I was born into a middle class Jewish family of La Plata, Argentina, in 1956. I use to tell my students of the Development of Vaccines course, which I give at the University, that I belong to the last generations vaccinated with the Salk and the anti-variola vaccines. This makes me part of the history of vaccine development itself. It seems that my faith as a vaccinologist was determined by that time.

La Plata is a University town to which my father moved in order to study Chemistry. His family came from Ukraine to the agriculture colonies that Baron Hirsh bought in Entre Rios, Argentina, to host the Jews that escaped from the European persecutions before World War I. My mother’s family, on the other hand, came to Argentina from Poland just before World War II.

My father, Marcos Palatnik, was a bright, extremely humorous and clever man, who became a notorious scientist in the field of immunogenetics, in Argentina and Brazil.

He always had a passion for science, and had a great talent for Mathematics and Statistics as well. He had a microscope at home and taught me how to identify the blood cells when I was at kindergarten. Since then, the microscope has always been my close companion. At the age of thirteen, we traveled to the Jewish colonies of Entre Rios, for the 15th anniversary of my father’s cousin. During the big party, I saw several poor children looking through the window. One girl had a swollen eye. My father explained to me that it was the Romaña’s sign of Chagas Disease, and that this little girl had been bitten by a blood-sucking bug that transmits Trypanosoma cruzi. At that time, I promised myself that I would dedicate my career to cure or prevent, nothing less than Chagas Disease.

Later, during my fundamental and high school studies I realized that microorganisms and infectious diseases interested me more than genetics, despite my father’s influence. Mainly protozoal diseases intrigued me. I studied two years at the Faculty of Medicine of La Plata, but moved to Israel in 1977, when my family moved to Rio de Janeiro, Brazil. After working for a year in a kibbutz as the person responsible to control the cotton plantation plagues, I was accepted at the Hebrew University of Jerusalem, where I studied and graduated as Bachelor of Science in Biology (BSc) in 1980. This represented an extremely important experience for me. I was impregnated for life with the high scientific and humanistic spirit of the Hebrew University.

During the last year of my BSc studies, I chose all the Microbiology, Protozoology, Helminthology and Virology courses offered by the High Medical School of Hadassah. At the Kuvin Center of Parasitic Diseases I met Professors Charles Greenblatt, Lionel Schnur and Josi El-On, who by that time had identified the Excreted factor of Leishmania. The Kuvin Center was the WHO reference center for Leishmaniasis and they had developed a human live-vaccine against the disease. I told Professor Dan Shapira that I would like to work with Chagas Disease. He answered that they did not have Chagas Disease in Israel and that I should work on Leishmaniasis instead. Therefore, in 1980 I changed my “oath” from Chagas disease to Leishmaniasis, and have been a “leishmaniac” ever since.

After graduation I moved to Rio de Janeiro, where my family lived and developed my MSc and PhD studies in Microbiology, at the Federal University of Rio de Janeiro. During the MSc thesis, I learned how to purify and characterize glycoconjugates of a lizard Leishmania (L. adleri) and of the insect parasite Leptomonas samueli. I was also a research student of the Weizmann Institute of Science in Rehovot, Israel, working on the respiratory burst of Entamoeba histolytica.

Back in Brazil, during my PhD Thesis, I was finally allowed to work with a pathogenic Leishmania! I isolated a glycoprotein complex, that we called the Fucose-Mannose ligand (FML), a lipopeptidophosphoglycan and a polysaccharide from cells of Leishmania donovani, the agent of human visceral leishmaniasis in Asia and Africa. At that time, Prof. Radovan Borojevic was my PhD co-advisor. In his lab, I managed to identify the FML glycoprotein complex as the most potent inhibitor of the penetration of the parasite into macrophages. Monoclonal antibodies against FML recognized a glycoprotein band of 36kDa as its main component.

My undergraduate studies at the Hebrew University and my stage at Professor Radovan’s lab inspired me to follow in the fields of applied science and in biotechnology.

