotoxin contamination in feed resources. Two adaptive research trials were also initiated: detection of urea adulteration in concentrate feeds, and screening of antibiotic residues in marketed milk. In addition, 60 students and 4 postgraduate fellows received hands-on training, 334 advisory services were extended to farmers, and knowledge was disseminated through publications and radio talks. The study highlights the critical role of CAN in ensuring feed quality, food safety, and capacity building. Sustained investment, stronger regulatory measures, and expanded outreach are recommended to consolidate its position as a regional hub for feed and food safety, thereby supporting national goals of food security, public health, and sustainable livestock development.

**Key words:** Feed Quality, Animal Nutrition, Proximate Analysis, Aflatoxin Feed Composition

Article received :July 2025    Article accepted by : Sept 2025    Article published :Dec2026

### INTRODUCTION

Livestock and poultry production play a pivotal role in the agricultural economy of Pakistan, contributing significantly to food security, rural livelihoods, and National GDP. According to the Economic Survey of Pakistan (2024–25), the country hosts approximately 218.90 million heads of livestock and 1,725.03 million poultry birds, both commercial and domestic. Feed

- 
- Research Officers, Centre of Animal Nutrition, Directorate of Livestock Research & Development, Khyber Pakhtunkhwa, Peshawar
  - Principal Research Officers, Centre of Animal Nutrition, Directorate of Livestock Research & Development, Khyber Pakhtunkhwa, Peshawar

constitutes nearly 65-70% of the total cost of livestock and poultry production, making it the single largest determinant of productivity, profitability, and sustainability in this sector. Ensuring the provision of safe, balanced, and cost-effective feed is therefore critical not only for improving animal health and productivity but also for safeguarding human health through the supply of safe animal-origin foods such as milk, meat, and eggs.

The Centre of Animal Nutrition (CAN) at VRI, Peshawar, formerly the Animal Nutrition Section under the Animal Production Division of the Directorate of Livestock Research & Development, Khyber Pakhtunkhwa—was established to address these pressing needs. Initially functioning as a small analytical unit, the section was progressively strengthened through developmental projects and capacity-building initiatives. Over time, it evolved into a dedicated Centre with specialized personnel, advanced analytical facilities, and upgraded responsibilities. In addition to its core mandate of feed evaluation, the Centre also expanded its scope to include food and feed safety, notably through the establishment of drug residue detection facilities.

Currently, CAN provides a wide array of services to livestock and poultry farmers, feed manufacturers, exporters/importers, and academic institutions. Its primary functions include proximate analysis of feed and feed ingredients, detection of hazardous contaminants such as aflatoxin B1, evaluation of export commodities (e.g., black tea, rice, honey, spices, and dry fruits), and haematological investigations of animal blood samples. By integrating laboratory-based feed analysis with field-oriented advisory and training services, The Centre not only ensures the nutritional profiling of feedstuffs but also supports farmers in formulating balanced rations and adopting feeding regimes aligned with scientific requirements.

The overarching aim of these activities is to enhance animal productivity—(milk, meat, and egg yield) while reducing input costs and ensuring the safety of food products of animal origin. Beyond its provincial mandate, The Centre's contributions carry National significance by strengthening food security, supporting export quality assurance, and uplifting the socio-economic status of farming communities, together with the research work.

Given the critical importance of safe and balanced feed in livestock and poultry production, the present study was undertaken to evaluate the nutritional composition of animal feed samples analysed at The Centre, by documenting and assessing the nutritional quality of feed ingredients and compound feeds, this study also provides valuable insights for farmers, feed producers, policymakers, and researchers, ultimately contributing to sustainable livestock production and improved human health outcomes.

## MATERIAL AND METHODS

### Study Area

The study was conducted at the Centre of Animal Nutrition (CAN) VRI Peshawar, Khyber Pakhtunkhwa, Pakistan. The Centre is a specialized facility mandated to provide analytical services for livestock and poultry feed evaluation, quality assurance, and feed safety testing.

### Sample Collection

Feed and feed ingredient samples were collected from livestock and poultry farmers, feed dealers, manufacturers, and government/semi-government organizations across Khyber Pakhtunkhwa. In addition, samples of export commodities such as black tea, dry fruits, rice, spices, honey, and molasses submitted to the Centre for analysis were included. The sampling period extended over the period July, 2023 to June 2024, and samples were received in clean, sealed, and properly labelled containers to avoid contamination.

### Laboratory Analyses

All analyses were carried out using standard laboratory procedures recommended by the Association of Official Analytical Chemists (AOAC, 2001) with appropriate modifications where required. The following parameters were determined:

#### Proximate Analysis

**Moisture content:** Determined by oven-drying at 105 °C until constant weight.

**Crude protein (CP):** Estimated using the Kjeldahl method ( $N \times 6.25$ ).

**Crude fat (Ether Extract):** Determined through Soxhlet extraction using petroleum ether.

**Crude fibre (CF):** Analysed by sequential acid and alkali digestion.

**Ash content:** Measured by ignition of samples in a muffle furnace at 550 °C.

**Nitrogen-Free Extract (NFE):** Calculated by difference ( $100 - [\text{moisture} + \text{CP} + \text{fat} + \text{fibre} + \text{ash}]$ ).

