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(54) Title: USE OF IMMUNE SUPPRESSIVE DOMAINS AS MEDICAMENTS

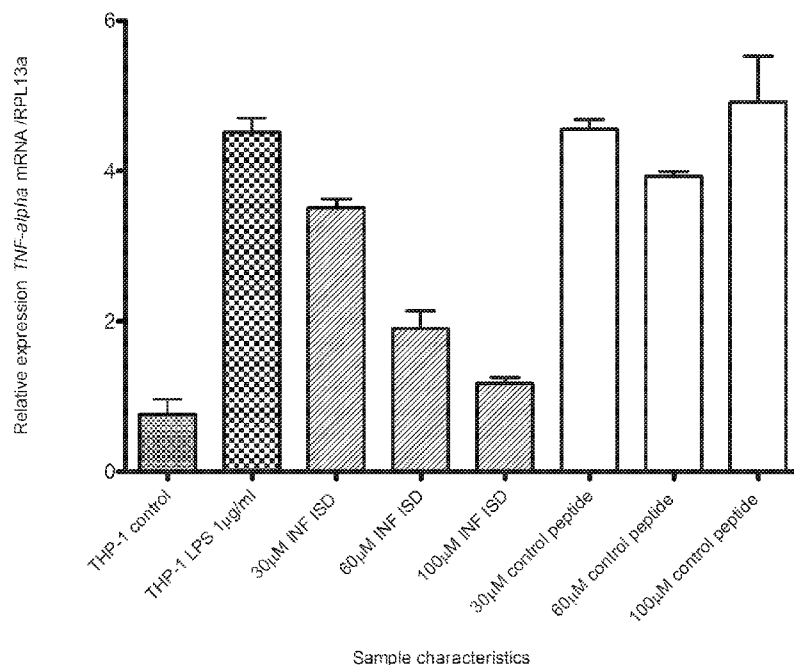


Fig. 1

(57) Abstract: The present invention concerns uses of immune suppressive domains. In particular, the present invention concerns a use of an immune suppressive domain (ISD) for immune suppression and for reduction of inflammation.



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Use of Immune Suppressive Domains as Medicaments

The present invention relates to uses of immune suppressive domains. In particular, the present invention concerns a use of an immune suppressive domain (ISD) for immune suppression and for reduction of inflammation. Further, the invention concerns a class of multifunctional drugs for treatment of inflammatory diseases or as coatings for biomaterial or nanoparticles. Additionally, the invention relates to compositions comprising immunosuppressive polypeptides that are derived from enveloped RNA viruses. The present invention also relates to methods for producing said compositions, as well as the usage of said compositions for treatment of inflammatory disorders or protection of nanoparticles, biomaterials and/or medical devices such as catheters, implants, plaster, etc to prevent or subdue undesired immunological adverse effects from the host.

Technical Background

Retroviral infections cause a significant immunosuppression. A small part of the viral glycoprotein induces a significant immunosuppressive effect. This part has been termed the immunosuppressive domain (ISD) and comprise only 17 amino acids. ISD when produced as an isolated 17 amino acid peptide has several effects on the immune response, which among others are: In vitro inhibition of Natural Killer cells, cytotoxic T lymphocytes (CTLs) and inhibition of IL-2 dependent proliferation of T lymphocytes [Cianciolo 1985, Denner 1994, Harrell 1986, Kleinerman 1987]. Furthermore, human endogenous retroviruses can antagonize the immune-dependent elimination of tumor cells injected into immunocompetent mice after transduction of these tumor cells by an envelope-expression vector [Mangenev 1998]. ISD activates intracellular signaling molecules causing inhibition of Th1 cytokines (IL-1 α , IL-2, IL-6, IL-12, INF α , TNF α) [Haraguchi 1995, Haraguchi 1995a, Haraguchi 2008, coelcialli 2012]). Finally, a human gene syncytin-2 contains a homologous domain with immunosuppressive activity. This gene is expressed during placental morphogenesis and is believed to be involved in paterno-fetal immune tolerance [Mangenev 2007].

For sepsis many papers has described the desired effect upon the cytokine profile following treatment. Below are reference for three such papers:

In one investigation plasma levels of critically ill patients of resistin, active PAI-1, MCP-1, IL-1 alpha, IL-6, IL-8, IL-10, and TNF-alpha were significantly elevated compared to 60 healthy blood donors. Making these cytokines targets for downregulation by immunosuppressive peptides (BMC Surg. 2010 Sep 9;10:26. Sepsis induced changes of adipokines and cytokines - septic patients compared to morbidly obese patients. Hillenbrand A, Knippschild U, Weiss M, Schrezenmeier H, Henne-Bruns D, Huber-Lang M, Wolf AM. Department of General-, Visceral-, and Transplantation Surgery, University Hospital of Ulm, Steinhoevelstr, Ulm, Germany. Andreas.Hillenbrand@uniklinik-ulm.)

In a second paper A prospective observational study was used to determine the predictive role of Tumor Necrosis Factor alpha (TNF α), Interleukin (IL)-1 β and IL-6 as three main pro-inflammatory cytokines and Acute Physiology and Chronic Health Evaluation (APACHE II) and Sequential Organ Failure Assessment (SOFA) as two scoring systems in mortality of critically ill patients with severe sepsis. Fifty and five patients with criteria of severe sepsis were included in this study. An exclusion criterion was post Cardiopulmonary Resuscitation (CPR) status. Cytokines (TNF α , IL-1 β and IL-6) were assayed in the first, third and seventh days in blood of patients. RESULTS AND MAJOR CONCLUSION: Among three measured cytokines, sequential levels of TNF α and IL-6 showed significant differences

between survivors and nonsurvivors. IL-6 had a good correlation with outcome and scoring systems during the period of this study. The areas under the receiver operating characteristic (AUROC) curve indicated that APACHE II (0.858, 0.848, 0.861) and IL-6 (0.797, 0.799, 0.899) had discriminative power in prediction of mortality during sequential measured days. Multiple logistic regression analysis identified that evaluation of APACHE II and TNF α in the first day and APACHE II and IL-6 in the third and seventh days of severe septic patients are independent outcome predictors. Results of this study suggest that IL-6 and APACHE II are useful cytokine and scoring systems respectively in prediction of mortality and clinical evaluation of severe septic patients. (Daru. 2010;18(3):155-62. Identification of enhanced cytokine generation following sepsis. Dream of magic bullet for mortality prediction and therapeutic evaluation. Hamishehkar H, Beigmohammadi MT, Abdollahi M, Ahmadi A, Mahmoodpour A, Mirjalili MR, Abrishami R, Khoshayand MR, Eslami K, Kanani M, Baeri M, Mojtahedzadeh M. Department of Clinical Pharmacy, Faculty of Pharmacy and Pharmaceutical Sciences Research Center, Tehran University of Medical Sciences, Tehran).

Paper 3: J Immunol. 2010 Oct 1;185(7):4302-10. Epub 2010 Sep 3. The agonists of formyl peptide receptors prevent development of severe sepsis after microbial infection. Kim SD, Kim YK, Lee HY, Kim YS, Jeon SG, Baek SH, Song DK, Ryu SH, Bae YS. Department of Biological Sciences, Sungkyunkwan University, Suwon, South Korea.

Autoimmune diseases

Autoimmune diseases arise from an inappropriate immune response of the body against substances and tissues normally present in the body. In other words, the immune system mistakes some part of the body as a pathogen and attacks its own cells. This may be restricted to certain organs (e.g. in autoimmune thyroiditis) or involve a particular tissue in different places (e.g. Goodpasture's disease which may affect the basement membrane in both the lung and the kidney). The treatment of autoimmune diseases is typically with immunosuppression—medication which decreases the immune response. For autoimmune diseases several papers have described the desired effect upon the cytokine profile following treatment. Below is the abstract and reference for one such

As described in one paper: The concept of therapeutic vaccination represents a novel strategy of active immunotherapy that can be applied to autoimmune disease. The principle is to design molecules which can trigger an immune response, targeting a cytokine that is pathogenic and over-expressed in a given disease. The mostly available vaccines are an application of vaccination using either the self-protein coupled to a carrier (type I A), or a modified form of the protein engineered to include neo-epitopes (type I B). These approaches have been developed in models of several autoimmune diseases, mainly in TNF α -dependent diseases such as rheumatoid arthritis and Crohn's disease, but also in systemic lupus erythematosus, multiple sclerosis and myasthenia gravis. Clinical trials are in progress in rheumatoid arthritis, Crohn's disease and diabetes. The benefit/risk ratio of anti-cytokine vaccination is currently under study to further develop the vaccination strategies. (Swiss Med Wkly. 2010 Nov 1;140:w13108. doi: 10.4414/sm.w.2010.13108. Anti-cytokine vaccination in autoimmune diseases. Delavallée L, Duvallet E, Semerano L, Assier E, Boissier MC. University Paris 13, PRES Paris Cité Sorbonne, Bobigny, France. laure.delavallee@upmc.fr).

Asthma

Asthma is the common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm. Symptoms include wheezing, coughing, chest tightness, and shortness of breath. Asthma is clinically classified according to the frequency of symptoms, forced expiratory volume in 1 second (FEV₁), and peak expiratory flow rate.

Asthma may also be classified as atopic (extrinsic) or non-atopic (intrinsic).

It is thought to be caused by a combination of genetic and environmental factors. Treatment of acute symptoms is usually with an inhaled short-acting beta-2 agonist (such as salbutamol). Symptoms can be prevented by avoiding triggers, such as allergens and irritants, and by inhaling corticosteroids. Leukotriene antagonists are less effective than corticosteroids and thus less preferred. Its diagnosis is usually made based on the pattern of symptoms and/or response to therapy over time. The prevalence of asthma has increased significantly since the 1970s. As of 2010, 300 million people were affected worldwide. In 2009 asthma caused 250,000 deaths globally.

For Asthma several papers has described the desired effect upon the cytokine profile following treatment. Below is the abstract and reference for two such papers:

The first paper notes that Asthma is a common, disabling inflammatory respiratory disease that has increased in frequency and severity in developed nations. We review studies of murine allergic airway disease (MAAD) and human asthma that evaluate the importance of Th2 cytokines, Th2 response-promoting cytokines, IL-17, and proinflammatory and anti-inflammatory cytokines in MAAD and human asthma. We discuss murine studies that directly stimulate airways with specific cytokines or delete, inactivate, neutralize, or block specific cytokines or their receptors, as well as controversial issues including the roles of IL-5, IL-17, and IL-13Ralpha2 in MAAD and IL-4Ralpha expression by specific cell types. Studies of human asthmatic cytokine gene and protein expression, linkage of cytokine polymorphisms to asthma, cytokine responses to allergen stimulation, and clinical responses to cytokine antagonists are discussed as well. Results of these analyses establish the importance of specific cytokines in MAAD and human asthma and have therapeutic implications. (J Immunol. 2010 Feb 15;184(4):1663-74. Importance of cytokines in murine allergic airway disease and human asthma. Finkelman FD, Hogan SP, Hershey GK, Rothenberg ME, Wills-Karp M. Department of Medicine, Cincinnati Veterans Affairs Medical Center, Cincinnati, OH 45220, USA. finkelman@pol.net).

The second paper notes that a growing list of cytokines that contribute to the pathogenesis of asthma has been identified. The purpose of this review is to explore the specific cytokines involved in asthma, including their functions, cell sources, and clinical evidence that they participate in asthma. Existing data from clinical trials of cytokine antagonists in asthmatic patients are then reviewed to determine the efficacy and safety of these compounds. RECENT FINDINGS: Cytokine antagonists that have been investigated recently in asthma include monoclonal antibodies directed against interleukin (IL)-5, tumor necrosis factor-alpha (TNFα), and IL-4/IL-13. Ongoing and future clinical investigations of inhibitors directed at IL-9, IL-13, IL-17, and thymic stromal lymphopoietin may offer potential new agents that will play roles in the treatment of severe asthma. (Curr Opin Pulm Med. 2011 Jan;17(1):29-33. Cytokine inhibition in severe asthma: current knowledge and future directions. Corren J. Research Division, Allergy Medical Clinic, Los Angeles, California 90025, USA. jcorren@ucla.edu).

Arthritis

Arthritis (from Greek arthro-, joint + -itis, inflammation; plural: arthritides) is a form of joint disorder that involves inflammation of one or more joints.

There are over 100 different forms of arthritis. The most common form, osteoarthritis (degenerative joint disease), is a result of trauma to the joint, infection of the joint, or age. Other arthritis forms are rheumatoid arthritis, psoriatic arthritis, and related autoimmune diseases. Septic arthritis is caused by joint infection.

The major complaint by individuals who have arthritis is joint pain. Pain is often a constant and may be localized to the joint affected. The pain from arthritis is due to inflammation that occurs around the joint, damage to the joint from disease, daily wear and tear of joint, muscle strains caused by forceful movements against stiff, painful joints and fatigue.

For Arthritis several papers has described the desired effect upon the cytokine profile following treatment. Below is the abstract and reference for two such papers:

The first paper sets out to analyze circulating cytokines and regulatory T cells (Treg) in patients with rheumatoid arthritis (RA) of different durations, and their association with functional interleukin 10 (IL-10) and tumor necrosis factor α (TNF α) genotypes in patients treated with corticosteroids. METHODS: Serum levels of IL-6, IL-10, IL-17, IL-18, TNF α , and transforming growth factor- β (TGF- β) were quantified in 196 patients and 61 healthy controls. Percentage of CD4+CD25^{high} cells was determined by flow cytometry and Foxp3 expression by real-time reverse-transcription polymerase chain reaction. Data were related to clinical measurements and presence of the genotype -1082GG IL-10/-308GG TNF α , previously associated with good response to corticosteroids. RESULTS: Levels of TNF α , IL-6, and IL-18 were significantly higher in patients compared to controls, while TGF- β and IL-10 were lower. Serum samples of patients at disease onset (n = 32) had increased IL-6 and decreased TGF- β , but there were no differences in other cytokines. These patients also presented a higher percentage of CD4+CD25^{high} cells than those with established disease, although no significant differences were detected in Foxp3. Patients under corticosteroid treatment who were carriers of the good responder genotype had higher levels of TGF- β , Foxp3, and Treg compared to patients with other genotypes, while relatively lower levels of TNF α and IL-17 were observed. CONCLUSION: Patients at onset of RA present fewer alterations in cytokine levels and Treg than those with longer disease duration, supporting the role of disease progression in subsequent changes. The antiinflammatory balance observed in high IL-10/low TNF α patients treated with prednisone supports the use of these genetic polymorphisms as predictors of response to corticosteroid therapy. (J Rheumatol. 2010 Dec;37(12):2502-10. Epub 2010 Oct 15. Cytokines and regulatory T cells in rheumatoid arthritis and their relationship with response to corticosteroids. de Paz B, Alperi-López M, Ballina-García FJ, Prado C, Gutiérrez C, Suárez A. Department of Functional Biology, Immunology Area, University of Oviedo, Oviedo, Spain.)

The second paper provides studies of the inflammatory process in the inflamed synovium from rheumatoid arthritis patients have shown an intricate network of molecules involved in its initiation, perpetuation and regulation trial balances the pro- and anti-inflammatory process. This system is self-regulating though the action of anti-inflammatory and pro-inflammatory cytokines cytokine

receptor antagonists and naturally occurring antibodies cytokines. Inflammatory synovitis in rheumatoid arthritis (and possibly in other inflammatory arthritides) appears to be the result of an imbalance in the cytokine network with either an excess production of pro-inflammatory cytokines or from inadequacy of the natural anti-inflammatory mechanisms. Using this knowledge the newer therapeutic approaches to RA and other inflammatory arthritides are being aimed at correcting this imbalance. Monoclonal antibodies to INF-alpha (humanised form of this is called infliximab), soluble TNF-alpha receptors (etanercept) are already in clinical use and adalimumab (humanised TNF-alpha antibody). IL-1Ra is undergoing clinical trials. Other promising therapeutic agents that could regulate the cytokine network are in various stages of laboratory and clinical evaluation. These studies promise to yield therapeutic targets that could dramatically change the way inflammatory diseases would be treated in the future. The now established efficacy of infliximab and etanercept in inflammatory arthritides could be considered just a glimpse of the exciting scenario of the future. (J Assoc Physicians India. 2006 Jun;54 Suppl:15-8. Cytokine network and its manipulation in rheumatoid arthritis. Malaviya AM. A7R Clinic for Arthritis and Rheumatism, Consultant Rheumatologist Indian Spinal Centre, New Delhi - 110 07.)

Inflammatory bowel disease

In medicine, inflammatory bowel disease (IBD) is a group of inflammatory conditions of the colon and small intestine. The major types of IBD are Crohn's disease and ulcerative colitis.

For Inflammatory bowel disease several papers have described the desired effect upon the cytokine profile following treatment. Below is the abstract and reference for two such papers:

The first paper discloses that Cytokines play a central role in the modulation of the intestinal immune system. They are produced by lymphocytes (especially T cells of the Th1 and Th2 phenotypes), monocytes, intestinal macrophages, granulocytes, epithelial cells, endothelial cells, and fibroblasts. They have proinflammatory functions [interleukin-1 (IL-1), tumor necrosis factor (TNF), IL-6, IL-8, IL-12] or antiinflammatory functions [interleukin-1 receptor antagonist (IL-1ra), IL-4, IL-10, IL-11, transforming growth factor beta (TGF beta)]. Mucosal and systemic concentrations of many pro- and antiinflammatory cytokines are elevated in inflammatory bowel disease (IBD). An imbalance between proinflammatory and antiinflammatory cytokines was found for the IL-1/IL-1ra ratio in the inflamed mucosa of patients with Crohn's disease, ulcerative colitis, diverticulitis, and infectious colitis.

Furthermore, the inhibition of proinflammatory cytokines and the upplementations with antiinflammatory cytokines reduced inflammation in animal models, such as the dextran sulfate colitis (DSS) model, the trinitrobenzene sulfonic acid (TNBS) model, or the genetically engineered model of IL-10 knockout mice. Based on these findings a rationale for cytokine treatment was defined. The first clinical trials using neutralizing monoclonal antibodies against TNF alpha (cA2) or the antiinflammatory cytokine IL-10 have shown promising results. However, many questions must be answered before cytokines can be considered standard therapy for IBD. (World J Surg. 1998 Apr;22(4):382-9. Cytokines in inflammatory bowel disease. Rogler G, Andus T. Department of Internal Medicine I, University of Regensburg, Germany.)