In 1986, I was also approved by public tender, and became Auxiliary Professor of Medical Parasitology and started my academic career at the Federal University of Rio de Janeiro (UFRJ). I have developed my whole career, including the Full Professor position (2006) in UFRJ, where I also have taught General Microbiology since 1990 and Vaccine Development since 2003.

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My research interests also included the study of the structure/functional properties of saponin adjuvants capable of optimizing prophylactic or curative vaccine formulations against leishmaniasis, dengue and Avian Influenza. In addition, I worked on the development of diagnostic and prognostic tools for human and canine leishmaniasis and described the transmission of visceral leishmaniasis (VL) through blood transfusion in hamsters. Furthermore, we proved that polytransfused renal patients undergoing hemodialysis in endemic areas for VL showed significantly increased antibody titers to FML when compared to such patients in non-endemic areas. Additionally, we described the presence of *Leishmania* DNA in blood and bone marrow samples from asymptomatic blood donors that had anti-FML antibodies. We studied more than 1,500 blood donors in Natal. Thus, our pioneer studies indicated the possible transmission of VL by blood transfusion and these results were considered as evidence in United States and Europe, for the regulatory standards of blood-bank donor control of VL endemic areas. I received an homage from the City Council of Rio de Janeiro in recognition of our work.

These projects also included the use of the FML-ELISA for screening of donors and recipients of transplanted organs. These investigations showed that patients with the active disease were seropositive for the FML antigen, and moreover, seropositive but asymptomatic individuals, developed the disease within up to six months. In other words, seropositivity for FML had a prognostic value on the development of the disease. Along this whole period (1995–2001), we collaborated intensively with Prof. Kleber G Luz of the Federal University of Rio Grande do Norte (UFRN) in the North East of Brazil. This collaboration gave me the opportunity to study, for the first time, samples of human patients and asymptomatic subjects of an endemic area of VL. To that end, I supervised two UFRN students and set up a leishmaniasis diagnostic serology laboratory at the Hospital Giselda Trigueiro in Natal, which received most of the cases in the state. Before that, patients were diagnosed only by observation of the parasite in bone marrow puncture smears which is a very risky procedure.

The history of my professional life overlaps with the history of our results. If someone wants to tell my story he will not mention a series of positions in diverse institutions, but he will tell the logical history of the development of different generations of vaccines against leishmaniasis. Aiming to obtain control of the epidemics, I worked with and studied all the new disciplines that were necessary to improve the formulation and to make it available to the public health sector. I still do that, every day. Such goals guided my work and guided my life. One could say that my scientific story follows the evolution of vaccinology. My scientific history follows exactly a program of a course of vaccine development, and route of immunization for the FML-vaccine. The best adjuvant performance. Together with Professor Parente of UFRJ, we carried out structure-function studies of many plant saponins. We discovered for instance, that the QS-21 sapogenin has a C4-aldehyde in a predominating axial position, which promotes a preferential induction of antibody responses. In contrast, the QS-21 sapogenin enriched in C-4 aldehyde in the equatorial position exacerbates the intradermal response and IFN-γ secretion. We further disclosed the composition of the commercialized saponins. The QS-21 sapogenin is currently industrialized and used in the canine vaccine against VL designed in our laboratory as well as in three other canine anti-*Leishmania* vaccines licensed after and in the pipeline for human vaccines against HIV and Malaria.

In 1996, in a meeting, I met Jorge Arias, an outstanding entomologist who worked at the Pan American Office of Health. He told me to “stop playing” with mice and hamsters and to start vaccinating dogs. He said that the epidemics of VL were spreading out and that a canine vaccine trial would represent, not only a test in a bigger animal model, but would also promote protection to dogs and indirectly, to humans. He encouraged me to ask for funding from the Brazilian National Foundation of Health (FUNASA) to perform the field trials with dogs. This was a complete new world for me. A new scale of work. I would have the opportunity to see in the field if our hypotheses were correct or if I was working with an artifact .... I remember the emotion and the fear ...

