

# PASTEUR INSTITUTE IN TUNIS

## THE BIOMEDICAL ANALYSIS LABORATORIES OF THE PASTEUR INSTITUTE IN TUNIS

Diagnosis and Public Health includes:

- 18 specialized laboratories and units
- **Services:**
  - Test samples are taken to IPT or referred by hospitals and other public and private health.
  - The microbiological investigations in human and animal pathology are central in accordance.
  - The immunological and biochemical tests, hormonal dosages, hematological and histopathological analyzes.
  - Cytogenetic studies, trisomy 21 screening tests, molecular diagnosis of leukemia (RT-PCR bcr-abl), genotyping and sequencing.
  - Convention with Cerba laboratories
- **Other commitments:**
  - Training and mentoring activities
  - Applied research in clinical biology.

### 1- LABORATORY FOR MYCOBACTERIA

Identifying cases of mycobacterial infections and test their susceptibility to anti-TBTests conducted systematically on any sample are:

- Direct examination (Zhiel Nielson stain)
- Lowenstein-Jenson culture medium
- Biochemical identification and / or PCR / spoligotyping
- Antibiogram (Rifampicin, Isoniazid, Streptomycin, Ethambutol, Pyrazinamide, Ethionamide, ofloxacin, kanamycin, D-Cycloserine)
- The detection of M. tuberculosis by PCR in addition to the direct examination.
- The PCR targeting the RecA gene for confirmation of infections by atypical mycobacteria
- PRA technique for identifying atypical mycobacteria
- The rpoB gene sequencing (at the request of clinicians) at a strong suspicion of a transmission of multidrug-resistant or MDR strain)

### 2- CENTRAL LABORATORY OF MEDICAL BIOLOGY

- **Diagnostic activities**
  - The LCBM is organized into three sectors which provide common biomedical analysis:
    - **BIOCHEMISTRY**
      - Carbohydrate balance.
      - Lipid profile.
      - Liver function tests.
      - Renal balance.
      - The electrolytes
      - phosphocalcic balance sheet.
      - Exploration of muscle enzymes and pancreatic.
    - **HEMATOLOGIE**
      - Hematology Cell Analysis
        - Blood count, the study of blood smear, sedimentation rate, blood grouping and some immuno-hematology tests (test Direct Coombs, indirect).
      - Analysis Hemostasis
        - Routine tests: PT with INR, APTT , TS: bleeding time, (Fg), determination of coagulation factors.
        - Specialized analyzes: complete thrombophilia balance: PC dosage, PS, ATIII, (APCR), (ACC).
    - **BACTERIOLOGIE**
      - Analysis of organic products in the context of diagnostic activities. .
      - Control of culture media (sterility, fertility, pH ...).
      - Control of blood products horses, sheep and rabbits for sale.
      - Identification of bacterial strains.
      - Hygiene control some hospitals.
- **Supervision of students**

### 3- LABORATORY OF PARASITOLOGY-MYCOLOGY

- **Activities**
  - Biological diagnostic and mentoring.
  - It is the national reference laboratory for malaria.
  - The coaching activity is one of the main tasks of the service

The laboratory consists of 4 subunits:

- Direct parasitological diagnostic unit
  - Pest Search in feces, urine, blood (hématozoïres), skin and bone marrow (Leishmania), placenta and amniotic fluid (toxoplasma) and in wastewater.
- Mycology unit
  - Skin samples and appendages in search of yeasts or filamentous.
- Serology Unit
  - Toxoplasma serology serology but seeking anti-hydatid antibodies, anti-leishmaniasis, anti-plasmodium anti-Aspergillus, anti Toxocaracanis or anti-amoeba.
- Molecular Biology Unit
  - Quantitative PCR in the prenatal diagnosis of congenital toxoplasmosis and the diagnosis and therapeutic monitoring of visceral leishmaniasis.