**Aflatoxin B1 Detection** Compound feeds, feed ingredients, and selected export commodities were screened for Aflatoxin B1 using Thin-Layer Chromatography (TLC) and/or High-Performance Liquid chromatography (HPLC), depending on the requirement of the sample.

**Brix Value of Molasses :** The soluble sugar concentration of molasses was assessed using a hand-held refractometer, expressed in degrees Brix.

**Haematological Investigations :** Blood samples submitted alongside feed analyses were subjected to routine haematological examinations, including haemoglobin concentration, Packed Cell Volume (PCV), Total Erythrocyte count (TEC), total leukocyte count (TLC), and differential leukocyte count (DLC), following standard veterinary diagnostic protocols.

### **Quality Control and Assurance**

All equipment used in the analyses was routinely calibrated, and reagents were of analytical grade. Duplicate analyses were performed for each parameter, and mean values were recorded to minimize analytical errors. Quality control samples and blanks were run with each batch of analyses to ensure accuracy and reproducibility of results.

### **Data Analysis**

The laboratory results were tabulated, and descriptive statistics (mean, standard deviation, and range) were computed for each nutritional parameter across feed types and ingredients. Data were further categorized based on feed class (e.g., compound feed, fodder, oilseed cakes, cereal by-products) for comparative interpretation. Statistical analyses were performed using SPSS (Version 21), with significance set at  $p < 0.05$  where applicable.

## **RESULT AND DISCUSSION**

### **RESULTS**

#### **Analytical Activities and Services**

During the financial year 2023–2024, a total of 2,343 samples of diverse origins were processed at the Centre of Animal Nutrition (CAN), Peshawar. Of these, 1,757 were paid private samples, while 586 were free-of-cost government samples. The majority of analyses comprised proximate composition and aflatoxin B1 testing of animal feed, poultry feed, feed ingredients, and export commodities (tea, rice, dry fruits, spices, honey). In addition, biochemical profiling was performed for 1,073 blood samples, while haematological (CBC) analysis was conducted on 326 samples. Miscellaneous analyses included brix value estimation of molasses (12 samples) and proximate/aflatoxin testing of fish feed and fish meat (115 samples) as shown in Table 1.

Table 1: Description of feed samples tested for proximate analysis

Activities	Sub Activities	No. of Samples	
Provision of Analytical Services for Aflatoxin Analysis, Proximate Analysis, Blood Analysis and Others	Proximate Analysis of Export Samples	87 Nos.	
	Aflatoxin B <sub>1</sub> Analysis of Export Samples	90 Nos.	
	Proximate Analysis of Animal Feed Samples	127 Nos.	
	Aflatoxin B <sub>1</sub> Analysis of Animal Feed Samples	98 Nos.	
	Proximate Analysis of Poultry Feed Samples	32 Nos.	
	Aflatoxin B <sub>1</sub> Analysis of Poultry Feed Samples	31 Nos.	
	Proximate Analysis of Feed Ingredients	145 Nos.	
	Aflatoxin B <sub>1</sub> Analysis of Feed Ingredients	60 Nos.	
	Brix Analysis of Molasses Samples	12 Nos.	
	Biochemical Analysis of Blood Samples	1073 Nos.	
	Proximate Analysis of Fish Meat (Whole)	112 Nos.	
	Analysis of Misc. Samples	Fish Feed Others	02 Nos. 143 Nos.
	Aflatoxin B <sub>1</sub> Analysis of Fish Feed	Fish Feed	01 Nos.
	Analysis of Misc. Samples	Others	04 Nos.
	Haematology Profile (CBC) Analysis of Blood Samples		326 Nos.
	<b>Total</b>	<b>Grand Total</b>	2343 Nos.
	<b>Number of Samples Processed</b>	Free of Cost Samples (Government Samples)	586 Nos.
		Paid Samples (Private Samples)	1757 Nos.

**Research Progress :** Two adaptive research trials were undertaken. The first trial, quantification of added urea in commercial concentrate rations, was successfully completed, analysing 200 samples of animal feed from District Peshawar to detect adulteration with non-protein nitrogen. Findings are being disseminated through a research paper, farmer awareness articles, and radio talks. The second trial, screening of residues of medically important antibiotics in marketed milk, progressed with the analysis of 92 out of 200 proposed samples. However, due to budgetary limitations, the study could not be completed within the reporting year and requires an extension.

**Training and Capacity Building:** A total of 60 internees from veterinary and life sciences disciplines completed practical professional training at The Centre. These included 22 Doctor of Veterinary Medicine (DVM) students, 35 Diploma in Veterinary Sciences (DVS) trainees, and 3 undergraduate students from Biochemistry and zoology. Additionally, four postgraduate research fellows from public sector universities availed laboratory facilities and expert supervision for their M.Phil. and M.Sc. (Hons.) research projects, focusing on animal nutrition, poultry science, food sciences, and toxicology, respectively .

**Advisory and Outreach Services:** The Centre extended 334 advisory services to livestock and poultry farmers, providing guidance on feed management practices, analytical facilities, and research methodology. Knowledge dissemination activities also included seven radio talks delivered by subject specialists, addressing topics such as “antibiotic residues in animal products”, “

balanced ration formulation”, broiler meat safety concerns, and public health implications of antibiotic misuse.