Fortunately, I was granted funding from FUNASA and the United Nation for Development Program (PNUD), and thus needed, with extreme urgency, to construct a kennel at the University, in order to develop a Phase II trial in it, and according to these results, to perform two field assays in the endemic area for VL of Rio Grande do Norte. Rio Grande do Norte is about 2,600 km from our laboratory and there was no internet at the time.

These tasks looked impossible to complete in a University that did not even have a Veterinary school. Luckily, I had a group of enthusiastic students, who were hard workers and crazy enough to accept the challenge. I must cite the name of Gulnara P Borja Cabrera. The PhD thesis of Gulnara included the kennel test and the two field trials of the FML-vaccine. At that time (1996–2000), there was no canine vaccine available against VL. The only human formulation was a live-vaccine licensed in Uzbekistan.

The kennel assay results disclosed the best route and schedule for immunization to achieve high efficacy, and the two field assays revealed that the FML-saponin vaccine protected 92–95% of vaccinated dogs and promoted 76–80% of Vaccine Efficacy (VE).

In 1999, the veterinary American vaccine company Fort Dodge invited me, to industrialize, in collaboration with UFRJ, the FML-saponin vaccine that was baptized Leishmune®. The goal was to make it available for Public
Health programs. I had a wonderful 5 years-experience scaling up Leishmune® at the plant, helping to writing the license files and performing the experiments with the industrial vaccine. I learned a lot about Good Manufacturing Processes and really enjoyed the experience of working in a highly dynamic and enthusiastic American vaccine company.

Leishmune® was licensed in 2003 for prophylaxis of canine VL in Brazil. It was safe and showed an immunotherapeutic potential. We studied the immune response of vaccinated animals and showed that Leishmune® was a transmission-blocking vaccine. Vaccination with Leishmune® in VL endemic and epidemic areas of Brazil determined a drastic reduction in the incidence of the canine and human disease and curtailed the epidemics. Having developed Leishmune® is one of the greatest accomplishments of my scientific life. Being able to translate our experimental results to a formulation that, when used at appropriate coverage, can interrupt the epidemics in nature represented a very important dream which fortunately came true.

In 1997, I talked for the first time, about a paper, with Professor Ray Spier, who was at that time the Main Editor of the Journal Vaccine-Elsevier. He was an extremely inspiring person for me. He believed that vaccines make the world a better place. Learning from him and his experience, I realized that I was not alone, and that because of my work I could be called “a vaccinologist”. I can say that I had the honor of being friends with him and participated in his initiative to establishing the International Society for Vaccines during the first International meeting of Vaccine-Elsevier, in Amsterdam, in 2007. I actually became an elected member of the Executive Board of the ISV Vaccine for three consecutive bi-annual periods. After Professor Spier retired, he invited me to be the Editor of the Special Volume of Procedia in Vaccinology that included all the contributions to the Meeting held in Philadelphia in 2014. In 2016, I started to work as Associate Editor of Frontiers in Immunology, Vaccines and Molecular Therapeutics.

During my career, I studied all the aspects of prevention and control of leishmaniasis. This has been recognized by the International Society for Vaccination that named me as a Fellow, in 2013. I also gave courses on the Development of Vaccines for graduate and undergraduate students of UFRJ, and directed MSc, PhD and Post Doc students.

After our successful collaboration with Fort-Dodge-Pfizer-Zoetis in the Leishmune® project, I found a special interest in working with vaccine industries and visited Intervet, in Boxmeer, the Netherlands, and Merck Sharp and Dohme, in West Point, USA. We aimed to develop recombinant vaccines for canine and human leishmaniasis with Intervet and Merck, respectively. Unfortunately, these projects did not continue, but I keep trying. These vaccines would be composed of the Nucleoside hydrolase of *L. donovani* (NH36), which was the main antigen of the FML complex.