### 4- GENERAL BACTERIOLOGY LABORATORY

- **Activities**
  - Analysis of organic products in the context of diagnostic activities.
  - Control of culture media
  - Control of blood products: horse blood, sheep blood and rabbit blood intended for sale
  - Identification of bacterial strains mainly from the production laboratory and vaccine control laboratory
  - Hygiene control some hospitals
- **Supervision of students**

### 5- LABORATORY OF CLINICAL VIROLOGY

- **Activities**
  - Provides routine diagnostic virology activities.
  - Hosts Tunisian and foreign interns for training
- **Clinical Biology Activities**
  - biomedical analysis performed for patients
  - The techniques are serological and molecular.
  - Molecular analyzes (research and / or assay of viral genomes) in continuous increase, far beyond the demands serological tests.
- **Public health activities**
  - Monitoring poliovirus, measles virus and rubella, as part of international programs of polio eradication and measles elimination.
  - Reference laboratory for of the Eastern Mediterranean Region for poliovirus surveillance since 1991 and on the measles surveillance since 2002.
  - The laboratory also provides virological investigation aseptic meningitis and epidemic conjunctivitis, samples.

### 6- CONTROL LABORATORY OF WATER AND FOODSTUFFS

- **Activities**

Bacteriological analysis of Water, Food and the study of enteric bacteria.
- **Public health activities:**
  - Diagnostic etiology and prevention of diarrheal diseases through research and study of enteric
  - Epidemiological surveillance of enteric epidemic.

- The laboratory is the National Reference Center and is a member of WHO GLOBAL SalmSurv. since 2000 and regularly participates in the External Quality Assurance System (EQAS).
- Monitoring the health quality of food and prevention of foodborne infections bacteriological analysis of food served and sold.
- Monitoring the sanitary quality of drinking water, swimming and the environment by bacteriological analysis of water.

## 7- MYCOPLASMA LABORATORY

- **Activities**
  - Mycoplasma diagnosis and monitoring activities and research.
  - The diagnostic and control activities : isolation and identification of mycoplasma strains from samples
  - Immunological and molecular tools for improved diagnosis Mycoplasma animal, especially avian and human.
  - In its oversight role avian mycoplasma or monitoring the effectiveness of a new vaccine mycoplasma
  - As for mycoplasma manmade most studied: Mycoplasma pneumoniae, an agent of SARS, Mycoplasma hominis and Ureaplasma urealyticum responsible for urogenital disorders.

## 8- ANIMAL PATHOLOGY LABORATORY

- **Analysis requests**
- **Activities**
  - Diagnosis and monitoring of infectious animal diseases.
    - monitoring the Newcastle disease (ND)
    - monitoring avian influenza (IA)
    - Diagnostic Laboratory of sheep pox in sheep
- As such, the Animal Pathology Laboratory provides:
  - Diagnosis and epidemiological clinical study of viral agents animals, avian particular:
  - Isolation, identification and characterization,
  - Determination of the nature of the isolates and their pathogenicity,
  - Participation in ad hoc surveys to better understanding and epidemiological monitoring,
  - Establishment of reference techniques while developing other laboratory techniques in accordance with international standards.
  - The epidemiological monitoring of animal diseases, particularly Newcastle disease and avian influenza
  - Participation in the development and adaptation of national control programs

## 9- RABIES LABORATORY

- **General presentation**
  - Diagnosis of Animal and Human rabies: (IFD) and (CCSVI) are reference techniques recommended by WHO and OIE
    - Key component of the National Programme of Fight against Rabies in Tunisia.
    - reference laboratory for the diagnosis of this disease in the country
  - Evaluation of the immune response
  - Evaluation of therapeutic activity of anti-rabies serum and rabies vaccines.
  - Works epidemiology of rabies.
  - Research on rabies within the Research Laboratory of Veterinary Microbiology activities.
  - Supervision of trainees sent by the WHO Regional Office (EMRO) and students in the framework of preparation of PFE, Master and PhD.

## 10- CLINICAL BIOCHEMISTRY LABORATORY

- **Laboratory Activities**
  - **ACTIVITIES DIAGNOSTIC**
  - **specialized analyzes**
    - The quantitation of specific proteins by nephelometry
    - The separation and determination of metabolites of catecholamines by HPLC with electrochemical detection
    - The analysis of certain trace elements by atomic absorption spectrophotometry
- **RESEARCH ACTIVITIES**

- collaboration with the research unit on Molecular exploration of orphan genetic diseases to research that focus on:
  - Biochemical and genetic study of primary hyperoxaluria in Tunisia.
  - biochemical and genetic study of risk factors for type 2 diabetes

- **SUPERVISION OF STUDENTS**

## 11- RADIO-IMMUNOLOGY LABORATORY

- **General presentation**

The main mission Hormonology of Oncology, the Prénatalogie and Allergology.