The second paper discloses that Ulcerative colitis and Crohn's disease are chronic inflammatory disorders of the GI tract. Although the disorders can usually be distinguished on clinical and pathological criteria, there are similarities in natural history and response to therapy. The purpose of

this article is to examine the inflammatory infiltrate in both disorders and the cytokine profiles in intestinal mucosa and peripheral blood. For both disorders, the predominant cells in inflamed mucosa are neutrophils and lymphocytes positive for CD4. There are also increases in the number of B cells, macrophages, dendritic cells, plasma cells, eosinophils and perhaps mast cells. Cytokine levels and cytokine expression are also similar for both disorders, with increases in TNF α and IFN γ consistent with a Th1 response. As inflammation occurs in a microbial environment, one possibility is that the nature of the inflammatory response is largely independent of initiating factors. One concept that might be useful is that of initiating cells and cytokines and effector cells and cytokines. Persuasive evidence exists for a defect in phagocytic cells in Crohn's disease, perhaps with the expansion of a subset of activated macrophages. There are also possible links to natural killer cells and changes in the regulation of IL-8 and perhaps IL-22. For ulcerative colitis, the cellular events are less clear, but natural killer T cells may be important as initiating cells, and there is some evidence for upregulation of cytokines involved in Th2 responses, including IL-4 and IL-13. For both disorders, proinflammatory cytokines include TNF α , IL-12, IL-23, and perhaps IL-17 and IFN γ . Research challenges include the identification, activation and function of subsets of inflammatory cells, as well as new ways to terminate the inflammatory response. (Expert Rev Gastroenterol Hepatol. 2011 Dec;5(6):703-16. Cells, cytokines and inflammatory bowel disease: a clinical perspective. Roberts-Thomson IC, Fon J, Uylaki W, Cummins AG, Barry S. Department of Gastroenterology and Hepatology, The Queen Elizabeth Hospital, Adelaide, South Australia, Australia. ian.roberts-thomson@health.sa.gov.au).

Food allergy

A food allergy is an adverse immune response to a food protein. They are distinct from other adverse responses to food, such as food intolerance, pharmacological reactions, and toxin-mediated reactions.

The protein in the food is the most common allergic component. These kinds of allergies occur when the body's immune system mistakenly identifies a protein as harmful. Some proteins or fragments of proteins are resistant to digestion and those that are not broken down in the digestive process are tagged by the Immunoglobulin E (IgE). These tags fool the immune system into thinking that the protein is harmful. The immune system, thinking the organism (the individual) is under attack, triggers an allergic reaction. These reactions can range from mild to severe. Allergic responses include dermatitis, gastrointestinal and respiratory distress, including such life-threatening anaphylactic responses as biphasic anaphylaxis and vasodilation; these require immediate emergency intervention. Individuals with protein allergies commonly avoid contact with the problematic protein. Some medications may prevent, minimize or treat protein allergy reactions.

Treatment consists of either immunotherapy (desensitisation) or avoidance, in which the allergic person avoids all forms of contact with the food to which they are allergic. Areas of research include anti-IgE antibody (omalizumab, or Xolair) and specific oral tolerance induction (SOTI), which have shown some promise for treatment of certain food allergies. People diagnosed with a food allergy may carry an injectable form of epinephrine such as an EpiPen, or wear some form of medical alert jewelry, or develop an emergency action plan, in accordance with their doctor.

The scope of the problem, particularly for young people, is a significant public health issue.

Food allergy is thought to develop more easily in patients with the atopic syndrome, a very common combination of diseases: allergic rhinitis and conjunctivitis, eczema and asthma. The syndrome has a strong inherited component; a family history of allergic diseases can be indicative of the atopic syndrome.

5 Food intolerance

Food intolerance or non-allergic food hypersensitivity is a term used widely for varied physiological responses associated with a particular food, or compound found in a range of foods.

Food intolerance is negative reaction, often delayed, to a food, beverage, food additive, or compound found in foods that produces symptoms in one or more body organs and systems, but it is not a true food allergy. A true food allergy requires the presence of Immunoglobulin E (IgE) antibodies against the food, and a food intolerance does not.

Food intolerances can be classified according to their mechanism. Intolerance can result from the absence of specific chemicals or enzymes needed to digest a food substance, as in hereditary fructose intolerance. It may be a result of an abnormality in the body's ability to absorb nutrients, as occurs in fructose malabsorption. Food intolerance reactions can occur to naturally occurring chemicals in foods, as in salicylate sensitivity. Drugs sourced from plants, such as aspirin, can also cause these kinds of reactions. Finally, it may be the result of non-IgE-mediated immune responses.

Non-allergic food hypersensitivity is the medical name for food intolerance, loosely referred to as food hypersensitivity, or previously as pseudo-allergic reactions. Non-allergic food hypersensitivity should not be confused with true food allergies

Food intolerance reactions can include pharmacologic, metabolic, and gastro-intestinal responses to foods or food compounds. Food intolerance does not include either psychological responses or foodborne illness.

Nanoparticle

In nanotechnology, a particle is defined as a small object that behaves as a whole unit in terms of its transport and properties. Particles are further classified according to size: in terms of diameter, coarse particles cover a range between 10,000 and 2,500 nanometers. Fine particles are sized between 2,500 and 100 nanometers. Ultrafine particles, or nanoparticles are sized between 100 and 1 nanometers. The reason for this double name of the same object is that, during the 1970-80's, when the first thorough fundamental studies were running with "nanoparticles" in the USA (by Granqvist and Buhrman) and Japan, (within an ERATO Project) they were called "ultrafine particles" (UFP). However, during the 1990s before the National Nanotechnology Initiative was launched in the USA, the new name, "nanoparticle" had become fashionable (see, for example the same senior author's paper 20 years later addressing the same issue, lognormal distribution of sizes). Nanoparticles may or may not exhibit size-related properties that differ significantly from those observed in fine particles or bulk materials. Although the size of most molecules would fit into the above outline, individual molecules are usually not referred to as nanoparticles.

Nanoparticle research is currently an area of intense scientific interest due to a wide variety of potential applications in biomedical, optical and electronic fields.

For coating and production of nanoparticles several papers has described the desired effect upon the cytokine profile following injection into the patient. Below is the abstract and reference two such papers:

The first paper discloses novel adjuvants and antigen-delivery systems with immunomodulatory properties that shift the allergenic Th2 response towards a Th1 or regulatory T cell response are desired for allergen-specific immunotherapy. This study demonstrates that 200-nm sized biodegradable poly(gamma-glutamic acid) (gamma-PGA) nanoparticles (NPs) are activators of human monocyte-derived dendritic cells (MoDCs). Gamma-PGA NPs are efficiently internalized by immature MoDCs and strongly stimulate production of chemokines and inflammatory cytokines as well as up-regulation of co-stimulatory molecules and immunomodulatory mediators involved in efficient T cell priming. Furthermore, MoDCs from allergic subjects stimulated in vitro with a mixture of gamma-PGA NPs and extract of grass pollen allergen *Phleum pratense* (Phl p) augment allergen-specific IL-10 production and proliferation of autologous CD4(+) memory T cells. Thus, gamma-PGA NPs are promising as sophisticated adjuvants and allergen-delivery systems in allergen-specific immunotherapy. (Vaccine. 2010 Jul 12;28(31):5075-85. Epub 2010 May 15. Immunomodulatory nanoparticles as adjuvants and allergen-delivery system to human dendritic cells: Implications for specific immunotherapy. Broos S, Lundberg K, Akagi T, Kadowaki K, Akashi M, Greiff L, Borrebaeck CA, Lindstedt M. Department of Immunotechnology, Lund University, Lund, Sweden.)

The second paper has the objective to examine what kinds of cytokines are related to lung disorder by well-dispersed nanoparticles. The mass median diameter of nickel oxide in distilled water was 26 nm. Rats intratracheally received 0.2 mg of nickel oxide suspended in distilled water, and were sacrificed from three days to six months. The concentrations of 21 cytokines including inflammation, fibrosis and allergy-related ones were measured in the lung. Infiltration of alveolar macrophages was observed persistently in the nickel oxide-exposed group. Expression of macrophage inflammatory protein-1alpha showed a continued increase in lung tissue and broncho-alveolar lavage fluid (BALF) while interleukin-1alpha (IL-1alpha), IL-1beta in lung tissue and monocyte chemotactic protein-1 in BALF showed transient increases. Taken together, it was suggested that nano-agglomerates of nickel oxide nanoparticles have a persistent inflammatory effect, and the transient increase in cytokine expression and persistent increases in CC chemokine were involved in the persistent pulmonary inflammation. (Nanotoxicology. 2010 Jun;4(2):161-76. Expression of inflammation-related cytokines following intratracheal instillation of nickel oxide nanoparticles. Morimoto Y, Ogami A, Todoroki M, Yamamoto M, Murakami M, Hirohashi M, Oyabu T, Myojo T, Nishi K, Kadoya C, Yamasaki S, Nagatomo H, Fujita K, Endoh S, Uchida K, Yamamoto K, Kobayashi N, Nakanishi J, Tanaka I. Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan. yasuum@med.uoeh-u.ac.jp).

Biomaterials

A biomaterial is any matter, surface, or construct that interacts with biological systems. The development of biomaterials, as a science, is about fifty years old. The study of biomaterials is called biomaterials science. It has experienced steady and strong growth over its history, with many companies investing large amounts of money into the development of new products. Biomaterials science encompasses elements of medicine, biology, chemistry, tissue engineering and materials science.

Biomaterials can be derived either from nature or synthesized in the laboratory using a variety of chemical approaches utilizing metallic components or ceramics. They are often used and/or adapted for a medical application, and thus comprises whole or part of a living structure or biomedical device which performs, augments, or replaces a natural function. Such functions may be benign, like being used for a heart valve, or may be bioactive with a more interactive functionality such as hydroxy-apatite coated hip implants. Biomaterials are also used every day in dental applications, surgery, and drug delivery. E.G. A construct with impregnated pharmaceutical products can be placed into the body, which permits the prolonged release of a drug over an extended period of time. A biomaterial may also be an autograft, allograft or xenograft used as a transplant material.

Materials scientists are currently paying more and more attention to the process inorganic crystallization within a largely organic matrix of naturally occurring compounds. This process typically generally occurs at ambient temperature and pressure. Interestingly, the vital organisms through which these crystalline minerals form are capable of consistently producing intricately complex structures. Understanding the processes in which living organisms are capable of regulating the growth of crystalline minerals such as silica could lead to significant scientific advances and novel synthesis techniques for nanoscale composite materials—or nanocomposites.

Biomaterials are used in: Joint replacements, Bone plates, Bone cement, Artificial ligaments and tendons, Dental implants for tooth fixation, Blood vessel prostheses, Heart valves, Skin repair devices (artificial tissue), Cochlear replacements, Contact lenses, Breast implants

Biomaterials must be compatible with the body, and there are often issues of biocompatibility which must be resolved before a product can be placed on the market and used in a clinical setting. Because of this, biomaterials are usually subjected to the same requirements as those undergone by new drug therapies.

For coating and production of biomaterials several papers has described the desired effect upon the cytokine profile following injection into the patient. Below is the abstract and reference three such papers:

The first paper discloses that some nickel (Ni) allergic patients develop complications following Ni-containing arthroplasty. In the peri-implant tissue of such patients, we had observed lymphocyte dominated inflammation together with IFN-gamma and IL-17 expression. OBJECTIVES: To determine whether Ni stimulation of peripheral blood mononuclear cells (PBMCs) of such patients would lead to a different cytokine pattern as compared to Ni-allergic patients with symptom-free arthroplasty. PATIENTS AND METHODS: Based on history and patch testing in 15 Ni-allergic patients (five without implant, five with symptom-free arthroplasty, five with complicated arthroplasty) and five non-allergic individuals, lymphocyte transformation test (LTT) was performed using PBMC. In parallel in vitro cytokine response to Ni was assessed by real-time reverse anscriptase-polymerase chain reaction (RT-PCR).

RESULTS: All 15 Ni-allergic individuals showed enhanced LTT reactivity to Ni (mean SI = 8.42 +/- 1.8) compared to the non-allergic control group. Predominant IFN-gamma expression to Ni was found both in the five allergic patients without arthroplasty and also in the five allergic, symptom-free arthroplasty patients. In contrast, in the five Ni-allergic patients with arthroplasty-linked

complications a predominant, significant IL-17 expression to Ni was seen but not in patients with symptom-free arthroplasty. CONCLUSIONS: The predominant IL-17 type response to Ni may characterize a subgroup of Ni-allergic patients prone to develop lymphocytic peri-implant hyper-reactivity. (Contact Dermatitis. 2010 Jul;63(1):15-22. Nickel (Ni) allergic patients with complications to Ni containing joint replacement show preferential IL-17 type reactivity to Ni. Summer B, Paul C, Mazoochian F, Rau C, Thomsen M, Banke I, Gollwitzer H, Dietrich KA, Mayer-Wagner S, Ruzicka T, Thomas P. Klinik und Poliklinik für Dermatologie und Allergologie, Ludwig-Maximilians-Universität, München, Germany. Burkhard.Summer@med.uni-muenchen.de).

The second paper says that cytokines, chemokines, and growth factors were analyzed periodically over eight weeks from the wound exudate fluid surrounding biomaterials implanted subcutaneously within stainless steel mesh cages. TNF-alpha, MCP-1, MIP-1alpha, IL-2, IL-6, IL-1beta, VEGF, IL-4, and IL-10 were measured from exudate samples collected from cages containing specimens of polyethylene (PE), polyurethane (PU), or organotin polyvinyl chloride (ot-PVC). Empty cages served as negative controls, and lipopolysaccharide (LPS) served as a positive control. Cytokine, chemokine, and growth factor concentrations decreased from the time of implantation to eight weeks post-implantation, and there was an overall increase in cytokine, chemokine, and growth factor production for material-containing cages compared to empty cages. However, cytokine production was only modestly affected by the different surface chemistries of the three implanted polymeric materials. (Biomaterials. 2009 Jan;30(2):160-8. Epub 2008 Oct 11. In vivo cytokine-associated responses to biomaterials. Schutte RJ, Xie L, Klitzman B, Reichert WM. Department of Biomedical Engineering, Duke University, Durham, NC 27708, USA.)

The third paper sets out to further elucidate the foreign body reaction, investigation of cytokines at biomaterial implant sites was carried out using a multiplex immunoassay and ELISA. Macrophage activation cytokines (IL-1beta, IL-6, and TNFalpha), cytokines important for macrophage fusion (IL-4 and IL-13), antiinflammatory cytokines (IL-10 and TGFbeta), chemokines (GRO/KC, MCP-1), and the T-cell activation cytokine IL-2 were quantified at biomaterial implant sites. Empty cages (controls) or cages containing synthetic biomedical polymer (Elasthane 80A (PEU), silicone rubber (SR), or polyethylene terephthalate (PET)) were implanted subcutaneously in Sprague-Dawley rats for 4, 7, or 14 days, and cytokines in exudate supernatants and macrophage surface adhesion and fusion were quantified. The presence of a polymer implant did not affect the levels of IL-1beta, TGFbeta, and MCP-1 in comparison to the control group. IL-2 was not virtually detected in any of the samples. Although the levels of IL-4, IL-13, IL-10, and GRO/KC were affected by polymer implantation, but not dependent on a specific polymer, IL-6 and TNFalpha were significantly greater in those animals implanted with PEU and SR, materials that do not promote fusion. The results indicate that differential material-dependent cytokine profiles are produced by surface adherent macrophages and foreign body giant cells in vivo. (J Biomed Mater Res A. 2009 Apr;89(1):152-9. Quantitative in vivo cytokine analysis at synthetic biomaterial implant sites. Rodriguez A, Meyerson H, Anderson JM. Department of Pathology, Case Western Reserve University, Cleveland, Ohio 44106, USA.)

Summary of the invention

According to an aspect, the present invention relates to compositions of immunosuppressive peptides derived from enveloped RNA viruses.

In another aspect the present invention relates to compositions of immunosuppressive peptides derived from the fusion peptide of enveloped RNA viruses.

In third aspect the present invention relates to compositions of immunosuppressive peptides derived from the fusion peptide of influenza virus.

- 5 In fourth aspect the present invention relates to a composition comprising one or more of said immunosuppressive peptides, or part thereof.

In a fifth aspect the present invention relates to a pharmaceutical composition comprising one or more immunosuppressive peptides and further comprising a pharmaceutical acceptable carrier or salt.

- 10 In a sixth aspect the present invention relates to usage of compositions of said immunosuppressive peptides for treatment of inflammatory disorders.

In a seventh aspect the present invention relates to usage of compositions of said immunosuppressive peptides for usage for protection of nanoparticles or biomaterials from undesirable immunological adverse reactions.

- 15 In a further aspect the present invention relates to a method of producing a composition comprising immunosuppressive peptides, said method comprising the steps of:
- a) providing one or more immunosuppressive peptides
 - b) optionally cross-linking the immunosuppressive peptides provided in step a),
 - c) optionally providing a carrier
 - 20 d) providing a substance
 - e) mixing the peptides of step a) or optionally step b) or step c) with the substance of step d.
 - f) obtaining the composition of the present invention.

- 25 According to an additional aspect, the invention concerns an immune suppressive domain for use as a medicament.

According to another aspect, the invention concerns a use of an immune suppressive domain for the manufacture of a medicament for immune suppression.

According to an additional aspect, the invention concerns a method for the preparation of a pharmaceutical composition comprising the steps of:

- 30 a. Providing one or more immunosuppressive peptides selected from Seqid 1 to Seqid 287 , and optionally cross-linking said one or more immunosuppressive peptides;
- b. Optionally providing a carrier;
- c. Providing a substance;

d. Mixing the provided one or more peptides with any carrier of optional step b. and the substance of step d. to obtain the pharmaceutical composition.