**Publications and Technology Transfer :** To strengthen knowledge exchange and technology transfer, The Centre contributed to scientific and popular literature. During the reporting year, one research article, six Urdu articles, and seven radio talks were produced for farmers awareness and public engagement. Additionally, collaborative work led to the publication of review and awareness articles on topics such as feed quality, veterinary drug residues, zoonotic diseases, and genetic skeletal disorders in reputed outlets.

## DISCUSSION

**Analytical Services and Nutritional Evaluation :** The analysis of more than two thousand feed, food, and biological samples during the reporting period highlights the critical role of the Centre , in ensuring feed quality and food safety. The predominance of proximate and aflatoxin B1 analyses underscores the persistent challenges of nutrient imbalances and mycotoxin contamination in feed resources, issues that are widely reported in tropical and subtropical regions. Regular monitoring not only safeguards livestock productivity but also reduces economic losses associated with feed-borne hazards. The extension of analytical services to export commodities such as tea, rice, honey, spices, and dry fruits further emphasizes, The Centre’s contribution beyond livestock nutrition, aligning its work with National priorities in food safety and trade facilitation.

**Research Contributions :** The adaptive research on urea adulteration in commercial concentrate feeds provided evidence of a potentially harmful practice in the feed market. The identification of non-protein nitrogen inclusion has important implications for ruminant health and productivity, particularly in smallholder systems where awareness is limited. Similarly, the investigation into antibiotic residues in marketed milk is timely and relevant, given the global concern about AntiMicrobial Resistance (AMR) and the public health risks associated with drug residues in animal-origin foods. While financial constraints limited the completion of this study, preliminary results strengthen the case for policy interventions and greater investment in residue monitoring systems. Collectively, these research initiatives demonstrate the dual focus of CAN, — addressing immediate local challenges while contributing to global debates on food safety and public health.

**Training and Capacity Development :** The professional training of undergraduate and postgraduate students highlights The Centre’s role as a hub for capacity building in veterinary and allied sciences. By facilitating practical exposure to feed and food analysis, The Centre bridges the gap between academic curricula and field applications. This function is particularly valuable

in regions where laboratory-based learning opportunities are limited. Moreover, the support provided to postgraduate fellows for their thesis, research reinforces the role of CAN as a partner institution in higher education and scientific advancement.

**Advisory and Outreach Services :** The provision of advisory services to farmers and the dissemination of technical knowledge through radio programs reflect a strong emphasis on community engagement. Such activities ensure that scientific findings are translated into practical solutions, at the farm level. For example, awareness campaigns on antibiotic residues, balanced feeding, and broiler meat safety directly address pressing issues of consumer health and livestock management. This participatory approach not only builds trust with stakeholders but also enhances the adoption of scientific recommendations.

**Publications and Knowledge Dissemination :** The research outputs, popular science articles, and awareness material, published during the reporting year illustrate a balanced approach to knowledge dissemination. By targeting both scientific audiences and farming communities thus the Centre maximizes its impact across the research-to-application continuum. The production of Urdu-language articles and farmer-oriented content is particularly significant in enhancing accessibility and ensuring that key messages reach grassroots stakeholders.

**Broader Implications :** Taken together, the activities of CAN, during the reporting period, demonstrate an integrated model of service delivery, research, training, and outreach. This model not only addresses immediate challenges of feed quality and animal productivity but also contributes to the larger goals of food safety, public health, and socio-economic development. The findings emphasize the need for continued investment in laboratory infrastructure, sustained funding for adaptive research, and stronger linkages with The National Livestock Policy frameworks. By building on these foundations, The Centre can further strengthen its role as a Reference Institution in Animal Nutrition and Food Safety (RIANFS) within Pakistan and the broader region.

## CONCLUSIONS AND RECOMMENDATIONS

### CONCLUSIONS

The study underscores the vital role of The Centre, in promoting safe, balanced, and cost-effective feed for livestock and poultry. Through its analytical services, adaptive research, training, and outreach, contributes significantly to improved animal productivity, food safety, and farmer livelihoods. However, challenges such as feed adulteration and drug residues highlight the need for sustained investment in infrastructure, stronger regulatory measures, and expanded awareness initiatives. By strengthening partnerships and building research capacity, The Centre can further establish itself as a regional hub for feed and

food safety, supporting National goals of food security, public health, and sustainable livestock development.

## RECOMMENDATIONS

To further strengthen its impact, the Centre of Animal Nutrition should expand routine feed and food quality monitoring through regular analyses and database, while also securing funding and advanced equipment to enhance research capacity. Stronger policy measures are needed to enforce regulations against feed adulteration and to monitor drug residues in animal-origin products. Training programs for students, feed manufacturers, and extension workers should be scaled up, coupled with targeted farmer and consumer awareness campaigns in local languages. Ensuring sustainability through government support and public-private partnerships will be critical, and positioning the Centre as a regional hub for feed and food safety will enhance its long-term role in livestock and public health developments.