In therapeutic monitoring: pharmacological interference, immunological or other inherent in the assays themselves.

- 1- In Hormonology various axes are explored:
  - Hypothalamic-pituitary-thyroid axis: FT4, TSH, ATPO, ATG.
  - Hypothalamic-pituitary-gonadal axis: FSH, LH, PRL, E2, PG, Testosterone, D4AD, DHEA, DHEAS.
  - Hypothalamic-pituitary-adrenal ACTH, serum and urine cortisol, 17OH PG, aldosterone, renin.
  - Hypothalamic-pituitary-growth hormone GH.
  - Parathyroid: PTH.
- 2- In Oncology, serum markers of certain cancers are dosed: ACE, AFP, CA15 / 3 CA19 / 9, CA125, PSA.
- 3- In Prénatalogie, the laboratory performs screening for trisomies 21 and 13.18 and closed neural tube defects.
- 4- In Allergy, are dosed total serum IgE and specific with respect to a range of a hundred allergens?
- 5- In Vitamin ology, analyzes to vitamins B9 and B12.

## 12- LABORATORY OF CLINICAL IMMUNOLOGY

- **General presentation**

- Perform analyzes for diagnosis and monitoring of patients with monoclonal gammopathy, and autoimmune diseases.
- Monitors the patients with HIV infection.
- Mentoring sessions with students from different institutions Immunology.
- Research activity on the study of the pathophysiology; Celiac disease (CD), multiple myeloma (MM) and psoriasis.
- Collaboration with INSERM U793 team led by Dr. N. Kite Bensussan the Necker Faculty in Paris helped to better understand the pathophysiology of MC demonstrating
- Collaboration with the National Registry of Bone Marrow Center and in the National Therapeutic protocol based on the joint use of thalidomide-dexamethasone combined with autologous stem cell transplantation, a research work aims to better understand the pathophysiology of MM.
- Collaboration with Dr. Samar Samoud (AHU, FarhatHached Hospital, Sousse).

## 13- LAB CYTO-IMMUNOLOGY

- **General presentation**

- Specialized clinical biology activity oriented particularly towards the cellular and molecular immunological exploration of children with suspected hereditary immunodeficiencies (IHL).
- Cyto-immunology continues to develop its research programs on the study of the molecular basis of IHL. Alongside these activities.

## 14- LABORATORY OF HEMATOLOGY

- **General presentation**

- Study of hemoglobin and erythrocyte enzymes Hb electrophoresis to detect hemoglobinopathies
- Molecular study of leukemia:
- Immunophenotypic study of leukemia
- Haemostasis& cytology

## 15- LABORATORY OF HUMAN AND EXPERIMENTAL PATHOLOGY

- **General presentation**

In particular dermatopathology, interstitial pneumonia, gynecological pathology, infectious disease and complications of post-allogeneic hematopoietic stem cells.

- Diagnostic activities pathological laboratory based on histopathological and conventional cytology and specialized investigations applied in the field of pathology with the establishment regularly, new histotechnologiques tools.

- Since 2006, the laboratory is part of the WHO International Network of HPV laboratories as Reference Laboratory for the South Mediterranean region
  - contribute to the effective monitoring of HPV infection
  - Provide support information, training courses, technical support and advice for small laboratories of the southern Mediterranean region's resources.

## 16- LABORATORY OF HISTOLOGY AND CYTOGENETICS

- **General presentation**

- The realization of karyotypes and molecular genetic testing.
- In parallel, it provides training activities
- The conduct of research activities particularly in the field of human molecular genetics.

The laboratory activities have a major contribution to:

- Prevention of genetic origin and disability, through postnatal diagnosis, genetic counseling, premarital diagnosis and evaluation of genetic risks associated with assisted reproduction
- Better support for patients and their families and in the fields of infertility, hematological malignancies and various hereditary diseases including Fanconi anemia.