According to an additional aspect, the invention concerns a pharmaceutical composition obtainable according to the invention.

- 5 According to another aspect, the invention concerns a pharmaceutical composition comprising an immune suppressive domain as an active substance.

According to an additional aspect, the invention concerns a use of the composition according to the invention, for treatment of a disease by IV injection.

- 10 According to an additional aspect, the invention concerns the use of the composition according to the invention, to increase the half-life of nanoparticles or biomaterials in vivo in a patient.

According to an additional aspect, the invention concerns a vaccine comprising an immune suppressive domain selected among Seqid 275 to 287 against PRRS.

- 15 According to another aspect, the invention concerns a vaccine against PRRS comprising a mutated immunosuppressive domain selected among Seqid 275 to Seqid 287, subject to the proviso that the immunosuppressive properties of said domain have been abrogated.

According to another aspect, the invention concerns a peptide having the sequence of an Immune Suppressive Domain according to the invention.

According to an aspect, the invention concerns the use of a peptide according to the invention, said use being selected among any of the uses of Immune Suppressive Domains of the invention.

- 20 According to an aspect, the invention concerns a method of treatment of an indication selected among the indications of the present application and the viral infections of Table 1 comprising administration of an effective amount of an entity selected among the Immune Suppressive Domains of the invention, the compositions of the invention, and the peptides of the invention.

Detailed Disclosure

- 25 According to an embodiment, the present invention concerns compositions of one or more immunosuppressive peptides. Immunosuppressive polypeptides are polypeptides that are capable of suppressing an immune response in animals, including human beings and other animal such as domestic or agricultural (cats, dogs, cows, sheep, horses, pigs, etc.) or test species such as mouse, rats, rabbits and the like.
- 30 In one embodiment of the present invention the immunosuppressive polypeptides are capable of at least 5% inhibition of T-lymphocyte proliferation, at least 10%, at least 20%, such as at least 30%, at least 40%, at least 50%, such as at least 60%, such as at least 70% inhibition of T-lymphocyte proliferation. In particular embodiments the immunosuppressive peptides of the present invention are capable of at least 75% inhibition of T-lymphocyte proliferation, at least 80%, such as at least
- 35 85%, at least 90%, such as at least 95%, at least 97%, such as at least 99%, at least 100% inhibition of T-lymphocyte proliferation.

According to another embodiment of the present invention the immunosuppressive polypeptides are capable of suppressing the immune response in an animal suffering from a general skin inflammation according to the TPA model, an irritant contact dermatitis model, as described herein below. According to the present invention, the immunosuppressive polypeptides of the present invention are capable of reducing the ear thickening in mice challenged with phorbol 12-myristate 13-acetate (TPA), the ear thickening being reduced with at least 5%, such as at least 10%, at least, 15%, at least 20%, such as at least 25%, at least 30%, at least 35%, such as at least 40%, at least 45%, such as at least 50%, at least 55%, such as at least 60%, at least 65%, such as at least 70%, at least 75%, such as at least 80%, at least 85% reduction of ear thickening following TPA challenge.

Hence, the present invention comprise one or more immunosuppressive peptides, such as 2, for example 3, such as 4, such as 5, for example 6, such as 7, such as 8, for example 9, such as 10, such as 11, for example 12, such as 13, such as 14, for example 15, such as 16, such as 17, for example 18, such as 19, such as 20 immunosuppressive peptides.

The present invention may comprise the same immunosuppressive polypeptide, or the compositions may comprise different immunosuppressive polypeptides. In one embodiment of the present invention, the immunosuppressive polypeptides are monomeric. In another embodiment of the present invention the immunosuppressive polypeptides are dimeric. In another embodiment of the present invention the immunosuppressive polypeptides are trimeric. In yet another embodiment of the present invention the immunosuppressive polypeptides are multimeric. Thus, according to the present invention the immunosuppressive polypeptides may be monomeric, homologous dimeric, heterologous dimeric, homologous trimeric, heterologous trimeric, homologous multimeric and/or heterologous multimeric. In a particular preferred embodiment the immunosuppressive polypeptides of the present invention are homologous dimeric.

Additionally, the present invention may comprise combinations of di-, tri-and/or multimeric immunosuppressive peptides. In one embodiment the present invention comprises homologues dimeric peptides in combination with other homologous dimeric peptides. In another embodiment the invention comprises homologous dimeric peptides in combination with heterologous dimeric peptides. The following combinations of peptides are also within the scope of this invention: homologous dimeric peptides with homologous trimeric, homologous dimeric with heterologous trimeric, heterologous dimeric with homologous trimeric, heterologous dimeric with heterologous trimeric, homologous dimeric with homologous multimeric, heterologous dimeric with homologous multimeric, homologous dimeric with heterologous multimeric, heterologous dimeric with heterologous multimeric, homologous trimeric with homologous multimeric, homologous trimeric with heterologous multimeric, heterologous trimeric with homologous multimeric and heterologous trimeric with heterologous multimeric immunosuppressive peptides.

In certain embodiments of the present invention the immunosuppressive polypeptides are homologous dimers, such as homologous dimers formed by two of the peptides SEQ ID NO: 4, and/or two of the peptides with SEQ ID NO: 119, and/or two of the peptides with SEQ ID NO: 120, and/or two of the peptides with SEQ ID NO: 121, and/or two of the peptides with SEQ ID NO: 122, and/or two of the peptides with SEQ ID NO: 123, and/or two of the peptides with SEQ ID NO: 124,

and/or two of the peptides with SEQ ID NO: 125, and/or two of the peptides with SEQ ID NO: 126. In one embodiment the monomeric peptides are cross-linked into a dimer by cross-linking the peptides N-terminal to N-terminal or C-terminal to C-terminal. In a preferred embodiment the peptides are cross-linked via a disulfide bond wherein the peptides are cross-linked C-terminal to C-terminal.

In other certain embodiments of the present invention the immunosuppressive polypeptides are heterologous dimers, such as heterologous dimers formed by two peptides in the following combinations: SEQ ID NO: 4 with SEQ ID NO: 119; and/or SEQ ID NO: 4 with SEQ ID NO: 120, and/or SEQ ID NO: 4 with SEQ ID NO: 121, and/or SEQ ID NO: 4 with SEQ ID NO: 122, and/or SEQ ID NO: 4 with SEQ ID NO: 123, and/or SEQ ID NO: 4 with SEQ ID NO: 124, and/or SEQ ID NO: 4 with SEQ ID NO: 125, and/or SEQ ID NO: 4 with SEQ ID NO: 126 and/or with a sequence selected from SEQ ID NO: 119 to 126 with a sequence selected from SEQ ID NO: 119 to 126.

In one embodiment the monomeric peptides are cross-linked into a dimer by cross-linking the peptides N-terminal to N-terminal or C-terminal to C-terminal. In a preferred embodiment the peptides are cross-linked via a disulfide bond wherein the peptides are cross-linked C-terminal to C-terminal.

The immunosuppressive polypeptides of the present invention may be of different length. However, it is appreciated that the active component of the immunosuppressive peptides have a maximum length of about 100 amino acids, such as about 90 amino acids, for example about 80 amino acids, such as about 70 amino acids, such as about 60 amino acids, for example about 50 amino acids, such as 40 amino acids, for example about 35 amino acids.

In particular embodiments the length of the active component of the immunosuppressive peptides is 35 amino acids, or 34, or 33, or 32, or 31, or 30, or 29, or 28, or 27, or 26, or 25, or 24, or 23, or 22, or 21, or 20, or 19, or 18, or 17, or 16, or 15, or 14, or 13, or 12, or 11, or 10, or 9, or 8, or 7, or 6, or 5, or 4, or 3 amino acids long. Thus, the immunosuppressive peptides of the present invention have lengths and amino acid sequences corresponding to any of SEQ ID NO:1 to SEQ ID NO:287 as listed herein below. A special feature of the immunosuppressive peptides of the present invention is that they may contain an extra cysteine (Cys or C) residue, either in the N-terminal or C-terminal of the polypeptide. In a particular embodiment the cysteine residue is located in the C-terminal of the peptides. The presence and function of this cysteine residue is primarily so as to crosslink two or more polypeptides together, preferable via disulfide bonds, as described herein below. However, the function of the extra cysteine may be other than that of cross-linking. Thus, the immunosuppressive peptides of the present invention may have amino acid sequences corresponding to any of SEQ ID:1 to SEQ ID:287, and wherein the immunosuppressive peptides further contain an extra cysteine (Cys or C) residue at either the N-terminal or C-terminal of the peptide.

The immunosuppressive peptides of the present invention may be a combination of the peptides corresponding to SEQ ID NO:1 to SEQ ID NO:287. Thus also comprise one part of one of the peptides

Moreover, the present invention also encompasses polypeptides, wherein one or more amino acid residues are modified, wherein said one or more modification(s) are preferably selected from

the group consisting of in vivo or in vitro chemical derivatization, such as but not limited to acetylation or carboxylation, glycosylation, such as glycosylation resulting from exposing the polypeptide to enzymes which affect glycosylation, for example mammalian glycosylating or deglycosylating enzymes, phosphorylation, such as modification of amino acid residues which results in phosphorylated amino acid residues, for example phosphotyrosine, phosphoserine and phosphothreonine. The polypeptide according to the invention can comprise one or more amino acids independently selected from the group consisting of naturally occurring L-amino acids, naturally occurring D-amino acids as well as non-naturally occurring, synthetic amino acids. One or more amino acid residues of the polypeptide of the present invention are modified so as to preferably improve the resistance to proteolytic degradation and stability or to optimize solubility properties or to render the polypeptide more suitable as a therapeutic agent. The invention also relates to polypeptides of the invention where blocking groups are introduced in order to protect and/or stabilize the N-and/or C-termini of the polypeptide from undesirable degradation. Such blocking groups may be selected from the group comprising but not limited to branched or non-branched alkyl groups and acyl groups, such as formyl and acetyl groups, as well substituted forms thereof, such as acetamidomethyl. The invention also relates to the following: The polypeptides according to present invention, wherein the one or more blocking groups are selected from N-terminal blocking groups comprising desamino analogs of amino acids, which are either coupled to the N-terminus of the peptide or used in place of the N-terminal amino acid residue. The polypeptide according to present invention, but not limited to wherein the one or more blocking groups are selected from C-terminal blocking groups wherein the carboxyl group of the C-terminus is either incorporated or not, such as esters, ketones, and amides, as well as descarboxylated amino acid analogues. The polypeptide according to present invention, wherein the one or more blocking groups are selected from C-terminal blocking groups comprising ester or ketoneforming alkyl groups, such as lower (C1 to C6) alkyl groups, for example methyl, ethyl and propyl, and amide-forming amino groups, such as primary amines (-NH₂), and mono- and di-alkylamino groups, such as methylamino, ethylamino, dimethylamino, diethylamino, methylethylamino, and the like. The polypeptide according to present invention, wherein free amino group(s) at the N-terminal end and free carboxyl group(s) at the termini can be removed altogether from the polypeptide to yield desamino and descarboxylated forms thereof without significantly affecting the biological activity of the polypeptide. The increased properties may be achieved for example by chemical protection, i.e. by reacting the proteins and peptides of the present invention with protecting chemical groups, or by the incorporation of non-naturally occurring amino acids, e.g. D-amino acids, with the result of prolonging the half-life of the proteins and peptides of the present invention.

Cross-linking

The immunosuppressive polypeptides of the present invention are suitably used alone, but is preferably coupled to another material or cross-linked to itself to increase its biological or immunological activity, particularly if the polypeptide is relatively short, or to achieve certain properties on the material being coupled. In a specific aspect of this invention, any or all of the immunosuppressive polypeptides may be cross-linked to increase its activity, to facilitate its delivery in vivo, and/or to render the polypeptides resistant towards hydrolysis and/or proteolysis. The cross-linked polypeptide may be formed in situ by allowing the monomers to oxidize (e.g., for disulfide

bonds) or it may be synthesized by using a specific cross-linking agent.

The cross-linking between the polypeptide chains may occur at either end of the polypeptide, or in the middle of the polypeptide, depending on which end is most appropriate. For example, if the N-terminal or the C-terminal of the polypeptides comprises cysteine residues, these are preferably cross-linked by linking it to another cysteine residue on another homologous or heterologous polypeptide of the present invention, thereby forming a disulfide bond. Preferably the immunosuppressive polypeptides of the present invention are cross-linked by disulfide bonds at the C-terminal.

Polypeptide chains may be polymerized by cross-linking agents, either directly or indirectly through multifunctional polymers. Two polypeptides may be cross linked at their C-or N-termini using a multifunctional cross-linking agent. The agent is used to cross-link the terminal amino-or carboxyl groups. Generally, both terminal carboxyl groups or both terminal amino groups are crosslinked to one another, although by selection of the appropriate crosslinking agent the alpha amino group of one polypeptide is crosslinked to the terminal carboxyl group of the other polypeptide. Preferably, the polypeptides are substituted at their C-termini with cysteine. Under conditions well known in the art a disulfide bond can be formed between the terminal cysteines, thereby cross-linking the polypeptide chains.

Additional cross-linking sites on the polypeptides, include epsilon amino groups found on lysine residues, as well as amino, imino, carboxyl, sulfhydryl and hydroxyl groups located on the side chains of internal residues of the peptides. Cross-linking through externally added cross-linking agents is obtained, e.g., using any of a number of reagents familiar to those skilled in the art, for example, via carbodiimide treatment of the polypeptides. Other non-limiting examples of suitable multifunctional cross-linking agents include 1,1-bis(diazoacetyl)-2-phenylethane; glutaraldehyde; N-hydroxysuccinimide esters such as esters with 4-azidosalicylic acid; homobifunctional imidoesters including disuccinimidyl esters such as 3,3'-dithiobis (succinimidylpropionate) and dimethyl adipimidate dihydrochloride, bifunctional maleimides such as bis-N-maleimido1,8-octane; disuccinimidyl suberate, and bis(sulfosuccinimidyl) suberate.

Heterobifunctional cross-linking reagents include those with an N-hydroxysuccinimide moiety at one end and a maleimido group on the other end; succinimidyl 4-(Nmaleimidomethyl)cyclohexane-1-carboxylate (SMCC), sulfo-SMCC, mmaleimidobenzoyl-N-hydroxysuccinimide ester (MBS); sulfo-MBS; succinimidyl 4-(p-maleimidophenyl)butyrate (SMPB); sulfo-SMPB; N-succinimidyl(4-iodoacetyl)aminobenzoate (SIAB); sulfo-SIAB; 1-ethyl-3-(3dimethylaminopropyl)carbodiimide hydrochloride (EDC); and N-hydroxysulfosuccinimide. Cross-linking agents such as methyl-3-[(p-azidophenyl)dithio] propionimidate yield photoactivatable intermediates which are capable of forming cross-links in the presence of light. If necessary, sensitive residues such as the side chains of the diargininyl group are protected during cross-linking and the protecting groups removed thereafter.

Polymers capable of multiple cross-linking serve as indirect cross-linking agents. For example, cyanogen bromide activated carbohydrates may be used for cross-linking the peptides herein. Cross-linking to amino groups of the peptides is accomplished by known chemistries based upon cyanuric chloride, carbonyl diimidazole, aldehyde reactive groups (PEG alkoxide plus diethyl acetal of

bromoacetaldehyde; PEG plus DMSO and acetic anhydride, or PEG chloride plus the phenoxide of 4-hydroxybenzaldehyde). Also useful are succinimidyl active esters, activated dithiocarbonate PEG, and 2,4,5-trichlorophenylchloroformate-or pnitrophenylchloroformate-activated PEG. Carboxyl groups are derivatized by coupling PEG-amine using carbodiimide.

5 Administration forms, formulations and dosage regimes

Pharmaceutical compositions containing a composition of the present invention may be prepared by conventional techniques, e.g. as described in Remington: The Science and Practice of Pharmacy 1995, edited by E. W. Martin, Mack Publishing Company, 19th edition, Easton, Pa. The compositions may appear in conventional forms, for example suspensions or topical applications such as a solution, gel, cream, lotion, shake lotion, ointment, foam, shampoo, mask or similar forms. But also patches, gazes and bandages and the like may be used for topical application of the composition of the present invention.

Whilst it is possible for the compositions or salts of the present invention to be administered as the raw chemical, it is preferred to present them in the form of a pharmaceutical formulation. Accordingly, the present invention further provides a pharmaceutical formulation, for medicinal application, which comprises a composition of the present invention or a pharmaceutically acceptable salt thereof, as herein defined, and a pharmaceutically acceptable carrier therefore.

The pharmaceutical compositions and dosage forms may comprise the compositions of the invention or its pharmaceutically acceptable salt or a crystal form thereof as the active component. The pharmaceutically acceptable carriers can be either solid, semisolid or liquid. Emulsions may be prepared in solutions in aqueous propylene glycol solutions or may contain emulsifying agents such as lecithin, sorbitan monooleate, or acacia. Aqueous solutions can be prepared by suspending or mixing the active component in water and adding suitable colorants, flavors, stabilizing and thickening agents. Aqueous suspensions can be prepared by dispersing the finely divided active component in water with viscous material, such as natural or synthetic gums, resins, methylcellulose, sodium carboxymethylcellulose, and other well known suspending agents. Solid form preparations include suspensions and emulsions, and may contain, in addition to the active component, colorants, stabilizers, buffers, artificial and natural dispersants, thickeners, and the like.

The compositions of the present invention may take such forms as suspensions, solutions, or emulsions in oily or aqueous vehicles, for example solutions in aqueous polyethylene glycol. Examples of oily or nonaqueous carriers, diluents, solvents or vehicles include propylene glycol, polyethylene glycol, vegetable oils (e.g., olive oil), and injectable organic esters (e.g., ethyl oleate), and may contain formulatory agents such as preserving, wetting, emulsifying or suspending, stabilizing or dispersing agents. Alternatively, the active ingredient may be in powder form, obtained by aseptic isolation of sterile solid or by lyophilisation from solution for constitution before use with a suitable vehicle, e.g., sterile, pyrogen-free water.