## REFERENCES

- Waqas, M., Pervaiz, W., Zia, K. M., & Iqbal, S. Z. (2021). Assessment of aflatoxin B1 in animal feed and aflatoxin M1 in raw milk samples of different species of milking animals from Punjab, Pakistan. *Journal of Food Safety*, 41(3), e12893.
- Pakistan Economic Survey (2024-25), available from [https://finance.gov.pk/survey\\_2024.html](https://finance.gov.pk/survey_2024.html), accessed on 12<sup>th</sup> July 2025.
- Tipu, M. A. (2020). Trends of Aflatoxin in livestock feed and various feed ingredients in Pakistan. *Pakistan Journal of Science*, 72(4).
- Mujahid, Khan, F., Hayat, S. U., Khan, R. A., Khan, A. H., & Khan, S. (2025). Aflatoxin B1 in compound feed and feed ingredients from Khyber Pakhtunkhwa. *Food Additives & Contaminants: Part B*, 18(1), 40-47.
- Ismail, A., Riaz, M., Akhtar, S., Yoo, S. H., Park, S., Abid, M., ... & Ahmad, Z. (2017). Seasonal variation of aflatoxin B1 content in dairy feed.
- Malghani, N. A., Kandhro, A. A., Mahesar, S. A., Sohu, S., & Lanjwani, M. F. (2023). Physico-chemical, Proximate and Fatty Acid Analysis of Animal Feeds Marketed in Sindh, Pakistan. *Pakistan Journal of Scientific & Industrial Research Series A: Physical Sciences*, 66(1), 7-15.
- Ali Khan, E., Rizwan, M., Wang, Y., Munir, F., & Hua, J. (2025). Challenges and Future Prospects of Pakistan's Animal Industry: Economic Potential, Emerging Trends, and Strategic Directions. *Veterinary Sciences*, 12(8), 733.
- Solangi, A. W., Shah, A. H., Barham, G. S., & Samo, M. T. (2024). Prevalence and Quantification of Aflatoxin B1 in Broiler Meat and Poultry Feed at Different Zones of Sindh, Pakistan. *Lahore Garrison University Journal of Life Sciences*, 8(3), 394-409.

## AN UPDATE OF SHOULDERING HEAVY TASK OF MANUFACTURING VACCINE IN THE CENTER OF BIOLOGICAL PRODUCTION AT VRI-PESHAWAR (2023-24)

Muhammad Fahad<sup>1</sup>, Kaleem Ullah<sup>2</sup>, Shams-Ul-Hayat<sup>3</sup> and Rafi Ullah<sup>4</sup>

### ABSTRACT

This study presents a detailed overview of biological vaccine production at the Center for Biological Production (CBP), Veterinary Research Institute (VRI) Peshawar, during the fiscal year 2023–24. The CBP is responsible for producing both bacterial and viral vaccines critical for disease control in livestock and poultry across Khyber Pakhtunkhwa, AJK, GB and other regions. Data was compiled from operational records across five major sections: media preparation, bacterial vaccine production, sterilization, quality control and viral vaccine section. A total of 3.45545 million doses of bacterial vaccines produced during the period, comprising: Haemorrhagic Septicaemia – Alum Precipitated Vaccine (HS-APV) with 0.81054 million doses, Black Quarter Vaccine (BQV) with 0.59922 million doses, Enterotoxaemia Vaccine cum lamb Dysentery Vaccine (ETV cum LDV) with 1.6986 million doses, Anthrax Spore Vaccine (ASV) with 0.3425 million doses, and HS Oil-Based Vaccine and 0.00459 million doses. Additionally, the viral vaccine section manufactured 31.0655 million doses of Newcastle Disease Vaccine (NCDV) for poultry. Comprehensive safety and sterility testing were conducted to ensure vaccine quality. These production efforts not only support animal health but also contribute significantly to provincial Non-Tax Revenue (NTR). The study concludes by recommending expanded stakeholder engagement through on-site visits and academic participation in CBP activities.

**Keywords:** Vaccine production, bacterial and vaccines, viral vaccines, VRI Peshawar, disease control,

Article Received :July 2025 Article Accepted :Sept 2025 Article Published :Dec 2025

### INTRODUCTION

Biological production, commonly known as vaccine production, plays a vital role in the prevention and control of infectious diseases, particularly in developing countries. Vaccination remains the most cost effective and immunologically sound method to safeguard both human and animal populations against endemic and epidemic diseases (FAO/WHO/OIE, 2001–2020). In livestock, bacterial and viral diseases can lead to widespread morbidity, mortality and economic losses. The early adoption of prophylactic vaccination strategies is therefore essential in disease management and animal health security.

In Pakistan, institutions such as the Veterinary Research Institute (VRI) Peshawar have

- 
- Research Officer, Media & Sterilization Section, Center of Biological Production, Veterinary Research Institute, Khyber Pakhtunkhwa, Peshawar.
  - Research Officer, Bacterial Vaccine Section, Center of Biological Production, Veterinary Research Institute, Khyber Pakhtunkhwa, Peshawar.
  - Senior Research Officer, Bacterial Vaccine Section, Center of Biological Production, Veterinary Research Institute, Khyber Pakhtunkhwa, Peshawar.
  - Principal Research Officer, Center of Biological Production, Veterinary Research Institute, Khyber Pakhtunkhwa, Peshawar.

historically carried the responsibility of manufacturing Biologicals for disease prevention. The Center for Biological Production (CBP) at VRI Peshawar serves as a critical hub for the production and distribution of vaccines across Khyber Pakhtunkhwa and other regions including Azad Jammu & Kashmir (AJK), Gilgit Baltistan (GB) and the Remount Veterinary & Farms Corps (RVFC) of the Pakistan Army. The vaccines are supplied to the Directorate General of Livestock & Dairy Development (Extension Wing) for field use in veterinary hospitals and mobile units.