## 17- LABORATORY OF FOOD TOXINS

- **General presentation**

- Control and analysis
- Research activities

- **Diagnosis and public health**

- Reference diagnostic activity for the dosage and identification of marine biotoxins.
- The monitoring of marine toxins is carried out in a strict regulatory framework, dictated by European regulations.

- **Research**

- biotoxins
- Molecules and therapeutic targets extracted from seaweed

- **Biotoxins**

The aim of our research is to identify the causes of toxicities observed in the mouse when not linked to known toxins, to study ways to improve detection tools and characterization of health hazards.

The main objectives are:

- Determine the structure, origin and transformation of the ways of microalgal toxins in marine food products.
- Development of physical-chemical analysis methods and / or biological following the standards of specificity, speed and reliability.
- Health risk assessment.
- validated purification techniques and shellfish detoxification

- **Molecules and therapeutic targets extracted from seaweed**

## 18- LABORATORY OF EPIDEMIOLOGY AND ECOLOGY OF PARASITIC

- The Department of Epidemiology and parasite ecology is a university hospital laboratory Medical Parasitology.
- This is a specialized service of Parasitology :needs in the areas of diagnosis, care and control of endemic and emerging parasitic diseases but also those at risk of introduction or relocation in Tunisia.
- Service activities cover aspects of investigation, analysis and intervention on priority epidemiological events and interest.
- They fit within national programs.
- Not limited to the medical aspect also to ecological aspects, environmental and veterinary through the study of zoonotic reservoirs targeted parasites and modalities of transmission.
- By its academic quality, LEEP also improves training in Medical Parasitology by the development of a specialized training field for the benefit of young health managers and as students in various sciences.

## SERVICE OUTSIDE CONSULTANTS

Provides pre and post diagnostic activity. It centralizes all the samples to different laboratories, biomedical analysis concerning both routine analysis as specialized analyzes

## SERVICE VACCINATIONS

- Vaccines performed at the Pasteur Institute in Tunis
  - flu
  - preventive rabies
  - measles
  - tuberculin
  - typhoid fever
  - hepatitis B virus
  - viral hepatitis A
  - poliomyelitis
  - diphtheria-tetanus
  - meningitis
  - yellow fever
- Rabies vaccination

## PUBLIC HEALTH PROGRAMS

- **National programs**

- **Eradication of poliomyelitis With the involvement of the clinical virology laboratory (Regional Reference Laboratory)**
  - This activity is approximately 200 to 300 samples analyzed stool year.
  - Looking for enterovirus on several cell lines, typing all poliovirus or non-polio isolated genetic characterization and a surge of poliovirus isolates to determine the wild or vaccine-derived and, if strain wild, to determine its native or imported origin.
  - The realization of specific studies to refine the national polio eradication system
  - .Furthermore, the laboratory has always been among the first in the international network of WHO reference laboratories, to introduce new diagnostic technologies enteroviruses.
- **Fight against AIDS With the involvement of the clinical virology laboratory (National Reference Laboratory)**
  - Monitoring the implementation of routine screening for HIV infection in some populations at risk (with regular screening every month).
  - Officials laboratory of Immunology and Virology actively participate in the activities of the National Technical Committee monitoring the National Program against AIDS
- **The fight against malaria With the involvement of Parasitology laboratory for diagnosis (National Reference Laboratory)**
  - Vaccination for prophylaxis
  - It provides a check-up by 10% and thick blood smears performed outskirts, about 6000 slides per year, as well as control all the positive labeled blades.
  - Contributes to the monitoring of non-permanent resident students in Tunisia and sports from malaria-endemic areas; this activity covers about 500 individuals annually.
  - The vaccination service occurs by the board and prescription of chemoprophylaxis for travelers heading to areas with malaria risk
- **Monitoring food and water With the involvement of the water control laboratory and foodstuffs (Regional Program or Greater Tunis)**
  - Monitoring of the sanitary quality of drinking water and foodstuffs, necessary to prevent foodborne infections and waterborne diseases.
  - Monitoring of the sanitary quality of bathing water of shellfish waters and sewage, particularly in the framework of the international program WHO / UNEP on the pollution of the Mediterranean Sea.
  - Participation in the establishment of the Tunisian standards (INNORPI) concerning the quality of water and food.
- **Fight against diarrhea With the involvement of the laboratory control water and food (National Center for Salmonella, Shigella and Vibrio cholera)**
  - investigation beyond the current tests for the identification of E. coli pathovars,
  - determine serotype and phage biotype essential to any epidemiological study
  - to participate in the national supervision of human and veterinary salmonellosis, shigellosis and cholera, informing
  - the counselor laboratories for both technical problems for epidemiological information that interests them
- **Fight against rabies With the involvement of rabies laboratory (National Laboratory confirmation of human and animal rabies) – Vaccination**
  - The prevention of disease in animals, reservoir and vector, through the organization of annual campaigns of mass vaccination of dogs,
  - The population control canine mainly by organizing rambling dog slaughter campaigns,
  - The management of people at risk of contamination rabies after contact with different types of suspicious animals.