Oils useful in formulations include petroleum, animal, vegetable, or synthetic oils. Specific examples of oils useful in such formulations include peanut, soybean, sesame, cottonseed, corn, olive, petrolatum, and mineral. Suitable fatty acids for use in parenteral formulations include oleic acid, stearic acid, and isostearic acid. Ethyl oleate and isopropyl myristate are examples of suitable fatty

acid esters.

Suitable soaps for use in formulations include fatty alkali metal, ammonium, and triethanolamine salts, and suitable detergents include (a) cationic detergents such as, for example, dimethyl dialkyl ammonium halides, and alkyl pyridinium halides; (b) anionic detergents such as, for example, alkyl, aryl, and olefin sulfonates, alkyl, olefin, ether, and monoglyceride sulfates, and sulfosuccinates, (c) nonionic detergents such as, for example, fatty amine oxides, fatty acid alkanolamides, and polyoxyethylenepolypropylene copolymers, (d) amphoteric detergents such as, for example, alkyl-.beta.-aminopropionates, and 2-alkyl-imidazoline quaternary ammonium salts, and (e) mixtures thereof.

The formulations typically will contain from about 0.5 to about 25% by weight of the active ingredient in solution. Preservatives and buffers may be used. In order to minimize or eliminate irritation at the site of injection, such compositions may contain one or more nonionic surfactants having a hydrophile-lipophile balance (HLB) of from about 12 to about 17. The quantity of surfactant in such formulations will typically range from about 5 to about 15% by weight. Suitable surfactants include polyethylene sorbitan fatty acid esters, such as sorbitan monooleate and the high molecular weight adducts of ethylene oxide with a hydrophobic base, formed by the condensation of propylene oxide with propylene glycol. The parenteral formulations can be presented in unit-dose or multi-dose sealed containers, such as ampoules and vials, and can be stored in a freeze-dried (lyophilized) condition requiring only the addition of the sterile liquid excipient, for example, water, immediately prior to use.

Pharmaceutically acceptable salts

Pharmaceutically acceptable salts of the instant compositions, where they can be prepared, are also intended to be covered by this invention. These salts will be ones which are acceptable in their application to a pharmaceutical use. By that it is meant that the salt will retain the biological activity of the parent composition and the salt will not have untoward or deleterious effects in its application and use in treating diseases.

Pharmaceutically acceptable salts are prepared in a standard manner. If the parent composition is a base it is treated with an excess of an organic or inorganic acid in a suitable solvent. If the parent composition is an acid, it is treated with an inorganic or organic base in a suitable solvent.

The compositions of the invention may be administered in the form of an alkali metal or earth alkali metal salt thereof, concurrently, simultaneously, or together with a pharmaceutically acceptable carrier or diluent, especially and preferably in the form of a pharmaceutical composition thereof, whether by oral, rectal, or parenteral (including subcutaneous) route, in an effective amount.

Examples of pharmaceutically acceptable acid addition salts for use in the present inventive pharmaceutical composition include those derived from mineral acids, such as hydrochloric, hydrobromic, phosphoric, metaphosphoric, nitric and sulfuric acids, and organic acids, such as tartaric, acetic, citric, malic, lactic, fumaric, benzoic, glycolic, gluconic, succinic, p-toluenesulphonic

acids, and arylsulphonic, for example.

Uses of compositions containing said immunosuppressive peptides

The present invention comprises in one embodiment a pharmaceutical composition and/or compositions for the treatment and/or prevention and/or amelioration of inflammatory disorders.

Below is a non-limiting list of the inflammatory disorders that the compositions of the present invention can be used to treat, prevent or ameliorate. The compositions of the present invention may be directed towards the treatment, prevention or amelioration of other inflammatory disorders than the ones listed herein below. The list below may thus be regarded as the inflammatory disorders that in preferred embodiments are target conditions for the compositions of the present invention.

We anticipate that the immunosuppressive peptides disclosed in this application will be advantageous for treatment of many other types of inflammatory disorders where a reduction of anti-inflammatory responses in the patient is desirable. This is especially valid for diseases/applications where a reduction in the level of cytokines like TNF α , IL-17, IL-6. Especially for diseases/applications like Arthritis, Asthma, Autoimmune diseases, Sepsis, Inflammatory bowel disease, Coating of biomaterials and nanoparticles where a reduction of one or several of these cytokines has been reported as desirable.

Below a number of such inflammatory disorders where a decreased immunogenic response is required is described in more detail. The description of relevant diseases should only be considered as examples as many more diseases could be treated these immunosuppressive peptides. Also included is the usage of these immunosuppressive peptides for coating of nanoparticles and biomaterials as a decreased immunogenic response is also desired in these cases to prolong the half-life of these materials, increase biocompatibility or decrease foreign body reactions.

Sepsis

Sepsis is a potentially deadly medical condition characterized by a whole-body inflammatory state (called a systemic inflammatory response syndrome or SIRS) that is triggered by an infection. The body may develop this inflammatory response by the immune system to microbes in the blood, urine, lungs, skin, or other tissues. A lay term for sepsis is blood poisoning, also used to describe septicaemia. Severe sepsis is the systemic inflammatory response, infection and the presence of organ dysfunction.

Severe sepsis is usually treated in the intensive care unit with intravenous fluids and antibiotics. If fluid replacement isn't sufficient to maintain blood pressure, specific vasopressor medications can be used. Mechanical ventilation and dialysis may be needed to support the function of the lungs and kidneys, respectively. To guide therapy, a central venous catheter and an arterial catheter may be placed; measurement of other hemodynamic variables (such as cardiac output, mixed venous oxygen saturation, or stroke volume variation) may also be used. Sepsis patients require preventive measures for deep vein thrombosis, stress ulcers and pressure ulcers, unless other conditions prevent this. Some patients might benefit from tight control of blood sugar levels with insulin

(targeting stress hyperglycemia). The use of corticosteroids (low dose or otherwise) is controversial. Activated drotrecogin alfa (recombinant protein C) has not been found to be helpful, and has recently been withdrawn from sale.

In addition to symptoms related to the provoking infection, sepsis is characterized by presence of acute inflammation present throughout the entire body, and is, therefore, frequently associated with fever and elevated white blood cell count (leukocytosis) or low white blood cell count (leukopenia) and lower-than-average temperature, and vomiting. The modern concept of sepsis is that the host's immune response to the infection causes most of the symptoms of sepsis, resulting in hemodynamic consequences and damage to organs. This host response has been termed systemic inflammatory response syndrome (SIRS) and is characterized by an elevated heart rate (above 90 beats per minute), high respiratory rate (above 20 breaths per minute or a partial pressure of carbon dioxide in the blood of less than 32), abnormal white blood cell count (above 12,000, lower than 4,000, or greater than 10% band forms) and elevated or lowered body temperature, i.e. under 36 °C (96.8 °F) or over 38 °C (100.4 °F). Sepsis is differentiated from SIRS by the presence of a known or suspected pathogen. For example SIRS and a positive blood culture for a pathogen indicates the presence of sepsis. However, in many cases of sepsis no specific pathogen is identified.

This immunological response causes widespread activation of acute-phase proteins, affecting the complement system and the coagulation pathways, which then cause damage to the vasculature as well as to the organs. Various neuroendocrine counter-regulatory systems are then activated as well, often compounding the problem. Even with immediate and aggressive treatment, this may progress to multiple organ dysfunction syndrome and eventually death.

The term "amino acid" and "amino acid sequence" refer to an oligopeptide, peptide, polypeptide, or protein sequence, or a fragment of any of these, and to naturally occurring or synthetic molecules. Where "amino acid sequence" is recited to refer to a sequence of a naturally occurring protein molecule, "amino acid sequence" and like terms are not meant to limit the amino acid sequence to the complete native amino acid sequence associated with the recited protein molecule. Thus, the term "amino acid" comprises any synthetic or naturally occurring amino carboxylic acid, including any amino acid occurring in peptides and polypeptides including proteins and enzymes synthesized in vivo thus including modifications of the amino acids. The term amino acid is herein used synonymously with the term "amino acid residue" which is meant to encompass amino acids as stated which have been reacted with at least one other species, such as 2, for example 3, such as more than 3 other species. The generic term amino acid comprises both natural and non-natural amino acids any of which may be in the "D" or "L" isomeric form.

One-letter symbol	Three-letter symbol	Amino acid (trivial name)
A	Ala	alanine
B	Asx	aspartic acid or asparagine
C	Cys	cysteine
D	Asp	aspartic acid
E	Glu	glutamic acid

F	Phe	phenylalanine
G	Gly	glycine
H	His	histidine
I	Ile	isoleucine
K	Lys	lysine
L	Leu	leucine
M	Met	methionine
N	Asn	asparagine
P	Pro	proline
Q	Gln	glutamine
R	Arg	arginine
S	Ser	serine
T	Thr	threonine
U*	Sec	selenocysteine
V	Val	valine
W	Trp	tryptophan
X	Xaa	unknown or other amino acid, i.e. X can be any of the conventional amino acids.
Y	Tyr	Tyrosine
Z	Glx	glutamic acid or glutamine (or substances such as 4-carboxyglutamic acid and 5-oxoproline that yield glutamic acid on acid hydrolysis of peptides)

The term "polypeptide" refers to a peptide having at least two, and preferably more than two amino acids. "Monomeric polypeptide" refers to a polypeptide that is a monomer as opposed to a dimer, trimer or polymer in the sense that the monomeric polypeptide is not crosslinked or otherwise bonded to another polypeptide chain. The term "dimer" thus refers to a moiety wherein two monomeric polypeptides are crosslinked to each other. In the same way, a trimeric polypeptide refers to a moiety wherein three monomeric polypeptides are crosslinked to each other, while the term "polymer" or "multimer" refers to a moiety wherein at least two polypeptides, and preferably more than three polypeptides are crosslinked to each other.

- 5
- 10 The expression "cross-linker" or "cross-linking moiety" refers to a linking moiety conferred by an external cross-linking agent used to crosslink one polypeptide with one or more polypeptides as described further in detail herein below.

The term "homology" refers to sequence similarity or, interchangeably, sequence identity, between two or more polynucleotide sequences or two or more polypeptide sequences.

The phrases "percent identity" and "% identity," as applied to polypeptide sequences, refer to the percentage of residue matches between at least two polypeptide sequences aligned using a standardized algorithm. Methods of polypeptide sequence alignment are well-known. Some alignment methods take into account conservative amino acid substitutions. Such conservative substitutions, explained in more detail above, generally preserve the charge and hydrophobicity at the site of substitution, thus preserving the structure (and therefore function) of the polypeptide.

"Percent identity" may be measured over the length of an entire defined polypeptide sequence, for example, as defined by a particular SEQ ID number, or may be measured over a shorter length, for example, over the length of a fragment taken from a larger, defined polypeptide sequence, for instance, a fragment of at least 6, at least 8, at least 10, at least 15, at least 20, at least 30, at least 40, at least 50, at least 70 or at least 150 contiguous residues. Such lengths are exemplary only, and it is understood that any fragment length supported by the sequences shown herein, in the tables, figures or Sequence Listing, may be used to describe a length over which percentage identity may be measured.

The term "carrier" refers to a compound that is conjugated to the polypeptide(s) either to increase the number of polypeptides, for increasing activity or immunosuppressive effect of the polypeptide(s), to confer stability to the molecules, to increase the biological activity of the peptides, or to increase its serum half-life. The "carrier" may be a protein carrier or a non-protein carrier. Non-limiting examples of non-protein carriers include liposomes, micelles, polymeric nanoparticles and diaminoethane. The liposome may comprise glycosaminoglycan hyaluronan (HA) and/or PEG. In one embodiment, the carrier is an immunoliposome. Other carriers include protamines, or polysaccharides e.g. aminodextran or chitosan. Non-limiting examples of protein carriers include, keyhole limpet hemocyanin, serum proteins such as transferrin, bovine serum albumin, human serum albumin, whale myoglobin, ovalbumin, immunoglobulins, lysozyme, carbonic anhydrase, or hormones, such as insulin. In other embodiments of the present invention, the carrier may be a pharmaceutical acceptable carrier as described herein below. The immunosuppressive peptides of the present invention may be coupled to the carrier by means of cross-linking as further described herein below.

The terms "protein modification", "protein stability" and "peptide stability" is used to describe the state of the immunosuppressive proteins and peptides, in particular the state wherein said proteins and/or peptides are more resistant to degradation and/or have increased properties towards hydrolysis and/or proteolysis. In particular, proteolytic stability refers to the resistance toward the action of proteolytic enzymes, also known as proteases, i.e. enzymes that catalyzes the hydrolysis of the amide/peptide-bond of the protein or peptide. Moreover, the present invention also encompasses polypeptides, wherein one or more amino acid residues are modified, wherein said one or more modification(s) are preferably selected from the group consisting of in vivo or in vitro chemical derivatization, such as but not limited to acetylation or carboxylation, glycosylation, such as glycosylation resulting from exposing the polypeptide to

enzymes which affect glycosylation, for example mammalian glycosylating or deglycosylating enzymes, phosphorylation, such as modification of amino acid residues which results in phosphorylated amino acid residues, for example phosphotyrosine, phosphoserine and phosphothreonine. The polypeptide according to the invention can comprise one or more amino acids independently selected from the group consisting of naturally occurring L-amino acids, naturally occurring D-amino acids as well as non-naturally occurring, synthetic amino acids. One or more amino acid residues of the polypeptide of the present invention are modified so as to preferably improve the resistance to proteolytic degradation and stability or to optimize solubility properties or to render the polypeptide more suitable as a therapeutic agent. The invention also relates to polypeptides of the invention where blocking groups are introduced in order to protect and/or stabilize the N-and/or C-termini of the polypeptide from undesirable degradation. Such blocking groups may be selected from the group comprising but not limited to branched or non-branched alkyl groups and acyl groups, such as formyl and acetyl groups, as well substituted forms thereof, such as acetamidomethyl. The invention also relates to the following: The polypeptides according to present invention, wherein the one or more blocking groups are selected from N-terminal blocking groups comprising desamino analogs of amino acids, which are either coupled to the N-terminus of the peptide or used in place of the N-terminal amino acid residue. The polypeptide according to present invention, but not limited to wherein the one or more blocking groups are selected from C-terminal blocking groups wherein the carboxyl group of the C-terminus is either incorporated or not, such as esters, ketones, and amides, as well as decarboxylated amino acid analogues. The polypeptide according to present invention, wherein the one or more blocking groups are selected from C-terminal blocking groups comprising ester or ketone-forming alkyl groups, such as lower (C1 to C6) alkyl groups, for example methyl, ethyl and propyl, and amide-forming amino groups, such as primary amines (-NH₂), and mono- and di-alkylamino groups, such as methylamino, ethylamino, dimethylamino, diethylamino, methylethylamino, and the like. The polypeptide according to present invention, wherein free amino group(s) at the N-terminal end and free carboxyl group(s) at the termini can be removed altogether from the polypeptide to yield desamino and decarboxylated forms thereof without significantly affecting the biological activity of the polypeptide. The increased properties may be achieved for example by chemical protection, i.e. by reacting the proteins and peptides of the present invention with protecting chemical groups, or by the incorporation of non-naturally occurring amino acids, e.g. D-amino acids, with the result of prolonging the half-life of the proteins and peptides of the present invention.

The term "penetration promoting" or "penetration enhancing" as used herein refers to compounds that facilitate the delivery of the immunosuppressive peptides of the present invention to the target site of action. In particular the term refers to the transcutaneous delivery of the immunosuppressive peptides. Simple topical application of the present invention may not always yield an adequate result, as the outermost layer of the skin provides an outstanding barrier against the external environment. While single penetration enhancers can aid topical delivery, combinations of several penetration enhancers may most effective. The amount of penetration enhancer which may be used in the invention varies from about 1 to 100 percent although adequate enhancement of penetration is generally found to occur in the range of about 1 to about 10 percent by weight of the formulation to be delivered. Non-limiting examples of penetration enhancers are entities that falls within liposomes, transferosomes niosomes and

ethosomes, but may also be any of the many hundred known chemical penetration enhancers, of which sulfoxides, azones, pyrrolidones, fatty acids, terpenes and terpenoids, oxazolidinones and urea are non-limiting examples.

5 The term "immuno-modulation" as used herein refers to the process of where an immune response is either suppressed, partly or completely, or triggered or induced or enhanced. Likewise, the term "growth-modulation" as used herein refers to the process of where the cell proliferation is either suppressed, partly or completely, or where cell proliferation is induced or enhanced or promoted.

The term "substance" as used anywhere herein comprises any form of substance suitable for comprising the immunosuppressive polypeptides of the present invention.

10 Non-limiting examples of such substances are creams, lotions, shake lotions, ointments, gels, balms, salves, oils, foams, shampoos, sprays, aerosols as well as transdermal patches and bandages.

15 The term "treatment", as used anywhere herein comprises any type of therapy, which aims at terminating, preventing, ameliorating and/or reducing the susceptibility to a clinical condition as described herein. In a preferred embodiment, the term treatment relates to prophylactic treatment, i.e. a therapy to reduce the susceptibility of a clinical condition, a disorder or condition as defined herein.

20 Thus, "treatment," "treating," and the like, as used herein, refer to obtaining a desired pharmacologic and/or physiologic effect, covering any treatment of a pathological condition or disorder in a mammal, including a human. The effect may be prophylactic in terms of completely or partially preventing a disorder or symptom thereof and/or may be therapeutic in terms of a partial or complete cure for a disorder and/or adverse effect attributable to the disorder. That is, "treatment" includes (1) preventing the disorder from occurring or recurring in a subject, (2) inhibiting the disorder, such as arresting its development, (3) stopping or terminating the disorder or at least
25 symptoms associated therewith, so that the host no longer suffers from the disorder or its symptoms, such as causing regression of the disorder or its symptoms, for example, by restoring or repairing a lost, missing or defective function, or stimulating an inefficient process, or (4) relieving, alleviating, or ameliorating the disorder, or symptoms associated therewith, where ameliorating is used in a broad sense to refer to at least a reduction in the magnitude of a parameter, such as
30 inflammation, pain, and/or immune deficiency.