Over the years, CBP's production capacity has grown to meet increasing demand. For instance, a comparative study by Pervez Shah et al. (2022) reported that 35.977 million doses were produced in 2019–20, which increased to 43.547 million in 2020–21. In the current reporting year (2023–24), CBP produced a total of 3.45545 million doses of bacterial vaccines and 31.0655 million doses of viral vaccines, indicating sustained operational capacity and strong regional demand.

In addition to serving as a vaccine manufacturing unit, CBP contributes to the provincial economy by generating Non-Tax Revenue through vaccine sales. The revolving fund thus generated, supports the operational continuity of The Institute and future expansion plans. This introduction provides a background to the institution's historical role and emphasizes the relevance of its contributions to livestock disease control in Pakistan.

## **MATERIAL AND METHODS**

This study is based on the compilation and analysis of institutional records from the Center for Biological Production (CBP) at (VRI) Peshawar for the fiscal year 2023–24. The data was obtained from standardized internal documentation maintained by each section. The following sources were reviewed and validated by technical staff for this write up :-

- Sectional Report of Media Preparation (2023–2024)
- Bacterial Vaccine Production Records (2023–24)
- Annual Summary Report on Standardization and Quality Control (2023–2024)
- Viral Vaccine Section Reports (2023–2024)
- Vaccine Supply and Sales Logs (2023–24)

Table 1. Summary of Operational Sections at CBP, VRI Peshawar (2023–24)

Section	Core Responsibilities	Primary Data Sources
1. Media Preparation & Sterilization	Preparation of culture media (broths, agars); sterilization of glassware and plasticware	Sectional Report on Media Preparation (2023–2024)
2. Bacterial Vaccine Production	Production of bacterial vaccines (HS-APV, BQV, ETV, ASV, HS Oil-Based, etc.)	Bacterial Vaccine Production Records (2023–24)
3. Standardization & Quality Assurance	Maintenance of seed cultures; sterility and safety testing	Annual Summary Report on Standardization and QC (2023–2024)
4. Viral Vaccine Production	Production of Newcastle Disease Vaccine (NCDV) for poultry	Viral Vaccine Section Reports (2023–2024)
5. Supply and Sales	Packaging, labeling, dispatch to veterinary departments; revenue recording	Vaccine Supply and Sales Logs (2023–24)

The data collection included daily and monthly production logs, quality control test results, media usage inventories, sterilization logs and vaccine distribution records. Each document was verified for consistency, completeness and authenticity by cross referencing with the CBP's central registry.

The five operational sections reviewed in this study include:

- i. Media Preparation and Sterilization Section – responsible for preparing culture media and sterilizing labware.
- ii. Bacterial Vaccine Production Section – involved in the manufacturing of vaccines against hemorrhagic septicemia, black quarter, enterotoxaemia, anthrax and others.
- iii. Standardization and Quality Assurance Section – oversees bacterial strain maintenance, sterility testing and safety protocols.
- iv. Viral Vaccine Production Section – focused on the production of Newcastle Disease Vaccine (NCDV) for poultry.
- v. Supply and Sales Section – handles packaging, labeling and dispatch of vaccines to end users.

All procedures adhered to institutional biosafety guidelines and Standard Operating Procedures (SOPs). No animal experimentation was conducted beyond the routine use of laboratory animals for quality control testing, and ethical care standards were maintained throughout.

## RESULTS AND DISCUSSION

### RESULTS

The Center for Biological Production (CBP) at VRI Peshawar continued its role as a leading facility for livestock and poultry vaccine production during the fiscal year 2023–24. The data collected from internal records is summarized below, categorized by section.

**1. Bacterial Vaccine Production :** During the reporting year, CBP produced a total of 3.45545 million doses of bacterial vaccines. A detailed breakdown of vaccine types and their corresponding outputs is provided in Table 3.1.

**Table 3.1. Bacterial Vaccine Production at CBP, VRI Peshawar (2023–24)**

Vaccine Name	Abbreviation	Quantity (Bottles)	Dose per Bottle (no)	Total Doses (Million)
Hemorrhagic Septicemia – Alum Precipitated	HS-APV	13,509	60	0.81054
Black Quarter Vaccine	BQV	9,987	60	0.59922
Enterotoxaemia cum Lamb Dysentery Vaccine	ETV cum LDV	16,986	100	1.6986
Anthrax Spore Vaccine	ASV	6850	50	0.3425
Hemorrhagic Septicemia – Oil Based	HS-Oil	306	15	0.00459
<b>Total</b>	—	<b>40,866</b>	—	<b>3.45545</b>

The bacterial vaccines were distributed to veterinary institutions and hospitals across Khyber Pakhtunkhwa and also supplied on-demand to other provinces and organizations such as RVFC.