Later, we identified the most immunodominant regions of NH36 and its epitopes, which would be capable of generating protection. In this phase of our work, we migrated from a second-generation subunit vaccine, to a gene DNA vaccine that exhibited prophylactic and therapeutic efficacy in mice and dogs. As the theory of the epitope-based vaccines defends, one can increase the potency and effectiveness of a vaccine if, to optimize it, you use smaller and smaller, but more immunogenic fragments of the selected protein. I have been fascinated by this approach, and have tried to study everything related to it. Having started with a complex glycoprotein fraction, we were about to identify short peptide sequences that would be, if properly presented, able to generate protection. A new vaccine composed by these sequences would attract the attention of the vaccine industry because of the simplicity of the upstream processes. In fact, growing masses of protozoa cells or of engineered bacteria is more difficult than producing a multi-epitope vaccine by the chemical synthesis of combinations of 20 amino acid sequences.

We initially demonstrated that the protection of mice against VL is mediated by a CD4+ T cell response to the C-terminal domain (F3) of NH36. In contrast, protection against cutaneous leishmaniasis (CL) by *L. (L.) amazonensis* infection was dependent on both, a T CD4+ response against F3, and a T CD8+ reactivity against the N-terminal domain of NH36 (F1). A recombinant chimera vaccine composed of F1 and F3 cloned in tandem was more potent than a vaccination with each peptide alone, against infections by *L. (L.) infantum* chagasi and *L. (L.) amazonensis*. The chimera was also protective against the infection by *L. (V.) braziliensis*, by regulating the highly exacerbated inflammatory response determined by this *Leishmania* species. We identified the epitopes responsible for the Th1 and T regulatory and memory T-cell response of mice.

In contrast, and as predicted by immunoinformatics, the domains F1 and F2 of NH36 induced the strongest Th1 and Th17 response of CD4+ T cells of human patients of Brazil and Spain, that were asymptomatic or cured after VL. Patients before treatment, in contrast, showed a much stronger CD8+ T cell response against the F1 and F3 domains. We were then close to discovering the main sequences to include in a human vaccine. I need to say that I am a great admirer of Alessandro Sette, of the La Jolla Institute of Immunology. His team developed, I think, the most important dataset and algorithms (IEDB database) that disclose which sequences of the antigens constitute the best epitopes that interact with the HLA molecules on the surface of antigen presenting cells. With the help of the IEDB database we disclosed the most promiscuous epitopes of NH36 that bind to 70% of the 50 most common HLA human class II molecules. We know now which of these epitopes induce a better T CD4+ or CD8+ human response. This brought us to the current stage of designing a human multi-epitope vaccine against VL.

NH36 is a nucleoside hydrolase that releases purine and pyrimidines from nucleosides in the parasites and it does not exist in mammal cells. We tested *in vitro* and in mice and hamsters *in vivo*, the nucleoside analogs called Immmucilins designed and produced by prof. VL Schramm of the Albert Einstein College of Medicine, NY, USA and Profs. K Clinch, GB Evans and P Tyler of The Ferrier Research Institute New Zealand.

I am currently involved and still enthusiastic about the development of a universal vaccine against leishmaniasis. I consider myself lucky, because I have been able to accomplish half my dream of designing a canine vaccine that
reduced the incidence of the disease. I am still working and dreaming about the human vaccine. I am proud to see that the only chimeric recombinant vaccine that has arrived at the clinical trials stage for humans contains the NH36.

However, despite my strong motivation to work on a multi-epitope or defined vaccine, I know that crude or first generation vaccines can be more potent against infections. These vaccines are composed of the whole microorganism, are cross-protective and can generate protection against other strains of the same pathogen which suffered mutations. Thus, to generate cross-protection, a universal vaccine, if possible, should be based on the killed whole microorganism or on its highly conserved antigens and not on the proteins that suffered mutations. I cannot help feeling impotent when I realize that a single virus can threaten the whole World into a very severe and lethal pandemic, and there is already a licensed killed virus vaccine with adjuvant used for coronavirus of dogs. Instead, and as in the Middle Ages, we are seeing that a global and not perfect quarantine system is the only control tool available.