The term "animal" as used herein may be defined to include humans, domestic or agricultural (cats, dogs, cows, sheep, horses, pigs, etc.) or test species such as mouse, rats, rabbits and the like. Thus the animals may also be of bovine, equine, porcine, human, ovine, caprine or cervidae origin.

35 According to an embodiment, the present invention concerns an immune suppressive domain for use as a medicament.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is the fusion peptide of an envelope protein.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is the fusion peptide of a virus.

- 5 According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is the fusion peptide of an enveloped RNA virus.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is from a virus.

- 10 The inventors have inter alia identified three new groups of enveloped RNA viruses with immunosuppressive domains in their fusion protein:

1: The inventors have identified immunosuppressive domains among enveloped RNA viruses with type II fusion mechanism. Hitherto, immunosuppressive domains have not been described for any enveloped RNA viruses with a type II fusion mechanism. Immunosuppressive domains have been identified by the inventors at two positions in two different groups of viruses:

- 15 i. Co-localizing with the fusion peptide exemplified by the identification of a common immunosuppressive domain in the fusion peptide of Flavivirus (Dengue virus, west Nile virus etc), and
- ii. In the hydrophobic alpha helix N-terminal of the transmembrane domain in the fusion protein exemplified by the finding of an immunosuppressive domain in said helices of all flaviridae e.g. Hepatitis C virus, Dengue, west nile etc.

- 20 2: The inventors have identified immunosuppressive domains in the fusion protein among enveloped RNA viruses with type I fusion mechanism (excluding lentivirus, retrovirus and filovirus).

This position co-localizes with the fusion peptide of said fusion protein as demonstrated by the identification of a common immunosuppressive domain in the fusion peptide of all Influenza A and B types.

- 25 3: The inventors have identified potential immunosuppressive domains located at various positions of type I enveloped RNA viruses (excluding lentivirus, retrovirus and filovirus) as well as in enveloped RNA viruses featuring a fusion protein with neither a type I nor a type II fusion structure.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is from an influenza virus.

- 30 According to an embodiment, the invention concerns the immune suppressive domain, wherein said domain is derived from an enveloped RNA virus.

The expression "derived from a virus" means that the domain is substantially identical to the immune suppressive domain of the virus, optionally with mutations, insertions or deletions.

- 35 According to an embodiment, the invention concerns the immune suppressive domain, subject to the proviso that said immune suppressive domain is different from immunosuppressive domains obeying the conditions of:

- i) being from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus;
- ii) being located in the linker between the two heptad repeat structures just N-terminal of the transmembrane domain in the fusion protein; and
- 5 iii) including at least some of the first 22 amino acids located N-terminal to the first cysteine residue of the two well conserved cystein residues, located between 4 and 6 amino acid residues from one another and further located just N-terminal of the transmembrane spanning domain of the fusion protein.

10 The immunosuppressive domains of lentivirus, retroviruses and filoviruses show large structural similarity. Furthermore the immunosuppressive domain of these viruses are all located at the same position in the structure of the fusion protein, more precisely in the linker between the two heptad repeat structures just N-terminal of the transmembrane domain in the fusion protein. These heptad repeat regions constitute two alpha helices that play a critical role in the active mechanism of membrane fusion by these proteins. The immune suppressive domains can be located in relation to

15 two well conserved cystein residues that are found in these structures. These cystein residues are between 4 and 6 amino acid residues from one another and in many cases are believed to form disulfide bridges that stabilize the fusion proteins. The immune suppressive domains in all three cases include at least some of the first 22 amino acids that are located N-terminal to the first cysteine residue.

20 According to an embodiment, the invention concerns the immune suppressive domain, subject to the proviso, that said immune suppressive domain is different from immunosuppressive domains obeying the conditions of:

- i) being from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus; and
- 25 ii) being located in the linker between the two heptad repeat structures just N-terminal of the transmembrane domain in the fusion protein.

The in this context relevant immunosuppressive domains are all located at a very well-defined structure within their fusion proteins, at the bend in the heptad repeat just N-terminale of the transmembrane structure in the fusion protein.

30 According to an embodiment, the invention concerns the immune suppressive domain, wherein said immune suppressive domain is different from immunosuppressive domains from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the domain is selected among the sequences of Table 1 or sequences seqid 1 to seqid 287.

35 According to an embodiment, the invention concerns the immune suppressive domain, wherein the domain is obtainable from the sequences of Table 1 or the sequences seqid 1 to seqid 287, by at least one mutation, deletion or insertion.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the total number of mutations, deletions or insertions is selected among 1, 2, 3 and 4.

The term "mutation" is used with a number about this number of point mutation(s), i.e. 3 mutations mean 3 point mutations. The term "deletion" is used with a number about the deletion of this number of amino acid(s), i.e. 2 deletions means the deletion of 2 amino acids. The term "insertion" is used with a number about insertion of this number of amino acid(s), i.e. 1 insertion means the insertion of 1 amino acid.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the total number of mutations, deletions or insertions is more than 4.

- 10 According to an embodiment, the invention concerns the immune suppressive domain, whereby the obtained immune suppressive domain have abrogated immunosuppressive properties for use in a vaccine against Porcine Reproductive and Respiratory Syndrom (PRRS).

According to an embodiment, the invention concerns the immune suppressive domain for use in surgery, prophylaxis, therapy, or a diagnostic method.

- 15 According to an embodiment, the invention concerns the immune suppressive domain, wherein the domain is selected among the group consisting of seqid 4 and seqid 119 to seqid 126.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the domain is homologous to seqid 4.

- 20 According to an embodiment, the invention concerns the immune suppressive domain, which is a monomeric peptide.

According to an embodiment, the invention concerns the immune suppressive domain, cross-linked to at least one additional immunosuppressive peptide.

According to an embodiment, the invention concerns the immune suppressive domain, connected to at least one additional immunosuppressive peptide to form a dimer.

- 25 According to an embodiment, the invention concerns the immune suppressive domain, wherein said dimer is homologous and comprises at least two immunosuppressive peptides with SEQ ID NO. 4, which are cross-linked by a disulfide bond, N-terminal to N-terminal or C-terminal to C-terminal.

- 30 According to an embodiment, the invention concerns the immune suppressive domain, wherein said dimer is homologous and comprises at least two immunosuppressive peptides selected from SEQ ID NO. 119 to seqid 126, which are cross-linked by a disulfide bond, N-terminal to N-terminal or C-terminal to C-terminal.

According to an embodiment, the invention concerns the immune suppressive domain, connected to at least one additional immunosuppressive peptide to form a heterologous dimer.

- 35 According to an embodiment, the invention concerns the immune suppressive domain, connected to at least two additional immunosuppressive peptides to form a multimer.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said immunosuppressive peptides comprises one or more modifications.

According to an embodiment, the invention concerns the immune suppressive domain, wherein said modifications are selected from the group consisting of chemical derivatizations, L-amino acid
5 substitutions, D-amino acid substitutions, synthetic amino acid substitutions, deaminations and decarboxylations.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the peptides or proteins have increased resistance against proteolysis compared to peptides or proteins not comprising said at least one modification.

- 10 According to an embodiment, the invention concerns the immune suppressive domain or an immune suppressive peptide according to the invention, for use in diagnostics and/or treatment and/or prevention and/or amelioration of disease.

According to an embodiment, the invention concerns the immune suppressive domain, wherein the subject is a human or an animal.

- 15 According to an embodiment, the invention concerns the immune suppressive domain, for use on an organ.

It is envisaged that an ISD may be used for treating an organ, e.g. before transplantation.

According to an embodiment, the invention concerns the immune suppressive domain for immune suppression.

- 20 According to an embodiment, the invention concerns the immune suppressive domain for the preparation or treatment of transplantation patients.

According to an embodiment, the invention concerns the immune suppressive domain for a use comprising treatment and/or prevention and/or amelioration of an autoimmune or inflammatory disease.

- 25 According to an embodiment, the invention concerns the immune suppressive domain for a use comprising prophylaxis or treatment of a condition selected among Acute disseminated encephalomyelitis (ADEM), Addison's disease, Agammaglobulinemia, Alopecia areata, Amyotrophic Lateral Sclerosis, Ankylosing Spondylitis, Antiphospholipid syndrome, Antisynthetase syndrome, Atopic allergy, Atopic dermatitis, Autoimmune aplastic anemia, Autoimmune cardiomyopathy,
30 Autoimmune enteropathy, Autoimmune hemolytic anemia, Autoimmune hepatitis, Autoimmune inner ear disease, Autoimmune lymphoproliferative syndrome, Autoimmune peripheral neuropathy, Autoimmune pancreatitis, Autoimmune polyendocrine syndrome, Autoimmune progesterone dermatitis, Autoimmune thrombocytopenic purpura, Autoimmune urticaria, Autoimmune uveitis, Balo disease/Balo concentric sclerosis, Behçet's disease, Berger's disease, Bickerstaff's encephalitis,
35 Blau syndrome, Bullous pemphigoid, Cancer, Castleman's disease, Celiac disease, Chagas disease, Chronic inflammatory demyelinating polyneuropathy, Chronic recurrent multifocal osteomyelitis, Chronic obstructive pulmonary disease, Churg-Strauss syndrome, Cicatricial pemphigoid, Cogan syndrome, Cold agglutinin disease, Complement component 2 deficiency, Contact dermatitis, Cranial arteritis, CREST syndrome, Crohn's disease, Cushing's Syndrome, Cutaneous leukocytoclastic angiitis,

Dego's disease, Dercum's disease, Dermatitis herpetiformis, Dermatomyositis, Diabetes mellitus type 1, Diffuse cutaneous systemic sclerosis, Dressler's syndrome, Drug-induced lupus, Discoid lupus erythematosus, Eczema, Endometriosis, Enthesitis-related arthritis, Eosinophilic fasciitis, Eosinophilic gastroenteritis, Epidermolysis bullosa acquisita, Erythema nodosum, Erythroblastosis fetalis, Essential
 5 mixed cryoglobulinemia, Evan's syndrome, Fibrodysplasia ossificans progressiva, Fibrosing alveolitis, Gastritis, Gastrointestinal pemphigoid, Glomerulonephritis, Goodpasture's syndrome, Graves' disease, Guillain-Barré syndrome (GBS), Hashimoto's encephalopathy, Hashimoto's thyroiditis, Henoch-Schonlein purpura, Herpes gestationis, Hidradenitis suppurativa, Hughes-Stovin syndrome, Hypogammaglobulinemia, Idiopathic inflammatory demyelinating diseases, Idiopathic pulmonary
 10 fibrosis, Idiopathic thrombocytopenic purpura, IgA nephropathy, Inclusion body myositis, Chronic inflammatory demyelinating polyneuropathy, Interstitial cystitis, Juvenile idiopathic arthritis, Kawasaki's disease, Lambert-Eaton myasthenic syndrome, Leukocytoclastic vasculitis, Lichen planus, Lichen sclerosus, Linear IgA disease (LAD), Lou Gehrig's disease, Lupoid hepatitis, Lupus erythematosus, Majeed syndrome, Ménière's disease, Microscopic polyangiitis, Miller-Fisher
 15 syndrome, Mixed connective tissue disease, Morphea, Mucha-Habermann disease, Multiple sclerosis, Myasthenia gravis, Myositis, Narcolepsy, Neuromyelitis optica, Neuromyotonia, Occular cicatricial pemphigoid, Opsoclonus myoclonus syndrome, Ord's thyroiditis, Palindromic rheumatism, PANDAS (pediatric autoimmune neuropsychiatric disorders associated with streptococcus), Paraneoplastic cerebellar degeneration, Paroxysmal nocturnal hemoglobinuria (PNH), Parry Romberg syndrome,
 20 Parsonage-Turner syndrome, Pars planitis, Pemphigus vulgaris, Pernicious anaemia, Perivenous encephalomyelitis, POEMS syndrome, Polyarteritis nodosa, Polymyalgia rheumatica, Polymyositis, Primary biliary cirrhosis, Primary sclerosing cholangitis, Progressive inflammatory neuropathy, Psoriasis, Psoriatic arthritis, Pyoderma gangrenosum, Pure red cell aplasia, Rasmussen's encephalitis, Raynaud phenomenon, Relapsing polychondritis, Reiter's syndrome, Restless leg syndrome,
 25 Retroperitoneal fibrosis, Rheumatoid arthritis, Rheumatic fever, Sarcoidosis, Schizophrenia, Schmidt syndrome, Schnitzler syndrome, Scleritis, Scleroderma, Serum Sickness, Sjögren's syndrome, Spondyloarthropathy, Still's disease, Stiff person syndrome, Subacute bacterial endocarditis (SBE), Susac's syndrome, Sweet's syndrome, Sydenham chorea, Sympathetic ophthalmia, Systemic lupus erythematosus, Takayasu's arteritis, Temporal arteritis, Thrombocytopenia, Tolosa-Hunt syndrome,
 30 Transverse myelitis, Ulcerative colitis, Undifferentiated connective tissue disease, Undifferentiated spondyloarthropathy, Urticarial vasculitis, Vasculitis, Vitiligo, and Wegener's granulomatosis.

According to an embodiment, the invention concerns the immune suppressive domain for the treatment or prevention of acute or chronic inflammation.

According to an embodiment, the invention concerns the immune suppressive domain for the
 35 treatment or prevention of a disorder associated with inflammation.

According to an embodiment, the invention concerns the immune suppressive domain for the treatment or prevention of a disorder selected among Acne vulgaris, Allergy, Allergic rhinitis, Asthma, Atherosclerosis, Autoimmune disease, Celiac disease, Chronic prostatitis, Glomerulonephritis, Hypersensitivities, Inflammatory bowel diseases, Pelvic inflammatory disease, Reperfusion injury,
 40 Rheumatoid arthritis, Sarcoidosis, Transplant rejection, Vasculitis, interstitial cystitis, Cancer, Depression, Myopathies, and Leukocyte defects. These conditions are examples of diseases or conditions associated with inflammation.

According to an embodiment, the invention concerns the immune suppressive domain for a use comprising prophylaxis or treatment of sepsis.

According to an embodiment, the invention concerns the immune suppressive domain for a use comprising prophylaxis or treatment of asthma.

- 5 According to an embodiment, the invention concerns the immune suppressive domain for a use comprising prophylaxis or treatment of allergy.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for immune suppression.

- 10 According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for the preparation or treatment of transplantation patients.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of an autoimmune or inflammatory disease.

- 15 According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition selected among Acute disseminated encephalomyelitis (ADEM), Addison's disease, Agammaglobulinemia, Alopecia areata, Amyotrophic Lateral Sclerosis, Ankylosing Spondylitis, Antiphospholipid syndrome, Antisynthetase syndrome, Atopic allergy, Atopic dermatitis, Autoimmune aplastic anemia, Autoimmune cardiomyopathy, Autoimmune enteropathy, Autoimmune hemolytic anemia, Autoimmune hepatitis, Autoimmune inner ear disease, Autoimmune lymphoproliferative syndrome, Autoimmune peripheral neuropathy, Autoimmune pancreatitis, Autoimmune polyendocrine syndrome, Autoimmune progesterone dermatitis, Autoimmune thrombocytopenic purpura, Autoimmune urticaria, Autoimmune uveitis, Balo disease/Balo concentric sclerosis, Behçet's disease, Berger's disease, Bickerstaff's encephalitis, Blau syndrome, Bullous pemphigoid, Cancer, Castleman's disease, Celiac disease, Chagas disease, Chronic inflammatory demyelinating polyneuropathy, Chronic recurrent multifocal osteomyelitis, Chronic obstructive pulmonary disease, Churg-Strauss syndrome, Cicatricial pemphigoid, Cogan syndrome, Cold agglutinin disease, Complement component 2 deficiency, Contact dermatitis, Cranial arteritis, CREST syndrome, Crohn's disease, Cushing's Syndrome, Cutaneous leukocytoclastic angiitis, Dego's disease, Dercum's disease, Dermatitis herpetiformis, Dermatomyositis, Diabetes mellitus type 1, Diffuse cutaneous systemic sclerosis, Dressler's syndrome, Drug-induced lupus, Discoid lupus erythematosus, Eczema, Endometriosis, Enthesitis-related arthritis, Eosinophilic fasciitis, Eosinophilic gastroenteritis, Epidermolysis bullosa acquisita, Erythema nodosum, Erythroblastosis fetalis, Essential mixed cryoglobulinemia, Evan's syndrome, Fibrodysplasia ossificans progressiva, Fibrosing alveolitis, Gastritis, Gastrointestinal pemphigoid, Glomerulonephritis, Goodpasture's syndrome, Graves' disease, Guillain-Barré syndrome (GBS), Hashimoto's encephalopathy, Hashimoto's thyroiditis, Henoch-Schonlein purpura, Herpes gestationis, Hidradenitis suppurativa, Hughes-Stovin syndrome, Hypogammaglobulinemia, Idiopathic inflammatory demyelinating diseases, Idiopathic pulmonary fibrosis, Idiopathic thrombocytopenic purpura, IgA nephropathy, Inclusion body myositis, Chronic inflammatory demyelinating polyneuropathy, Interstitial cystitis, Juvenile idiopathic arthritis, Kawasaki's disease, Lambert-Eaton myasthenic syndrome, Leukocytoclastic vasculitis, Lichen planus, Lichen sclerosus, Linear IgA disease (LAD), Lou

Gehrig's disease, Lupoid hepatitis, Lupus erythematosus, Majeed syndrome, Ménière's disease, Microscopic polyangiitis, Miller-Fisher syndrome, Mixed connective tissue disease, Morphea, Mucha-Habermann disease, Multiple sclerosis, Myasthenia gravis, Myositis, Narcolepsy, Neuromyelitis optica, Neuromyotonia, Occular cicatricial pemphigoid, Opsoclonus myoclonus syndrome, Ord's thyroiditis, Palindromic rheumatism, PANDAS (pediatric autoimmune neuropsychiatric disorders associated with streptococcus), Paraneoplastic cerebellar degeneration, Paroxysmal nocturnal hemoglobinuria (PNH), Parry Romberg syndrome, Parsonage-Turner syndrome, Pars planitis, Pemphigus vulgaris, Pernicious anaemia, Perivenous encephalomyelitis, POEMS syndrome, Polyarteritis nodosa, Polymyalgia rheumatica, Polymyositis, Primary biliary cirrhosis, Primary sclerosing cholangitis, Progressive inflammatory neuropathy, Psoriasis, Psoriatic arthritis, Pyoderma gangrenosum, Pure red cell aplasia, Rasmussen's encephalitis, Raynaud phenomenon, Relapsing polychondritis, Reiter's syndrome, Restless leg syndrome, Retroperitoneal fibrosis, Rheumatoid arthritis, Rheumatic fever, Sarcoidosis, Schizophrenia, Schmidt syndrome, Schnitzler syndrome, Scleritis, Scleroderma, Serum Sickness, Sjögren's syndrome, Spondyloarthropathy, Still's disease, Stiff person syndrome, Subacute bacterial endocarditis (SBE), Susac's syndrome, Sweet's syndrome, Sydenham chorea, Sympathetic ophthalmia, Systemic lupus erythematosus, Takayasu's arteritis, Temporal arteritis, Thrombocytopenia, Tolosa-Hunt syndrome, Transverse myelitis, Ulcerative colitis, Undifferentiated connective tissue disease, Undifferentiated spondyloarthropathy, Urticarial vasculitis, Vasculitis, Vitiligo, and Wegener's granulomatosis.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition selected among acute or chronic inflammation.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition associated with inflammation.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition selected among Acne vulgaris, Allergy, Allergic rhinitis, Asthma, Atherosclerosis, Autoimmune disease, Celiac disease, Chronic prostatitis, Glomerulonephritis, Hypersensitivities, Inflammatory bowel diseases, Pelvic inflammatory disease, Reperfusion injury, Rheumatoid arthritis, Sarcoidosis, Transplant rejection, Vasculitis, interstitial cystitis, Cancer, Depression, Myopathies, and Leukocyte defects.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of Sepsis.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of asthma.