**2. Viral Vaccine Production :** The viral vaccine section remained one of the most active units, producing 31.0655 million doses of Newcastle Disease Vaccine (NCDV) during the year. This was achieved through the filling of 277,299 vials, supporting the high demand of the poultry sector across the province and beyond.

**3. Media & Sterilization Section :** During 2023–24, the Media and Sterilization Section prepared large volumes of culture media to support bacterial vaccine production. The main types of media and their quantities are summarized in **Table 3.2**.

**Table No.2 Media Prepared at CBP, VRI Peshawar (2023–24)**

Type of Media	Volume Prepared (Litres)
Plain Broth	3,900
Glucose Broth	6,650
Tryptose Phosphate Broth	23
Robertson Media	64
MacConkey Agar	11.25
Nutrient Agar	14.70
Brain Heart Infusion Broth	5
<b>Total</b>	<b>14,667.95</b>

In addition, the section sterilized and recycled laboratory ware for reuse across different sections. This work ensured cost-effective use of resources maintaining biosafety.

**4. Standardization and Quality Control Section:** The Standardization and Quality Control (SQC) Section ensured the availability of viable bacterial seed cultures and the integrity of all vaccines produced during 2023–24. Seed cultures preserved and supplied to the bacterial vaccine production unit included:

- *Pasteurella multocida* (HS-APV): 20,000 ml
- *Pasteurella multocida* (HS-Oil): 250 ml
- *Clostridium chauvoei* (BQV): 14,500 ml
- *Clostridium perfringens* (ETV cum LDV): 26,000 ml
- *Bacillus anthracis* (ASV): 750 ml

To ensure vaccine quality, the QC unit conducted **62 safety tests** (inoculation trials using albino mice, rabbits, and guinea pigs) and **265 sterility tests** (using MacConkey agar, Nutrient agar, Fluid Thioglycollate Medium, and microscopic examination). All vaccine batches released during the year met prescribed biosafety and sterility standards, thereby maintaining confidence in the reliability of VRI vaccines.

**5. Laboratory Animals:** The Veterinary Research Institute (VRI) Peshawar maintained laboratory animals during 2023–24 for two primary purposes: (i) vaccine safety testing as part of quality assurance protocols, and (ii) supply to universities and research institutions where MPhil and PhD scholars utilize them for experimental work.

The records indicate that a total of 4,449 animals were maintained during the reporting year as reflected in the Table 3.

**Table No. 3 Laboratory Animals Maintained at CBP, VRI Peshawar (2023–24)**

Animal Type	Number Maintained/Used	Primary Use
Albino Mice	4,247	Safety testing / Research supply
Albino Rats	138	Safety testing / Research supply
Guinea Pigs	27	Safety testing / Research supply
Rabbits	37	Safety testing / Research supply
<b>Total</b>	<b>4,449</b>	—

Out of these, a significant proportion were used for 62 safety inoculation trials (to verify vaccine safety), while the remainder were sold to academic and research institutions. This dual role of laboratory animals contributes both to quality assurance and to supporting higher education research needs, also generating supplementary revenue for the institute.

## FORMAL DISCUSSION

The results of this study highlight the substantial role of the Center of Biological Production (CBP), VRI Peshawar, in meeting the regional demand for veterinary vaccines, during 2023–24. As a total of 3.45545 million doses of bacterial vaccines and 31.0655 million doses of Newcastle Disease Vaccine (NCDV) were manufactured, reflecting The Institute's sustained production capacity and relevance to livestock and poultry health.

When compared with historical records, the overall production aligns with the long-term trend of increasing demand for prophylactic vaccination in Pakistan. Pervez Shah et al. (2022) reported that 35.977 million doses were produced in 2019–20 and 43.547 million in 2020–21, indicating steady growth in output. Although the present year's cumulative bacterial vaccine output appears a bit lower in numerical terms, this is largely due to a greater emphasis on viral vaccine production, which meets the rapidly expanding requirements of the poultry industry.

The Standardization and Quality Control Section ensured vaccine reliability through preservation of master seed cultures and rigorous testing. The performance of 62 safety trials in laboratory animals and 265 sterility tests across selective media confirms the scientific robustness of the production process. This systematic approach not only maintains biosafety but also strengthens farmer confidence in locally manufactured vaccines, against the imported vaccines.

Similarly, the Media and Sterilization Section contributed significantly by preparing over 14,600 litres of culture media and sterilizing tens of thousands of laboratory ware items, ensuring uninterrupted operations. These activities highlight the importance of support services in sustaining vaccine production at scale.

The dual-purpose use of laboratory animals, for both vaccine safety testing and supply to academic researchers, further demonstrates the institute's contribution to the wider scientific community. By facilitating MPhil and PhD scholars with reliable animal models, VRI Peshawar extends its role beyond production to academic and research support.

Importantly, vaccine sales generated substantial NTR, feeding into a revolving fund that ensures operational sustainability and supports the next year's production cycle. This financial model enables CBP to function not only as a technical hub but also as a self-sustaining economic contributor to the province, including other areas .

Taken together, these findings confirm that VRI Peshawar's CBP continues to serve as a cornerstone of veterinary public health infrastructure in Pakistan. However, there remains a need to further expand farmer outreach, ensure periodic training, and strengthen interprovincial supply chains to maximize the impact of these biologicals in combating endemic diseases.