## RESEARCH AND DEVELOPMENT AT THE PASTEUR INSTITUTE IN TUNIS

- The IPT has invested in growth themes with a public health impact and encouraged the recruitment of scientists and the creation of research teams
- projects aimed the development of vaccines and improved diagnostic tools have multiplied.
- IPT has strengthened its capacity in bioinformatics analysis and biostatistics, as well as mathematical modeling. Currently, the IPT has to invest more in new disciplines such as genomics, transcriptomics and proteomics

## THE RESEARCH LABORATORIES OF THE PASTEUR INSTITUTE IN TUNIS

Since 1 January 2012, the Pasteur Institute in Tunis was reformed and replaced its seven laboratories and 4 research units, 9 laboratories.

Research lab	Responsible
Molecular microbiology, vaccinology and biotechnological development	Helmi Mardassi helmi.merdassi@pasteur.rns.tn
Transmission control and immunobiology of infections	Ridha Barbouche ridha.barbouche@pasteur.rns.tn
Veterinary Microbiology and Epidemiology	Abdejil Ghram abdeljelil.ghram@pasteur.rns.tn
Molecular epidemiology and experimental pathology applied to infectious diseases	Ikram GUIZANI ikram.guizani@pasteur.rns.tn
Biomedical Genomics and oncogenetics	Sonia ABDELHAK sonia.abdelhak@pasteur.rns.tn
Medical Parasitology, Biotechnology and Biomolecules	Aida BOURATBINE aida.bouratbine@pasteur.rns.tn
Molecular Hematology and cell	Salem ABBES salem.abbes@pasteur.rns.tn
Venoms and Biomolecules Therapeutic	Mohamed EL AYEB mohamed.elayeb@pasteur.rns.tn
Epidemiology and genetic diversity human liver and enteric viruses	Henda TRIKI henda.triki@pasteur.rns.tn

## 1-LABORATORY OF MOLECULAR MICROBIOLOGY, VACCINOLOGY AND BIOTECHNOLOGY DEVELOPMENT

### • Objectives:

- Three complementary areas of research with the ultimate goal the development of new processes and biomolecules for therapeutic and especially immunization.
- To explore new biotechnological approaches based on the use of new systems / gene expression vectors derived from genetic manipulation.
- The major themes will focus on rabies, tuberculosis, mycoplasma, FMD

## 2-LABORATORY TRANSMISSION, CONTROL AND IMMUNOBIOLOGY OF INFECTION

- The aim of our laboratory is to deepen the knowledge on leishmaniasis and tuberculosis.
- The approach is the mastery of tools for rigorous analysis of their transmission and monitoring, coupled with better investigation of the host immune responses to pathogens responsible.
  - **Epidemiology, Surveillance and Control**
    - i) study of cohorts Tunisian population-related leishmaniasis and tuberculosis,