According to an embodiment, the invention concerns the use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of allergy.

According to an embodiment, the invention concerns a method for the preparation of a pharmaceutical composition comprising the steps of:

a. Providing one or more immunosuppressive peptides selected from Seqid 1 to Seqid 287 , and optionally cross-linking said one or more immunosuppressive peptides;

b. Optionally providing a carrier;

c. Providing a substance;

5 d. Mixing the provided one or more peptides with any carrier of optional step b. and the substance of step d. to obtain the pharmaceutical composition.

According to an embodiment, the invention concerns the method, wherein said substance of step c. is selected from the group consisting of creams, lotions, shake lotions, ointments, gels, balms, salves, oils, foams, shampoos, sprays, aerosols, transdermal patches and bandages.

10 According to an embodiment, the invention concerns a pharmaceutical composition obtainable according to the invention.

According to an embodiment, the invention concerns a pharmaceutical composition comprising an immune suppressive domain as an active substance.

15 According to an embodiment, the invention concerns the pharmaceutical composition, wherein said immune suppressive domain is selected among the immune suppressive domains of the invention.

According to an embodiment, the invention concerns the pharmaceutical composition, further comprising at least one carrier.

According to an embodiment, the invention concerns the pharmaceutical composition, wherein said at least one carrier is a non-protein carrier and/or a protein carrier.

20 According to an embodiment, the invention concerns a use of the composition according to the invention, for treatment of a disease by IV injection.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a disease by direct injection at a site of inflammation.

25 According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a disease by inhalation.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a disease by oral delivery.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a disease by anal delivery.

30 According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a condition selected among a skin disease, Psoriasis, Arthritis, Asthma, Sepsis and inflammatory bowel disease.

According to an embodiment, the invention concerns the use of a composition of the invention for administration in a way selected among IV, IP, and IM.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment of Arthritis wherein the composition is injected directly at site of inflammation.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment of a condition selected among Gastrointestinal hyperresponsiveness, Food Allergy, Food
5 intolerance and inflammatory bowel disease, wherein the composition is delivered orally.

According to an embodiment, the invention concerns the use of a composition of the invention for treatment Asthma where the composition is delivered by inhalation.

According to an embodiment, the invention concerns the use of a composition of the invention for coating of nanoparticles and biomaterials. The immune suppressive domain may aid in suppressing
10 any immune response e.g. from a patient treated with or subjected to nanoparticles, e.g. for drug delivery or diagnostics, or biomaterials.

According to an embodiment, the invention concerns the use of a composition of the invention to aid in suppressing any immune response to nanoparticles or biomaterials.

According to an embodiment, the invention concerns the use of a composition of the invention to
15 increase the half-life of nanoparticles or biomaterials in vivo in a patient.

According to an embodiment, the invention concerns a vaccine comprising an immune suppressive domain, optionally mutated, for systemic immune suppression.

According to an embodiment, the invention concerns a vaccine comprising an immune suppressive domain selected among Seqid 275 to 287 against PRRS.

According to an embodiment, the invention concerns a vaccine comprising a peptide, obtained by performing at least one mutation, insertion or deletion of an immune suppressive domain selected
20 among Seqid 275 to 287.

According to an embodiment, the invention concerns a vaccine against PRRS comprising a mutated immunosuppressive domain selected among seqid 275 to seqid 287, subject to the proviso that the
25 immunosuppressive properties of said domain have been abrogated.

According to an embodiment, the invention concerns a peptide having the sequence of the Immune Suppressive Domain according to the invention.

According to an embodiment, the invention concerns the peptide having the sequence of the Immune Suppressive Domain according to the invention, modified by a number of point mutations
30 selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

According to an embodiment, the invention concerns the peptide having the sequence of the Immune Suppressive Domain according to the invention, modified by a number of point deletions
selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

According to an embodiment, the invention concerns the peptide having the sequence of the Immune Suppressive Domain according to the invention, modified by a number of point insertions
35 selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

According to an embodiment, the invention concerns the peptide according to the invention, capable of an inhibition selected among at least 5% inhibition of T-lymphocyte proliferation, at least 10%, at least 20%, such as at least 30%, at least 40%, at least 50%, such as at least 60%, such as at least 70% inhibition of T-lymphocyte proliferation, at least 75% inhibition of T-lymphocyte proliferation, at least 80%, such as at least 85%, at least 90%, such as at least 95%, at least 97%, such as at least 99%, and at least 100% inhibition of T-lymphocyte proliferation.

According to an embodiment, the invention concerns a peptide according to the invention, capable of suppressing the immune response in an animal, preferably according to the TPA model.

According to an embodiment, the invention concerns the use of a peptide according to the invention, for a use selected among any of the uses of the invention.

According to an embodiment, the invention concerns a method of treatment of an indication selected among the indications of the present application and the viral infections of Table 1 comprising administration of an effective amount of an entity selected among the Immune Suppressive Domains of the invention, the compositions of the invention, and the peptides of the invention.

The co-pending patent application PCT/DK2012/050381 provides a number of immunosuppressive domains. Table 1 is provided below. Sequences of the table are applicable for the purposes of the present invention. Vira of the table provide examples of relevant indications for the present invention.

TABLE 1

Family	Genus	Species (group)	Species (Strain)	Putative ISU as identified using the criteria described in this application for identification of immunosuppressive domains	Peptides from domains from fusion proteins exhibiting immunosuppressive activity (ISU)	Name of envelope attachment/ fusion protein	Group I Type II Fusion mechanism
Flavi-viridae	Flavi-virus	Aroa virus	Bussuquara virus guape virus Naranjal virus	seqid85 NRGWNNGCGLFGKG *****		Envelope protein p19E Fusion protein E	
				seqid7 GDAAWDFGSGGVFENSLGK **O****O****O**			
				seqid8 GGTAWDFGSGIGGVFTSVGK *O*****			
	Dengue virus	Dengue 1		seqid2 DRGWNGCGLFGKG *****	seqid2 DRGWNGCGLFGKG *****		
				seqid172 KGSSIGKMFESTYRGAKRMAILG			
		Dengue 2		seqid9 GDTAWDFGSLGGVFTSVGK *****O**	seqid2 DRGWNGCGLFGKG *****		
		Dengue 3		seqid173 KGSSIGKMFETARGAKRMAILG			
				seqid174 KGSSIGQMFETTRGAKRMAILG	seqid2 DRGWNGCGLFGKG *****		
				seqid204 GDTAWDFGSGGVFENSLGK			

					*****	*****
	<i>Dengue 4</i>			seqid10 GETAWDFGSGVGLLTSLGK *****oo***** seqid173 KGSSIGKMEFEATARGARRMAILG	seqid2 DRGWNGCGLFGKG *****	*****
	<i>Japanese encephalitis virus</i>			seqid11 LGTAWDFGSGVGFNSIG ***o*****	seqid2 DRGWNGCGLFGKG *****	
	<i>Koutango virus</i>			seqid12 LGTAWDFGSGVGIFTSLG	seqid2 DRGWNGCGLFGKG *****	
	<i>Murray Valley encephalitis virus</i>			seqid13 LGTAWDFGSGVGFNSIG	seqid2 DRGWNGCGLFGKG *****	
	<i>St. Louis encephalitis virus</i>			seqid11 LGTAWDFGSGVGFNSIG *****	seqid2 DRGWNGCGLFGKG *****	
	<i>Usutu virus</i>			seqid14 LGTAWDFGSGVGFNSVG *****	seqid2 DRGWNGCGLFGKG *****	
	<i>West Nile virus</i>			seqid15 LGTAWDFGSGVGFTSVG *****o*****	seqid2 DRGWNGCGLFGKG *****	
	<i>Kokobera virus unclassified Kokobera virus group</i>			seqid16 IGDDAWDFGSGVGIINSVG	seqid2 DRGWNGCGLFGKG	
	<i>Modoc virus</i>			seqid17 VGSAFWNSDQRFSAINLMD seqid18 DRGWNGCALFGKG		
	<i>Cowbone Ridge virus</i> <i>Jutiapa virus</i> <i>Sal Vieja virus</i> <i>San Perlita virus</i>					
	<i>Ilheus virus</i>			seqid84 LGTAWDFGSGVGFNSIG	seqid2 DRGWNGCGLFGKG	
	<i>Sepik virus</i>			seqid19 TGEHSWDFGSTGGFFASVG	seqid2 DRGWNGCGLFGKG	
	<i>Bagaza virus</i>			seqid20 LGTAWDFGSGVGFNSIG	seqid2 DRGWNGCGLFGKG	
	<i>Tembusu virus</i>			seqid83 LGTAWDFGSGVGLTSIG	seqid2 DRGWNGCGLFGKG	
	<i>Yokose virus</i>			seqid21	seqid2	

			IGDDAWDFGSGTGIFNTIG	DRGWNCGGLFGKG	
Rio Bravo virus group	Apoi virus	Entebbe bat virus	seqid22	seqid2	
			SSAFWNSDEFFHFSNLISII	DRGWNCGGLFGKG	
			seqid23	seqid2	
			GDDAWDFGSGTGIFNTIGKA	DRGWNCGGLFGKG	
			seqid24	seqid2	
Seaborne tick-borne virus group	Rio Bravo virus	Saboya virus	SSAYWSSSEFFTSAGIMRIL	DRGWNCGGLFGKG	
			seqid18		
			DRGWNCGALFGKG		
			seqid25		
			GSSSWDFSSAGGFFGSGKA		
Spondweni virus group	Meaban virus	Saumarez Reef virus	seqid26		
			GDAAWDFGSGGFMTSIGRA		
			seqid27		
			DRGWNHCGLFGKG		
			seqid28		
Tyuleniy virus	Tyuleniy virus	Tyuleniy virus	GETAWDFGSGGFFTSVGRG		
			seqid27		
			DRGWNHCGLFGKG		
			seqid29		
			GEAAWDFGSGAGFFQSVGRG		
Zika virus	Zika virus	Zika virus	seqid27		
			DRGWNHCGLFGKG		
			seqid30	seqid2	
			LGDTAWDFGSGGVFNLSLKG	DRGWNCGGLFGKG	
			*****oo**o**		
Kyasanur forest disease virus	Kyasanur forest disease virus	Kyasanur forest disease virus	seqid31		
			VGEHAWDFGSGGMLSSVG		
			*****oo*****		
			seqid27		
			DRGWNHCGLFGKG		
Langat virus	Langat virus	Langat virus	seqid32		
			VLGEHAWDFGSGGVMTSIG		
			seqid27		
			DRGWNHCGLFGKG		
			seqid33		
Louping ill virus	Louping ill virus	Louping ill virus	IGEHAWDFGSGAGGFFSSIG		
			*****oo**o**		
			seqid27		
			DRGWNHCGLFGKG		
			seqid34		
Omsk hemorrhagic fever virus	Omsk hemorrhagic fever virus	Omsk hemorrhagic fever virus	IGEHAWDFGSGTGGFLSSIG		
			seqid27		
			DRGWNHCGLFGKG		

		Powassan virus	seqid35 VGEHAWDFGVS VGGILSSVG *****O***** seqid36 DRGWGNHCGFFGKG ***** seqid27 DRGWGNHCGLFGKG		
		Royal Farm virus			
		Tick-borne encephalitis virus	seqid37 IGEHA WDFGSAGGFLSSIG seqid38 IGEHA WDFGSTGGFLTSVG seqid39 IGEHA WDFGSTGGFLASVG seqid27 DRGWGNHCGLFGKG		
	Yaounde virus		seqid40 LGDTAWDFGSI GG VFTSLG seqid41 VGSSSWDFSTSGFFSSVG seqid42 VGRSSWDFSSAGGFFSSVG	seqid2 DRGWNGCGLFGKG seqid2 DRGWNGCGLFGKG seqid2 DRGWNGCGLFGKG	
	Yellow fever virus group	Banji virus			
		Bouboui virus			
		Edge Hill virus			
		Uganda S virus			
		Wesselsbron virus			
		Yellow fever virus	seqid43 MGDTAWDFSSAGGFFFTSVG ***** seqid44 NRGWGTGCFKWGIG seqid45 NRGWGTGCFEWGLG	seqid2 DRGWNGCGLFGKG seqid2 DRGWNGCGLFGKG	
	unclassified Flavivirus	Batu Cave virus Cacipacore virus Calbertado virus Cell fusing agent virus Chaoyang virus Chimeric Tick-borne encephalitis virus/Dengue virus 4 Culex theileri flavivirus Donggang virus Duck hemorrhagic ovariitis virus Flavivirus Aedes/MO-Ac/ITA/2009 Flavivirus Anopheles/PV-Am/ITA/2009 Flavivirus CbaAr4001 Flavivirus FSME Flavivirus Phlebotomine/76/Arrabida/2007 Gadgets Gully virus			

		Greek goat encephalitis virus Jugra virus Kadam virus Kamiti River virus Kedougou virus Montana myotis leukoencephalitis virus Mosquito flavivirus Ngoye virus Nounane virus Phlebotomus flavivirus Alg_F19 Phlebotomus flavivirus Alg_F8 Quang Binh virus Russian Spring-Summer encephalitis virus Sokoluk virus Spanish sheep encephalitis virus T'Ho virus Tai forest virus B31 Tamana bat virus Tick-borne flavivirus Wang Thong virus Flavivirus sp.			
		Aedes flavivirus	seqid45 NRGWTGCFEWGLG seqid46 HVAGRYSKHGMAGIGSVWEDLVR		
		Culex flavivirus	seqid44 NRGWTGCFKWGIG seqid47 VDKYRRFGTAGVGG		
Hepa civi rus	Hepatitis C virus	Hepatitis C virus genotype 1 a		seqid3 GLIHLHQNIVDVQYLYG seqid175 PALSTGLIHLHQNIVDVQ	E1/E2
		Hepatitis C virus genotype 1b	seqid48 GLIHLHRNIVDVQYLYG seqid176 PALSTGLIHLHRNIVDVQ		
		Hepatitis C virus genotype 2	seqid49 GLIHLHQNIVDVQYMYG seqid175 PALSTGLIHLHQNIVDVQ		
		Hepatitis C virus genotype 3	seqid175 PALSTGLIHLHQNIVDVQ	seqid3 GLIHLHQNIVDVQYLYG	

		Hepatitis C virus genotype 4	seqid175 PALSTGLIHLHQINVDVQ	seqid3 GLIHLHQINVDVQYLYG	
		Hepatitis C virus genotype 5	seqid50 GLIHLHQINVDVQYLYG seqid177 PALSTGLIHLHQINVDVQ		
		Hepatitis C virus genotype 6	seqid175 PALSTGLIHLHQINVDVQ	seqid3 GLIHLHQINVDVQYLYG	
		All Hepatitis C virus		seqid3 GLIHLHQINVDVQYLYG	
Pestivirus	Border disease virus	Border disease virus - X818 Border disease virus 1 Border disease virus 2 Border disease virus 3 Border disease virus isolates	seqid51 NTTLNGSAFQLICPYGWWGRVEC seqid52 SYFQQYMLKGQYQWFDLE		E1/E2
	Bovine viral diarrhoea virus 1	Bovine viral diarrhoea virus 1-CP7 Bovine viral diarrhoea virus 1-NADL Bovine viral diarrhoea virus 1-Osloss Bovine viral diarrhoea virus 1-SD1 Bovine viral diarrhoea virus isolates and strains Bovine viral diarrhoea virus type 1a Bovine viral diarrhoea virus type 1b Pestivirus isolate 97-360 Pestivirus isolate Hay 87/2210 Pestivirus strain mousedeer Pestivirus type 1 isolates	seqid53 NTTLNGPAFQMVCPGLGWTGTVSC seqid54 SYFQQYMLKGQYQWFDLE		
	Bovine viral diarrhoea virus 2 (BVDV-2)	Bovine viral diarrhoea virus 2 Pestivirus sp. strain 178003 Pestivirus sp. strain 5250Giessen-3 Bovine viral diarrhoea virus-2 isolate SCP	seqid55 SLNGPAFQMVCPQGTGTIEC seqid56 DRYFQQYMLKGKQYQWFDLD		
	Classical swine fever virus	Classical swine fever virus Hog cholera virus strain Zoelen	seqid57 TLLNGSAFYLVCPIGWTGTIEC seqid58 SYFQQYMLKGQYQWFDLD		
	unclassified Pestivirus	Bovine viral diarrhoea virus 3	seqid59 TLLNGPAFQLVCPYGTGTIEC seqid60 DNYFQQYMLKGKQYQWFDLEATD		
		Chamois pestivirus 1	seqid61 TLLNGSAFQMVCPFGWTGTIEC		