## CONCLUSION

The CBP at VRI Peshawar produced 3.455 million bacterial vaccine doses and 31.066 million viral vaccine doses in 2023–24, reflecting its central role in livestock and poultry disease prevention. With strict quality control, efficient media preparation, and dedicated technical staff, the institute ensures reliable vaccine supply while generating valuable revenue. These efforts strengthen farmer confidence, support research, and contribute directly to animal health security in Pakistan.

## RECOMMENDATIONS

To further enhance vaccine production and impact, the following measures are suggested:

- i. **Farmer Engagement:** Organize periodic on-site visits and awareness sessions for registered farmers to build confidence in locally produced vaccines.
- ii. **Academic Collaboration:** Expand opportunities for veterinary students and research scholars to participate in vaccine production and quality control processes.
- iii. **Capacity Building:** Invest in modern equipment and staff training to improve efficiency and meet rising demand.
- iv. **Outreach Expansion:** Strengthen interprovincial distribution networks to ensure wider access to vaccines across Pakistan.

## REFRENCES

Pervez shah, Muhammad Ijaz Ali and Mirza Ali Khan (2022). A brief overview of compression of two annual reports of VRI Peshawar. PAKjlse Vol: XIV, No.14-pp1136-1144

FAO/WHO/OIE (2005) All annual reports (2023-24) on Disease of livestock vaccines used in member countries of UN

Muhammad Hafez (2023) presentation of LDF Activities PJLSC and books, Ocp 4<sup>th</sup> at VRI Peshawar vaccines

VRI-Annual Report (2010) (2022) (2023), Peshawar.

## **RECENT INSTRUCTIONS/GUIDE LINES FOR CONTRIBUTORS/AUTHORS**

1. The original Articles/Research papers be sent on A-4 size paper, with one inch margin on both right and left sides. The text should be on Font No.11.
2. The standard format should be Abstract, Introduction, Review of literature, Material and Methods, Result, Discussion, conclusions and Recommendations followed by references/literature cited (in alphabetical order). Reference must appear in the text and preferably for the last 10 years on APA style.
3. Number of tables be restricted to minimum possible as per format.
4. Two printed (hard copies) and a CD/or email (soft copy) may also be enclosed to quicken the process of Referees evaluation(s).
5. Colour prints, photographs, if indispensable, (include 200 prints/200 photographs with colour scheme advised). This is negotiable (4-6 pics ,captioned ,per page)
6. Reference be kept limited (Not more than 20) preferably for the last 10 years. Standard format be adopted (APA-Style),1/2 one page.
7. Contribution of Rs.4500/- (Four thousand five hundreds only) per article/paper be enclosed upto 5-6 pages. Each extra page will cost Rs.1000/- (one thousand only)in addition.
8. Abstracts be limited to one para of 100-150 words in between the A-4(with margins) paper supported in separate line, with Key Words for example.
  - Microbiology: Coliform bacilli; E-coli; incidence of food contamination, Pakistan.
  - Chemistry; Physico–Chemical analysis; algae, lotus lake water – Pakistan.
9. First screening of the papers will be within one month and acceptance/or otherwise will be communicated after a period of 30 (THIRTY) days.
10. Changes/Amendments/Reviewers comments and advises must be attended by the contributor(s) authors and final draft with CDs,/email be re-submitted to the Chief Editor within 14 days (hard copies, of course), along with the corrected ones.
11. Advertisements be sent according to subscribed rates.
12. Selected Scientific paper/Articles will be subjected to PEER REVIEWING simultaneously by the local as well as Foreign Referees, in accordance with the guidelines of HEC, Islamabad Pakistan.
13. Year Schedule of Processing Articles of Each next Volume is also enclosed.
14. Publishing PJLSc. upto this Volume-XVII (No.17), 2025 is on Annual basis.The Editorial Board in its 18<sup>th</sup> and 19<sup>th</sup> meeting agreed to publish PJLSc. Twice-a-year (on Bi-Annual Basis), immediate after the formal approval of HEC is obtained, with possible Financial Assistance.
15. We are now available on [www.pakjpsc.org](http://www.pakjpsc.org) as well as On-Line, URL-<http://www.pakjpsc.org/publication> and email [drmhafeez1949@gmail.com](mailto:drmhafeez1949@gmail.com)
16. The expenditure incurred on each Publications/volume of PJLSc is dependent on authors contributors and donations of EB Members and on No Profit No loss basis.