**Disclosure of potential conflicts of interest**

No potential conflicts of interest were disclosed.

**Notes on contributor**

*About Clarisa Beatriz Palatnik de Sousa,* Professor Palatnik de Sousa is currently a Full Professor of Microbiology and Chief of the Biology and Biochemistry Laboratory of *Leishmania* at the Institute for Microbiology “Prof. Paulo de Góes” of the Federal University of Rio de Janeiro. She is also level 1C Researcher of the Brazilian National Council of Scientific and Technological Development (CNPQ). She was Top Reviewer of Vaccine-Elsevier for two years (2007 and 2008), a member of the Executive Board of the International Society for Vaccines, for three biannual consecutive periods, from 2009 to 2013 and a member of the One Health Committee of the World Small Animals Veterinary Association (WSAVA) from 2011 to 2013. She was nominated Fellow of the International Society for Vaccines in October 2013. Professor Palatnik de Sousa was Editor in Chief of Procedia in Vacciology in 2014 and became an Associate Editor of Frontiers in Immunology: Vaccines and Molecular Therapies in 2016. In recognition of her work in vaccinology and public health in Brazil she received a Motion of Congratulations of the Rio de Janeiro Council Chamber. Her experience in vaccine development includes the development of the first licensed second-generation vaccine against visceral leishmaniasis in the World. The vaccine called Leishmune™, was also the first to be licensed for prophylaxis against canine visceral leishmaniasis. She led the identification and selection of the antigen, the development of the adjuvant, the scaling-up of the industrial formulations, the Phase I-III trials, the tests required by the regulatory agencies and described the impact of the use of the vaccine on the decrease of the human and canine disease in Brazilian endemic areas. She is at present investigating the potential use of the vaccine in immunotherapy and immunochemothery of the disease. Her expertise also includes the test and development of the functional structure studies on saponin adjuvants, mainly QS21 (*Quillaja saponaria*) and CP05 (*Calliandra Pulcherrima*). Dr Palatnik de Sousa’s group described that the main antigen of the Leishmune™ vaccine is a Nucleoside hydrolase of *Leishmania donovani*, they obtained the gene and developed a DNA and a recombinant vaccine using this protein for immunophylaxis and immunotherapy. At present, the main epitopes of the NH36 are being characterized in order to develop a synthetic vaccine against human leishmaniasis. Dr Palatnik de Sousa contributed to the analysis of the new legislation for the registration of vaccines against leishmaniasis by the Ministry of Health in Brazil. She is actively engaged in teaching Vaccinology and Vaccine development at the University for under graduate and Post-Graduate students, aiming to increase the number of scientists engaged in Vaccine development and the number of vaccines used in the Public Health sector. Dr Palatnik de Sousa initiated the development of new vaccine formulations against Dengue and Avian flu in the murine models. Her group identified the main domains and epitopes of the NH36 antigen active in the adaptive response against murine visceral leishmaniasis and is now searching for the major epitopes of NH36 recognized by human patients, in an attempt to guide the development of a human bivalent vaccine against visceral and cutaneous leishmaniasis. Simultaneously, she is engaged in testing the chemotherapeutic effect of Immucillins on visceral and cutaneous leishmaniasis. Dr Palatnik de Sousa scientific contributions include 79 scientifically peer-reviewed publications, 12 issued patent files (Brazil, Mexico, USA, European Patent Office, France, Portugal, Spain and Italy) and advice to 10 MSc and 9 PhD Thesis, 5 Post Doctoral, 15 graduate and 45 undergraduate fellowship students. Dr Palatnik de Sousa formal education include her Bachelor of Science (Biology) from the Hebrew University of Jerusalem, Israel and her Master of Science and PhD (Microbiology) from the Federal University of Rio de Janeiro. She was also a Research Student of the Biophysics and Biological Membranes Department of The Weizman Institute of Science, Rehovot, Israel.