Togaviridae	Alpha-virus	Unclassified Flaviviridae	Barkedji virus Canine hepatitis virus AAK-2011 GB virus A Douroucouli hepatitis GB virus A GBV-A-like agents GB virus D GBV-C/HGV group GB virus C Hepatitis GB virus C-like virus Hepatitis GB virus B Lammi virus Marmoset hepatitis GB virus A Nakiwogo virus Turkey meningoencephalitis virus	seqid62 DSYFQOYMLGGEYQYWFDDAKD seqid205 TLLNGPAFQLVCPYGTGTIECDSSYYQYTIK SGYQYWFDDTAKD				
Togaviridae	Alpha-virus	Aura virus Barmah Forest virus Middelburg virus Ndumu virus Salmon pancreas disease virus Getah virus Mayaro virus Trocara virus EEEV complex VEEV complex	Fort Morgan virus Highlands J virus Sindbis virus Western equine encephalomyelitis virus Whataroa virus	seqid63 GVYPFMWGGAYCFCDTENTQVS *****O*****O*O* seqid64 APFGCEIYTNPIRAENCAVGSIP *****O*OOO*O**OO*OO* seqid65 SDFGGIATVKYSASKSGKCAVH O***OOOOO*OOOOO*O*OO* seqid66 FSTANIHPERLQICTSYVTCKGDCHPP *OOOOOOO*OOOO*OOOO*OOO*O**				E2/E1
Togaviridae	VEEV complex	Cabassou virus Mucambo virus Pixuna virus	Venezuelan equine encephalitis virus	seqid67 GVYPFMWGGAYCFCD ***** seqid68 GDCHPPKDHIVTHPQYHAQ				

				*****O**O*O* seqid69 AVSKTAWTLTS *****OO*		
SVF complex	Bebaru virus O'nyong-nyong virus Ross River virus Semliki forest virus Una virus	seqid63 GVYPFMWGGAYCFCDTENTQVS *****O**O*O* seqid64 APFGCEIYTNPIRAENCAVGSIP *****O*OOO*O**OO*OO* seqid65 SDFGGIATVKYSASKSGKCAVH O**OOOOO*OOOOO*O*OO* seqid66 FSTANIHPFRLQICTSYVTCKGDCHPP *OOOOOOO*OOOO*OOOO*OOO*O**				
	Chikungunya virus	seqid67 GVYPFMWGGAYCFCD ***** seqid70 VHCAAECHPPKDHVNY OO*OO*O***** seqid71 PASHTTLGVQDISATAMSWV O****OO*****				

Rubella virus	Rubella virus (strain BRD1)	seqid72 ACTFWAVNAYSSGGYAQLASVFNPGGSYYK ***o***o***o***o***o***o***o
Rubella virus	Rubella virus (strain BRDII)	seqid73 QYHPTACEVEPAFGHSDAACWGFPDIT ***o***o***o***o***o***o***o
Rubella virus	Rubella virus (strain M33)	seqid74 MSVFALASVQHPHKTVRVKFTHT ***oo***oo***o***o***o***o
Rubella virus	Rubella virus (strain RN-UK86)	seqid159 ETRTVWQLSVAGVSC o***o***o***o***o***o***o
Rubella virus	Rubella virus (strain THEFIEN)	seqid76 NVTTEHPFCNMPHGHQLEVQVPP o***o***o***o***o***o***o
Rubella virus	Rubella virus (strain TO-336 vaccine)	seqid77 DPGDLVEYIMNYTGNQOSRW ***o***o***o***o***o***o
Rubella virus	Rubella virus (strain TO-336)	seqid78 GSPNCHGPDWASPVCORHSPDCS ***o***o***o***o***o***o
Rubella virus	Rubella virus (vaccine strain RA27/3)	seqid79 RLVGATPERPRRLV o***o***o***o***o***o***o
		seqid80 DADPELLRTAPGP *oo***o***o***o***o***o
		seqid81 GEVWVTPVIGSOARKCGL oo***o***o***o***o***o***o
		seqid86 HIRAGPYGHATVEM oo***o***o***o***o***o***o
		seqid87 PEWIHAHTSDPWHP o***o***o***o***o***o***o
		seqid88 PGPLGLKFKTVRFVALPR ***o***o***o***o***o***o
		seqid89 ALAPPNVRVTGVCYQCGTPAL oooo***o***o***o***o***o
		seqid90 EGLAPGGNCHLTVNGEDVG ***o***o***o***o***o***o
		seqid207 LLNTPPPYQVSCGG *****o***o***o***o***o

[illegible]

Bunya-viridae	Hanta-virus (continued on next page)	Amur virus Bayou virus Black Creek Canal virus Cano Delgadito virus Calabazo virus Catacanas virus Choclo virus Dobrava-Belgrade virus El Moro Canyon virus Hantaan virus Isla Vista virus Khabarovsk virus Laguna Negra virus Limestone Canyon virus Monongahela virus Muleshoe virus Muju virus New York virus Oran virus Playa de Oro virus Prospect Hill virus Puumala virus	seqid94 NPPDCPGVGTGCTACGVLD **o***o*****o*** seqid95 RKVCIQLGTEQTKTIDSND *oo*o*o*o*oo**o*o*** seqid96 DTLLFLGLEEGGMI FKQWCTTCQFGDPGDI M seqid97 GSFRKKCFATLPSCQYDGNVSG *o***o*o***o*o*ooo**oo** seqid98 ATKDSFQSFNITEPH **o***o**oooo* seqid99 GSGVGFNLVCSVSLTEC *****o*o*ooo**** seqid100 KACDSAMCYGSSTANLVRGQNT *****o***oooo*o**o** seqid101 GKGHSGSKFMCCHDKCSATGLVAAAPHL *****o*o*o***ooo*ooo**o*o**** seqid102 DDGAPQCGVHCWFKKSGEW ***o*o*ooo****oo****		Gn (G2) / Gc (G1)
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	Rio Mamore virus			
	Rio Segundo virus			
	Saaremaa virus			
	Seoul virus			
	Sin Nombre virus			
	Soochong virus			
	Thailand virus			
	Thottapalayam virus			
	Topografov virus			
	Tula virus			

Ortho-bunya-virus	Anopheles A virus Anopheles B virus Bakau virus Batama virus Bwamba virus Caraparu virus Kaeng Khoi virus Kairi virus Madrin virus Main Drain virus Marituba virus Nyando virus Oriboca virus Oropouche virus Sathuperi virus Shamonda virus Shuni virus Simbu virus Tacaiuma virus Tete virus Turlock virus unclassified Orthobunyavirus		seqid103 KHDELCTGCPVNVNINHQTGWLT *o*o***o**oooooooo*o*o seqid104 WGCEEFGLAVSDGCVFGSCQD **o*oo**o*oo**oo***** seqid105 GNGVPRFDYLCILASRKEVIVRKC *o*ooo*ooo*oooo*oooo*o*o* seqid106 SCAGCINCFQNIHC *o**oooooooo*		
Ortho-bunya-virus	Akabane virus	Sabo virus Tinaroo virus Yaba-7 virus			

Bunyamwera virus	Batai virus Birao virus Bozo virus Cache Valley virus Fort Sherman virus Germiston virus Guaroa virus Iaco virus Ilesha virus Lokern virus Maguari virus Mooke virus Ngari virus Northway virus Playas virus Potosi virus Shokwe virus Tensaw virus Tlacotalpan virus Xingu virus		
California Encephalitis virus	California encephalitis serogroup virus LEIV California encephalitis virus - BFS-283 Chatanga virus Inkoo virus Jamestown Canyon virus Jamestown Canyon-like virus Jerry Slough virus Keystone virus La Crosse virus Lumbo virus Melao virus Morro Bay virus San Angelo virus Serra do Navio virus Snowshoe hare virus South River virus Tahyna virus Triplittatus virus		

[illegible]

Rift Valley fever virus	seqid107 KTVSSELSCREGQSYWT **oo**oo*o**o*o** seqid108 GSFSPKCLSSRRC *****oooooo seqid109 ENKCFEQGGWGCFCFNVNPSCLFVHT **o*o**o*oo*oo**ooo**o*o**o seqid110 WGSVLSLDAEGISGSNSFSF **ooo*o**o*o*o*o*oo** seqid111 RQGFLEIRCNSE *o*****o**oo* seqid112 AHESCLRAPNLVSYKPMIDQLEC *oo**oo**oooo*o*oo*ooo* seqid113 DPFVFERGSLPQTR ***oo*oo*o***o* seqid114 QAFSKGSVQADLTLMFD ***oo*ooo*oooooooo* seqid115 CDA AFLNLTGCYSCNAG *o*o*o*oo*****oo* seqid116 CQILHFTVPEVEEEFMYS *ooo*ooo*oooooooo*o* seqid117 STV\NPKGSWN *o*o*oooooooo seqid118 FFDWFSGLMSWFGGPLK *o***oo*o**oooooooo	
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[illegible]

[illegible]

[illegible]

Influenza B virus	Influenza B virus	All strains	seqid126 GFFGAIAGFLEGGWEG seqid199 ISSQIELAVLLSNEGIIN seqid200 QIELAVLLSNEGIINSED	
			seqid125 GLFGAIAGFIEGGWPG seqid197 WSYNAKLLVLIENDRRTLID seqid198 NAKLLVLIENDRRTLIDLHD	
			seqid125 GLFGAIAGFIEGGWPG seqid189 WAYNAELLVLENNQKTLD seqid190 NAELLVLENNQKTLDLHD	
			seqid125 GLFGAIAGFIEGGWPG seqid195 WSYNAKLLVLENNDKTLD seqid196 NAKLLVLENNDKTLDLMD	
			seqid122 GLFGAIAGFIENGWQG seqid182 WSYNAELLVALENNQHTID seqid184 NAELLVALENNQHTIDVTD	seqid4 GLFGAIAGFIENGWEG
			seqid187 WSYNAELLVAMENQHTID seqid188 NAELLVAMENQHTIDLAD	
			seqid125 GLFGAIAGFIEGGWPG seqid197 WSYNAKLLVLIENDRRTLID seqid198 NAKLLVLIENDRRTLIDLHD	
INFA H11	QAEILLVAMENQHTIDMAD seqid125 GLFGAIAGFIEGGWPG seqid193 WSYNAQLLVLENEKTLTD seqid194 NAQLLVLENEKTLIDLHD			
INFA H12	seqid125 GLFGAIAGFIEGGWPG seqid189 WAYNAELLVLENNQKTLD seqid190 NAELLVLENNQKTLDLHD			
INFA H13	seqid125 GLFGAIAGFIEGGWPG seqid195 WSYNAKLLVLENNDKTLD seqid196 NAKLLVLENNDKTLDLMD			
INFA H14	seqid122 GLFGAIAGFIENGWQG seqid182 WSYNAELLVALENNQHTID seqid184 NAELLVALENNQHTIDVTD			
INFA H15	seqid187 WSYNAELLVAMENQHTID seqid188 NAELLVAMENQHTIDLAD	seqid4 GLFGAIAGFIENGWEG		
INFA H16	seqid125 GLFGAIAGFIEGGWPG seqid197 WSYNAKLLVLIENDRRTLID seqid198 NAKLLVLIENDRRTLIDLHD			

	Influenza C virus		Avian paramyxovirus 2 Yucaipa virus Avian paramyxovirus 3 Avian paramyxovirus 3b Avian paramyxovirus 4 Avian paramyxovirus 5 Avian paramyxovirus 6 Avian paramyxovirus 7 Avian paramyxovirus 8 Avian paramyxovirus 9 Newcastle disease virus Pigeon paramyxovirus 1 unclassified Avulavirus Avian paramyxovirus 10_Avian paramyxovirus duck/Miyagi/885/05 Avian paramyxovirus penguin/Falkland Islands/324/2007 Goosramyxovirus HZ Goose paramyxovirus JS/1/97/Go Goose paramyxovirus SF02	seqid 27 GAIALGVATAAAVVTAG oooo*o*oo*o*oo**			(F2/F1)
	Influenza A virus		Hendra virus Horse/Australia/Hendra/1994 Nipah virus unclassified Henipavirus Bat paramyxovirus Eid.hel/GH45/2008				F0

	Morbillivirus	Canine distemper virus Cetacean morbillivirus_Dolphin morbillivirus_Pilot whale morbillivirus Porpoise morbillivirus Measles virus Peste-des-petits-ruminants virus Phocine distemper virus Phocine distemper virus 1 Phocine distemper virus-2 Rinderpest virus			
	Respirovirus	Bovine parainfluenza virus 3 Porcine paramyxovirus strain Frost Porcine paramyxovirus strain Texas Human parainfluenza virus 1 Human parainfluenza virus 3 Simian Agent 10 Sendai virus unclassified Respirovirus Atlantic salmon respirovirus Guinea pig parainfluenza virus TS-9 Pacific salmon paramyxovirus Trask River 1983 Swine parainfluenza virus 3 Tursiops truncatus parainfluenza virus 1			

	Rubulavirus	Human parainfluenza virus 2 Human parainfluenza virus 2 (strain Greer) Human parainfluenza virus 2 (strain Toshiba) Human parainfluenza virus 4 Human parainfluenza virus 4a Human parainfluenza virus 4b Mapuera virus Mumps virus Parainfluenza virus 5 Porcine rubulavirus Simian virus 41 unclassified Rubulavirus Porcine parainfluenza virus Tuhoko virus 1 Tuhoko virus 2 Tuhoko virus 3		
	unclassified Paramyxovirinae	Atlantic salmon paramyxovirus Beilong virus Canine parainfluenza virus Chimeric human parainfluenza virus rPIV3-2 Fer-de-lance virus J-virus Menangle virus Mossmann virus Murayama virus Ovine parainfluenza virus 3 Pacific salmon paramyxovirus Paramyxovirus GonoGER85 Recombinant PIV3/PIV1 virus Reptilian paramyxovirus Salem virus Salmo salar paramyxovirus Snake ATCC-VR-1408 paramyxovirus Snake ATCC-VR-1409 paramyxovirus Tioman virus Tupaia paramyxovirus		

Pneumovirus	Human respiratory syncytial virus	Human respiratory syncytial virus A Human respiratory syncytial virus (strain RSB1734) Human respiratory syncytial virus (strain RSB5857) Human respiratory syncytial virus (strain RSB6190) Human respiratory syncytial virus (strain RSB6256) Human respiratory syncytial virus (strain RSB642) Human respiratory syncytial virus (strain RSB6614) Human respiratory syncytial virus A strain Long LinkOut Human respiratory syncytial virus A2 Human respiratory syncytial virus B Human respiratory syncytial virus (subgroup B / strain 18537) Human respiratory syncytial virus (subgroup B / strain 8/60) Human Respiratory syncytial virus 9320 Human respiratory syncytial virus B1 Human respiratory syncytial virus S2 Human respiratory syncytial virus strain R55-2 unclassified Human respiratory syncytial virus	seqid128 FLGLILGLGAAVTAGVA ***oo**o*o*ooo*o* seqid129 TNEAVVSLTNGMSVL **o*****o*o*** seqid130 VIRFQQLNKRLLLE **o***o*o**** seqid131 REFSSNAGLT ****o***o* seqid132 MLTDRELTISVGGM ***oo**o*oooo* seqid133 YVIQLPLFGVMDTDCW *oo***oo**o*o** seqid134 CLARADNGWYCHNAGLSYFP **ooo*o**o*o*****o*o** seqid135 DTLKSILTVPVTSREC **oo***o*oooo** seqid136 YDKISTSKIYVSTAVLTMTG *o*o*o***ooo*oo*o*o*o* seqid137 VSCYGHNSCTVIN ****ooo**oo* Seqid75 GIIRTLPDGCHYISNKGVDVQVGNVTYYLSK EVGK ***o*ooo**o*o*o*o*o*o*o*o*o* oo** seqid139 PLSFPDDKFDVAIRDVEHSINQTRTFLKASDQ LL **o**o*o*ooo*oo*ooo***ooo*ooo**o ** seqid140 KIMTSKTDISSSVITSIGAIVSCYG o*o***ooo*oo*o*oo*oo*o****		
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Coronaviridae	Metapneumovirus	Bovine respiratory syncytial virus	All strains	seqid128 FLGLILGLGAAGTAGVA ***oo**o*o*ooo*o*				(S1/S2) S
		Avian metapneumo-virus	All strains	seqid134 CLARADNGWYCHNAGSLSYFP **ooo*o**o*o*****o*o**				
		Human metapneumo-virus	All strains	seqid133 YVIQLPLFGVMDTDCW *oo***oo**o*o*o**				
Coronavirinae	Alphacorona-virus	Alphacoronavirus 1 Coronavirus group 1b Human coronavirus 229E Human coronavirus NL63 Miniopterus bat coronavirus 1 Miniopterus bat coronavirus HKU8 Porcine epidemic diarrhea virus Rhinolophus bat coronavirus HKU2 Scotophilus bat coronavirus 512 unclassified Alphacoronavirus		seqid141 RSAIEDLLFDKVKLSDVG **oo*****oo**ooo*o*				
				seqid142 VPFYNVQYRINGLGV o**oooo**o**o***				
				seqid143 VLSQNKLIANAFNNALHAIQ **oo***o*ooo*oo*ooo**				
				seqid144 TNSALVKIQAVVNANA *oo***o*o*o***oo*				
				seqid145 AEAQIDRLINGRLTALNAYVSQQL *oo*****o*ooo*oo*oo***				
				seqid146 SAAQAMEKVCVKSSSRINFCGNGNHILS o*oo*oo*oo*ooo*oo*oo*oo*oo*				
				seqid147 APYGLYFIHFENYVP **o*oo*o*oo*o*				
				seqid148 LQEAIKVLNHSYINLKDIGTYEYVYKWPWYVW oo*oo*o**o*ooo*ooo*oo*o*o*****o*				
				seqid209 EVFAQVKQMYKTPPTLKYFGGFNFSQIL				
				seqid210				
Coronavirinae	Gammacorona-virus	Avian coronavirus Beluga Whale coronavirus SW1						

		unclassified coronaviruses	Alpacacoronavirus CA08-1/2008 Bat coronavirus Bird droppings coronavirus Bovine respiratory coronavirus Chicken enteric coronavirus Coronavirus Anas Coronavirus oystercatcher/p17/2006/GBR Coronavirus red knot/p60/2006/GBR Ferret enteric coronavirus 1202 Ferret systemic coronavirus MSU-S Ferret systemic coronavirus WADL Guangxi coronavirusidae Human coronavirus NO Human enteric coronavirus strain 4408 Kenya bat coronavirus Mink coronavirus strain WD1133 Parrot coronavirus AV71/99 Quail coronavirus Italy/Elvia/2005 Tai Forest coronavirus unidentified coronavirus unidentified human coronavirus	EVFAQVKQMYKTPAIKDFGGFNFSQIL Segid211 SFIEDLLFNKVTLADAGF Segid212 SAIEDLLFNKVRLSDVGF Segid213 SILEDLLFNKVKLSDVGF Segid214 SAIEDLLFSKVKLADVGF Segid215 SAIEDLLFDKVKLSDVGF		
Arena-viridae	Arena-virus	LCMV-Lassa virus (Old World) complex	Ippy virus Lassa virus Lujo virus Lymphocytic choriomeningitis virus Mobala virus Mopeia virus	seqid149 NALINDQLIMKNHLRDIMGIPYC *O**O***O*O***O**O*** seqid150 FTWTLSDSSEKDTPPGYCLT OO*OOO*OO*OO***O*** seqid151 KCFCGNTAIAKCNQKHDEEFCMDMLRLFDFN ***O*OOO****OO*OO***OOO*OOO* seqid152 MLQKEYMERQGKTPLGLVDLEVS *OOO*OO***OO***OO***OO***O	Gpc (gpl/gp2)	