**PROPOSED ANNUAL SCHEDULE OF PROCESSING RESEARCH  
ARTICLES/PAPERS  
Pakistan Journal of Livestock Sciences (pakjisc.)For  
Vol-XVII, No.17 (2025)**

---

Arrival of Articles (Receiving)	January – May, 2026
Submission to Referees	June – July, 2026
Corrections expected	July – August, 2026
18 <sup>th</sup> & 19 <sup>th</sup> Editorial Board Meetings	July – August, 2026
Referring back to Authors	August – September, 2026
Final Acceptance	September – October, 2026
Draft typed	November, 2026
Proof readings	November, 2026
Final printing (Pre-binding proof reading)	December, 2026
Corrected published	December, 2026
Post-printing reading (addendum if any)	December, 2026
Dispatch to clientele	December, 2026

NB: Acceptance is accorded only when Research Articles are cleared by Respected Referees (both reviewed and peer reviewed)

Article No.	CONTENTS	PAGES
157	<b>QUICK SURVEY REPORT OF LIVESTOCK PRODUCTS IN CENTRAL AND SOUTHERN PUNJAB- (MARCH-2025)</b>  Salman Hafeez and Uzma Kanwal	1300-1303
158	<b>BOOK REVIEW:A CONCISE AND PRACTICAL APPROACH IN VETREERINARY MICROBIOLOGY-2025</b>  Muhammad Shahid	1304-1311
159	<b>INVESTMENT OPPORTUNITIES IN LIVESTOCK BY-PRODUCTS IN PAKISTAN</b>  Muhammad Hafeez <sup>1</sup> and Uzma Kanwal <sup>2</sup>	1312-1316
160	<b>PARASITOLOGICAL AND POULTRY DIAGNOSTIC WORK CONDUCT AT THE VETERINARY RESEARCH INSTITUTE, PESHAWAR</b>  Hamza Khan <sup>1</sup> , Sajid khan <sup>2</sup> , Anwar Mahmood <sup>3</sup> , Muhammad Irshad <sup>4</sup> , Barakat Khan <sup>5</sup> and Tariq Ali <sup>6</sup>	1317-1321
161	<b>RECENT DISEASE DIAGNOSIS EVIDENCES AT CENTRE OF MICROBIOLOGY VRI PESHAWAR</b>  Hamidullah <sup>1</sup> , Aziz Ullah <sup>2</sup> , Hayaz Uddin <sup>3</sup> , Muhammad Abbas <sup>4</sup> , Muhammad Tufail Ahmed Khan <sup>5</sup> , Najeebullah <sup>6</sup> , Muhammad Nauman Ul Islam <sup>7</sup> and Imtiaz Ali Shah <sup>8</sup>	1322-1326
162	<b>EFFECT OF FETAL BOVINE SERUM VS HORSE SERUM ON REVIVAL &amp; PROLIFERATION OF BHK-21 CELL LINE FOR FOOT &amp; MOUTH DISEASE VACCINE PRODUCTION</b>  Shahid Khan <sup>1</sup> , Dost Muhammad Khan <sup>2</sup> , Hammad Ullah <sup>2</sup> , Sania Subhan Qureshi <sup>2</sup> , Hameed h <sup>2</sup> , Arooba Akhter <sup>2</sup> , and Faiza Ashraf <sup>2</sup>	1327-1334
163	<b>A REVIEW OF OPERATIONAL OUTCOMES AND RESPONSIBILITIES AT ARID ZONE SMALL RUMINANTS RESEARCH INSTITUTE, KOHAT.</b>  Muhammad Idrees <sup>1</sup> and Farman Ullah, Abdur Raziq <sup>2</sup>	1335-1338
164	<b>ADVANCING LIVESTOCK PRODUCTION THROUGH APPLIED RESEARCH: INSIGHT FROM LRDS, SUREZAI PESHAWAR</b>  Faiz ul Hassan <sup>1</sup> , Khisrao kalim <sup>1</sup> , Din Muhammad <sup>2</sup> , Zahid Ullah <sup>3</sup> , Ikram Ullah <sup>3</sup> , Sajjad Khan <sup>3</sup> , Naeem Ullah <sup>3</sup> , Muhammad Fakhar uz zaman <sup>3</sup> , Zabit Ullah <sup>3</sup>	1339-1342
165	<b>SUSTAINABILITY EVIDENCED THROUGH DISEASE DIAGNOSTIC WORK AT VRDIC, KOHAT IN A SINGLE YEAR 2023-24</b>  Hafiz Abdul Majid <sup>1</sup> , Muhammad Asif <sup>2</sup> , Qamar Ullah <sup>3</sup> , Abdur Raziq <sup>4</sup> and Muhammad Farooq <sup>5</sup>	1343-1350
166	<b>STRENGTHENING LIVESTOCK FARMERS' DISEASE DIAGNOSIS SERVICES THROUGH VRDIC CHITRAL, KHYBER PAKHTUNKHWA</b>  Safir ullah <sup>1</sup> and Sana ullah <sup>2</sup>	1351-1357
167	<b>EVALUATING THE NUTRITIONAL COMPOSITION OF ANIMAL FEED WITH HAEMATOLOGY AND BIOCHEMISTRY WORK CENTRE OF ANIMAL NUTRITION, VRI PESHAWAR</b>  Ihsan Ullah <sup>1</sup> , Riaz Ahmad Khan <sup>2</sup> , Faiza Shahzadi <sup>3</sup> , Nakash Smark <sup>4</sup> and Khalid Khan	1358-1365
168	<b>AN UPDATE OF SHOULDERING HEAVY TASK OF MANUFACTURING VACCINE IN THE CENTER OF BIOLOGICAL PRODUCTION AT VRI-PESHAWAR (2023-24)</b>  Muhammad Fahad <sup>1</sup> , Kaleem Ullah <sup>2</sup> , Shams-Ul-Hayat <sup>3</sup> and Rafi Ullah <sup>4</sup>	1366-1373