- ii) strengthening surveillance for cutaneous leishmaniasis by a geographic information system and the development of mathematical models
- iii) promote standards of international best practices in clinical research and conduct clinical trials
- **Immunobiology of leishmaniasis**
  - i) identification of correlates of protection in cohorts of individuals at risk,
  - ii) Study Host parasite interaction by transcriptomic approaches, proteomic and régulomiques
  - iii) Study of the innate and adaptive immune responses induced by the vector components.
- **dysimmunity and Infection**
  - i) the escape of the pathogen to the immune responses,
  - ii) the susceptibility host genetics to infection
  - iii) immunological alterations associated to infectious stress in autoimmune pathologies

### 3-EPIDEMIOLOGY AND LABORATORY OF VETERINARY MICROBIOLOGY

- Study of animal pathogens to economic impact and / or medical (zoonotic) important work focusing on epidemiology and surveillance, control methods and the development of tools reliable and fast diagnosis

### 4-MOLECULAR EPIDEMIOLOGY AND EXPERIMENTAL PATHOLOGY APPLIED TO INFECTIOUS DISEASES

- Research programs capitalize on the expertise of the wearer laboratory (LR00SP04 - Ecology and Epidemiology Service Parasitaire) for Leishmaniasis.
- They also capitalize on the achievements of two other research teams were the respective two research units: UR "Human Papillomavirus" and UR "Biochemistry and Experimental Pathology".
- They are organized around three major cross-cutting themes:
  - Markers,
  - Diagnostics,
  - Molecules and therapeutic targets

- **General goals of the laboratory:**

- 1- To elucidate the molecular epidemiology of pathogens of interest (Leishmania, HPV, etc).
- 2- Develop markers or biomarkers and new generation of molecular diagnostic tools.
- 3- To develop experimental models for the purpose of translational enhancement.

### 5-BIOMEDICAL GENOMICS LABORATORY AND ONCOGENETICS Laboratory Objectives

- **Genetic diversity** : "Genomics and genetic disease," a genomic approach to identify the molecular basis of monogenic and multifactorial diseases in the Tunisian population
- **Population health**: "Genomics and Cancer" program focuses on the study of genetic factors predisposing to cancer and affecting their progress.
- In addition to these two programs, a program to support research that comprises two transverse projects:
  - one of genomics and biomedicine training aimed at developing skills in applied genomics to biomedicine
  - Another aimed at the enhancement of the identified biomarkers in different laboratory projects, the development of diagnostic kit and fellow tests.

### 6-MEDICAL PARASITOLOGY, BIOTECHNOLOGY AND BIOMOLECULES Laboratory Objectives

- Researchers at LR "PMB & B" interested in parasites with a public health interest in Tunisia, both endemic (leishmaniasis, toxoplasmosis), emerging (cryptosporidiosis) or at risk of re-emergence (malaria).
- They are structured in three complementary research programs:
  - 1- parasitic eco-epidemiology: dynamics modeling of transmission of parasites and understanding of their risk factors
  - 2- identifying biomarkers of parasitic infection and resistance to treatment and the development of biological analysis tools of biotechnology
  - 3- understanding the early stages of parasite infection and cellular and molecular elements that fight or contribute to its development, bioinformatics modeling of the mechanisms governing the cellular response to infection and characterization and evaluation of parasite molecules having a therapeutic or vaccinal interest

### 7-MOLECULAR AND CELLULAR HÉMATIOLOGIE

- **Laboratory objectives:**

- Working on the pathophysiological aspects of hereditary and acquired hematological abnormalities.

- identify genetic abnormalities at the base of the red blood cell abnormalities and bleeding phenotype correlations and search genotypes that can be observed between certain mutations and disease severity
- study the malignant h moopathies
- The work is focused on the search of polymorphisms of certain genes described to be involved in the modulation of hemoglobinopathies.
- Molecular and cytological exploration and the study of genetic predisposition to malignancies.

## 8-BIOMOLECULES AND THERAPEUTICS LABORATORY VENOMS

### • Laboratory objectives:

- Pharmacologically active drugs Biomolecules innovates models identified and purified from the venom of scorpions and vipers. The popular activities are their anti-tumor, anti-angiogenic and apoptotic tested in vitro and in vivo for disintegrins, the disintegrin-like, the C-type lectins and phospholipase A2. Also, nano anti-scorpion toxin antibodies, obtained by genetic engineering, and derivatives will be produced on a pilot scale for the development of their potential application in the new generation of immunotherapy antivenom

## 9-EPIDEMIOLOGY AND GENETIC DIVERSITY OF HUMAN LIVER AND ENTERIC VIRUSES

### • Presentation of the laboratory's activities

- Research activities on hepatitis and some viral diseases with epidemic potential have been conducted since the early 1990s,
- Diagnostic and public health activities conducted by the Clinical Virology Laboratory team.
- Research Unit and the Research Laboratory bear the same name: "Hepatitis and epidemic viral diseases .
  - focused mainly on viral hepatitis and enteroviruses as main drivers of certain epidemic diseases (poliomyelitis, meningitis and viral conjunctivitis
  - some work has also focused on other viral agents with epidemic potential including West Nile virus, Phlebovirus, adenovirus, measles virus and rubella virus.
- In late 2011, the research laboratory has been renewed under the new name: "Epidemiology and Genetics liver and enteric viruses."
  - viral hepatitis and
  - enteric viruses
    - essentially the sero-epidemiology, molecular epidemiology and the study of genetic diversity of viruses involved in connection with the clinical presentation of the infection, the effectiveness of prevention
      - methods (particularly vaccination) and performance of the laboratory methods used for diagnosis and monitoring of these viral agents

## INVENTION PATENTS FROM THE PASTEUR INSTITUTE IN TUNIS

- **GENE ASSOCIATED WITH Leishmania PARASITE VIRULENCE 2002**
- **LEISHMANIA POLYPEPTIDES OF MAJOR, POLYNUCLEOTIDES ENCODING SAME AND VACCINE, AND DIAGNOSTIC APPLICATIONS THEREOF therapeutical 2005**
- **COMPOSITION COMPRISING THE N-TERMINAL REGION OF LEISHMANIA HISTONE H2B, USE THEREOF FOR AN IMMUNE RESPONSE Inducing2005**
- **USE OF A DEAD-Box RNA inducing HELICASE FOR CYTOKINE PRODUCTION 2008**
- **METHODS TO IDENTIFY AND FACTORS LEISHMANIA VIRULENCE USE OF SUCH FACTORS AS VIRULENCE THERAPEUTIC, DIAGNOSTIC AND VACCINE TARGETS 2008**
- **VARIABLE DOMAINS OF camelid HEAVY CHAIN ANTIBODIES DIRECTED AGAINST- ANDROCTONUSAUTRALIS HECTOR TOXINS 2009**

## EDUCATION AND TRAINING AT THE PASTEUR INSTITUTE IN TUNIS

Any person wishing to study at the Pasteur Institute in Tunis, must above all be part of a structure university.

- **Postgraduate and Academic guidance**
  - From 1995 to 2010, the Laboratories of the Tunis Pasteur Institute enabled the preparation and defense of academic **degrees** and **657** postgraduate distributed as follows:
    - 5 State theses
    - 93 University theses
    - 298 briefs Master
    - PFE 167 (end of study project)
    - 58 medical doctoral theses
    - 19 veterinary doctorates
    - 17 engineering degrees in bio-industry and bioengineering
- **Education / Training / Continuing Education**

## VACCINES AND SERUMS PRODUCTS AT THE PASTEUR INSTITUTE OF TUNIS

The BCG vaccines -  
Intradermal BCG - Start:1927

- **BCG immunotherapy for fees**
- **The therapeutic sera**
- **Antivenom serum directed against two species of scorpions:**
  - -Anti-Androctonusaustralisgarzonii
  - -Anti-Buthusoccitanustunetanus
  - The antivipérin serum against two species of vipers
    - -Anti-Ceratascerastas
    - -Anti-Viperalebetina
  - The rabies serum

## DEVELOPMENT ACTIVITIES

- Rabies Vaccine for Human Use
- Rabies Vaccine for Veterinary Use
- Bacterial vaccines for veterinary use (mixed coal enterotoxaemia)

## **SERVICE UNITS**

- **Cytofluorometry unit flow**
- **Genetic sequencing unit**
- **Genetic typing unit**
- **Unit bio fermentation**
- **Protein sequencing unit**