Hepadnaviridae	Tacaribe virus (New World) complex	Amapari virus Chapare virus Flexal virus Guanarito virus Junin virus Latino virus Machupo virus Oliveros virus Paraná virus Pichinde virus Pirital virus Sabiá virus Tacaribe virus Tamiami virus Whitewater Arroyo virus	seqid150 FTWTLSDSEKDTPGGYCLT oo*ooo*oo*ooo**o**o seqid151 KCFGNTAIACNQKHDEEFCMDLRLFDEN ***o*ooo***oo*oo***oo*ooo* seqid152 MLQKEYMERQKTPGLGLVDFVFS *ooo*oo**oo**oo*o*oooo*o		
	Hepatitis B virus	HBV genotype A HBV genotype B HBV genotype C HBV genotype D HBV genotype E HBV genotype F HBV genotype G HBV genotype H Hepatitis B virus alpha1	seqid153 FNPLGFFPSHQLDPLF o***o*o*o*o*o*o*o* seqid154 ADWDKNPNKDPWP o*o*o*oo*oooo seqid155 MESITSGFLGPLLVLQAVFF oooooooo*ooooo**oooo seqid156 LLTRLTIQSLDSWWTSLNFLGGA oooooooo*oooo*oooo**o*o*oo seqid157 CPPTCPGYRWMC oo*o****o*o seqid158 LFIILLCLIFLLVLLDYQ *oo*ooo*oo*oo*oooo		L and M and S Where S mediates fusion
Genus Orthohepadnavirus	Hepatitis B virus LSH/chimpanzee Hepatitis B virus strain cpz Hepatitis B virus subtype adr Hepatitis B virus subtype adw Hepatitis B virus subtype adyw Hepatitis B virus subtype ayw				

Aravan virus					
Australian bat lyssavirus					
Duvenhage virus					
European bat lyssavirus 1					
European bat lyssavirus 2					
Irkut virus					
Khujand virus					
Lagos bat virus					
Mokola virus					
West Caucasian bat virus					
Lyssavirus					
Rabies virus	Rabies virus AB21 Rabies virus AB22 Rabies virus AVO1 Rabies virus BNG4 Rabies virus BNG5 Rabies virus China/DRV Rabies virus China/MRV Rabies virus CVS-11 Rabies virus ERA Rabies virus Eth2003 Rabies virus HEP-FLURY Rabies virus India Rabies virus Nishigahara RCEH Rabies virus Ontario fox Rabies virus Ontario skunk Rabies virus PM Rabies virus red fox/08RS-1981/Udine/2008 Rabies virus SAD B19 Rabies virus silver-haired bat-associated SHBRV Rabies virus strain Pasteur vaccin Rabies virus strain Street Rabies virus vnukovo-32 Thailand genotype 1 dog lyssavirus	seqid5 GFTCTGVVTEAETYNFVGYYT *o****o**o*oo*oooo** seqid6 SLHNPPDPYRWLRVTVKTT *oooooooooooo**o* Seqid138 ESLVIISPSVADLDPYDRSLHS *oooo**oooo*o**ooo Seqid91 CKLKLCGVGLRLMDGT *oooo**oooo*ooo* Seqid206 ILGPDGNVLIPEMQSS o**o*ooo*****o seqid82 QHMELESSEVPLVHPL *ooo**o*ooo**ooo**			

	unclassified Lyssavirus	Bokeloh bat lyssavirus European bat lyssavirus Lyssavirus Ozernoe Shimoni bat virus							
Novirhabdovirus	Hirame rhabdovirus Infectious hematopoietic necrosis virus Snakehead rhabdovirus Viral hemorrhagic septicemia virus								
	Bangoran virus Bimbo virus Bivens Arm virus Flanders virus Garba virus Klamath virus Malpais Spring virus Nasoule virus Ngaingan virus Ouango virus Sigma virus Tupaia virus Wongabel virus								
unassigned Rhabdoviridae									
Filoviridae		Lloviu virus (LLOV) Bundibugyo virus (BDBV; previously BEBOV) Reston virus (RESTV; previously REBOV) Sudan virus (SUDV; previously SEBOV) Tai Forest virus (TAFV; previously CIEBOV) Ebola virus (EBOV; previously ZEBOV) Marburg virus (MARV) Ravn virus (RAVV)	Seqid216 GAAIGLAWIPYFGPAAE oo*o*oo***o***ooo seqid217 GAAVGLAWIPYFGPAAE Seqid218 GAAAGLAWIPYFGPAAE Seqid219 DLAAGLSWIPFFPGIE Seqid220 HNAAGIAWIPYFGPAE						

Lentiviridae	Hiv1	Seqid221 AVGLGALFLGLGAAGSTMGAAS oooo**ooo*o*oooooooo*o seqid222 LTLTGQARQLLS o***o*o*o*o seqid223 GIVQQSNLLQAEAAQ o*****o*o*o*o seqid224 GLGAMFLGLGAAGSTMGAASITLTVQARQLL S Seqid225 GIGAMFLGLLSAAGSTMGAASITLTVQTRQLL S Seqid226 GIGAMFLGLLSAAGSTMGAASITLTVQTRQLL S Seqid227 GIGAVFLGLGAAGSTMGAASITLTVQARQLL S Seqid228 GVGALFLGLLSAAGSTMGAASITLTVQARQLL S Seqid229 GIGAMILGLGAAGSTMGAASITLTVQARQLL S Seqid230 GLGAMFLGLGAAGSTMGAASITLTVQARQLL S Seqid231 GFGAMFLGLGAAGSTMGAASITLTVQARQLL S Seqid232 TLGAMFLGLGAAGSTMGAASMTLTVQARQLL S Seqid233 GLGAVFLGLGAAGSTMGAASITLTVQARQLL S Seqid234 TIGAMFLGLGAAGSTMGAASITLTVQARQLL S Seqid235 TIGAMFLGLGAAGSTMGAASMTLTVQARQLL S
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Seqid236	TLGAMFLGLGAAGSTMGAASMTLTVQARLLF	S
Seqid237	TLGAMFLGLGAAGSTMGAASLTLTVQARLLL	S
Seqid238	GVGAMFLGLGAAGSTMGAASLTLTVQARQLL	S
Seqid239	GLGAMFLGLGAAGSTMGAASITLTVQARLLL	S
Seqid240	TLGAVFLGLGAAGSTMGAASLTLTVQARLLL	S
Seqid241	GIGAVFLGLGAAGSTMGAASITLTVQARKLL	S
Seqid242	GIGALFLGLGAAGSTMGAASVTLTVQARQLL	S
Seqid243	GLGALFLGLGAAGSTMGAASVTLTVQARQLL	S
Seqid244	GIGAMFLGLGAAGSTMGAASITLTVQARLLL	S
Seqid245	GIGAMFLGLGAAGSTMGAASVTLTVQARLLL	S
Seqid246	AIGALFLGLGAAGSTMGAASVTLTVQARLLL	S
Seqid247	TLGAMFLGLGAAGSTMGAASLTLTVQARQLL	S
Seqid248	GIGALFLGLGAAGSTMGAASMTLTVQARQLL	S
Seqid249	GIGAMFLGLGAAGSTMGAASLTLTVQARQLL	S
Seqid250	GIGAVFLGLGAAGSTMGAASMTLTVQARLLL	S

Seqid251	GIGALFLGFLGAAGSTMGAASITLTVQARQLLS
Seqid252	GIGAVFLGILGAAGSTMGAASITLTVQARQLLS
Seqid253	GIGAVFLGFLGAAGSTMGAASVTLTVQARQLLF
Seqid254	GLGAMFFGFLGAAGSTMGAASVTLTVQARQLLS
Seqid255	GIGALFLGFLGAAGSTMGAASITLTVQARQLLS
Seqid256	GLGALFVGFLGAAGSTMGAASITLTVQARQLLS
Seqid257	GIGALFLGFLGTAGSTMGAASVTLTVQARQLLS
Seqid258	GIGAMIFGFLGAAGSTMGAASITLTVQARQLLS
Seqid259	GLGAVLLGFLGTAGSTMGAASLTLTVQVRQLLS
Seqid260	GIGAVLFGFLGAAGSTMGAASITLTVQVRQLLS
Seqid261	GLGALFLGFLGAAGSTMGAASITLTVQARQLLS
Seqid262	o**ooo*o*oo*****o**oo**oo*o*o*o
Seqid263	GTLGAMFLGFLGAAGSTMGAASMTLTVQARQLL
Seqid264	GTIGAMFLGFLGAAGSTMGAASITLTVQARQLL

				Seqid264 GTIGAMFLGFLGAAGSTMGAASMTLTVQARLL L Seqid265 IGALFLGFLGAAGSTMGAASVTLTVQARLLS G			
				Seqid266 AVGMVIFLLVLAIMAMTASVTAA *****o*oo** Seqid267 FGISAIVAIVAATAIAASA **o*ooo*****o*o Seqid268 TLALVTATTAGLIGTTTGTSA Seqid269 HVMLALATVLSMAGAGTGATA Seqid270 GIGLVIMLVMTMAIVAAAGAS *o***oo*oo***o*o***o Seqid271 GVMVLGFLGFLAMAGSAMGA ooo**o**oooo*ooooo Seqid272 GVFVLGFLGFLATAGSAMGA oooo**oo*o*oo**ooooo Seqid273 GAIVLGLLGLGLAGSAMG *ooooooo*o*ooo**ooo Seqid274 GIGLVIVLAIMAIIAAAGAGLVANAVQ			
				Bovine lentivirus group Equine lentivirus group Feline lentivirus group Ovine/caprine lentivirus group Human immunodeficiency virus 2 Simian immunodeficiency virus Simian immunodeficiency virus others Ovine lentivirus			

	Arteriviridae	Porcine Reproduction Respiratory Syndrome (PRRS)	PRRS Type I	seqid275 SPKLGSRSLIPHSFCFWLFLLC seqid276 GNGNSSTYQYIYNLTIC seqid277 GTAWLSTHFSWAVETFVLYHILSL seqid278 GFLTTSHFDTLGLGAVSITGFC seqid279 RYAHTRTFTNFIVDDRGRIRW seqid280 SNNSSHIQLIYNLTIC seqid281 GTDWLAQKFDWAVETFVIFVLTH seqid282 GALTTSHFDTVGLATVSTAGY seqid283 IYAVCALAALICFVIRLAKNC seqid284 VSTAGYHGRYVLSIYAVCALAALICFVIRL			
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All cited references are incorporated by reference.

The accompanying Figures and Examples are provided to explain rather than limit the present invention. It will be clear to the person skilled in the art that aspects, embodiments and claims of the present invention may be combined.

Figures

INF ISD peptide is identical to INF-F#2 and are dimeric form of the peptide with the sequence [Seq id 287] GLFGAIAGFIENGWEGCGGEKEKEK

Fig. 1 shows the effect of the INF ISD peptide on TNF-alpha mRNA levels.

Fig. 2 shows the effect of peptide incubation on secreted TNF-alpha levels in the supernatant of THP-1 cells.

Figure 3 shows the effect of the INF ISD peptide on IL-1 beta mRNA levels in THP-1 cells.

Figure 4 shows the effect of the INF ISD peptide on IL-6 mRNA levels in THP-1 cells.

Figure 5 shows the effect of the INF ISD peptide on IL-8 mRNA levels in THP-1 cells.

Figure 6 shows the effect of the INF ISD peptide on IL-10 mRNA levels in THP-1 cells.

Figure 7 shows the effect of the INF ISD peptide on NF-kappa B mRNA levels in THP-1 cells.

Figure 8 shows the effect of the INF ISD peptide on the house holding gene RPL13a mRNA levels in THP-1 cells.

Figure 9 shows that in the presence of INF F#2, cells treated with LPS release significantly lower amounts of cytokines.

BMDCs were treated with LPS for 16 hours. Cell supernatants were then collected and analyzed for type I IFN using bioassay. Before LPS treatment cells were either pretreated with INF F#2, with the deletion mutant DI6 or not pretreated with any peptide.

Figure 10 shows inflammation-related enzyme and transcription factor gene expression kinetics of THP-1 monocytes stimulated with 1µg/ml LPS. Gene expression was expressed as relative gene expression towards RPL13a-expression and non-stimulated cells at time zero (Δ Ct). Data shown are means + standard deviation from two independent biological replications.

Figure 11 shows effects of INF ISD peptide on expression of NF-kappaB mRNA in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30µM, 60µM INF ISD peptide or 30µM, 60µM control peptide, and stimulated with 1µg/ml LPS. Data shown are the medians ± standard deviation from two independent biological replications.

Figure 12 shows effects of INF ISD peptide on expression of SP-1 mRNA in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM, 60μM INF ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the medians ± standard deviation from two independent biological replications.

- 5 Figure 13 shows effects of INF ISD peptide on protein secretion of IL-8 in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM or 60μM INF ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the median ± standard deviation from three independent experiments performed in duplicates.

- 10 Figure 14 shows effects of INF ISD peptide on protein secretion of IL-10 in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM or 60μM INF ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the median ± standard deviation from three independent experiments performed in duplicates.

- 15 Figure 15 shows effect of different stimulus on the secretion of IFN-gamma in PBMCs. PBMCs were incubated either with 1μg/ml or 50ng/ml PMA and 1μg/ml ionomycin or 10ng/ml SEB for indicated time periods. Data shown are the medians ± standard deviation from three independent technical replicates.

- 20 Figure 16 shows expression kinetics of IFN gamma expression in response to PMA/ionomycin treatment. Gene expression was expressed as relative gene expression towards RPL13a expression and non-stimulated cells at time zero (Δ Act). Data shown are the medians ± standard deviation from three independent technical replicates.

- 25 Figure 17 shows effect of INF ISD on secretion of protein of IFN-gamma in PMA/ionomycin stimulated PBMCs. PBMCs were incubated with either medium alone, 30μM or 60μM Flu ISU or 30μM or 60μM control peptide, and stimulated with 50ng/ml PMA and 1μg/ml ionomycin. Data shown are the medians ± standard deviation from three independent experiments performed in duplicates.

- 30 Figure 18 shows effects of SARS ([Seq id 285] AEVQIDRLITGRLQSLQTYVCGGEKEKEK) or Filo ISD ([Seq id 286] GAAIGLAWIPYFGPAAECGGEKEKEK) on expression of TNF-alpha mRNA in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM, 60μM SARS or Filo ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the medians ± standard deviation from two independent biological replications.

Figure 19 shows effects of SARS or Filo ISD on expression of IL-1βmRNA in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM, 60μM SARS or Filo ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the medians ± standard deviation from two independent biological replications.

- 35 Figure 20 shows effects of SARS or Filo ISD on expression of IL-1βmRNA in LPS-stimulated THP-1 cells. THP-1 cells were incubated with either medium alone, 30μM, 60μM SARS or Filo ISD peptide or 30μM, 60μM control peptide, and stimulated with 1μg/ml LPS. Data shown are the medians ± standard deviation from two independent biological replications.

Figure 21 shows interactions between INF ISD peptide (pFlu) and STING depends on distinct STING domains. To investigate further the interaction between STING and INF ISD peptide (pFlu) the C-terminal domain of STING was expressed with a HA-tag in HEK293 cells. STING was either in a wt form or with deletions. Lysates from transfected cells were used for pulldown using biotinylated

5 INF ISD peptide (pFlu) and streptavidin coated beads. The bead eluate was then immunoblotted using antibodies against HA-tag. As seen in the figure wt STING and the deletion mutant DN5 (162-N) was readily pulled down using INF ISD peptide (pFlu) whereas the deletion mutants DN6 (172-N) was not. These data indicate that amino acids 162-172 are necessary for interactions between pFlu and STING.

Examples

Example 1: ELISA

TNF- α ELISA assay

The supernatant from THP-1 cells treated with peptides was assayed on human TNF- α ELISA MaxTM Deluxe Set (Biolegend, #430205). ELISA assay was performed according to the manufacturer's protocol, as follows. Each incubation step was followed by sealing and shaking on the rotating table at 150-200 rpm, except the overnight incubation with the Capture Antibody, where plates were not shaken. One day prior running ELISA the 96-well assay plates were covered with the Capture Antibody, diluted 1:200 in 1x Coating Buffer (5x Coating Buffer diluted in ddH₂O). 100 μ L of this Capture Antibody solution was added into all wells, sealed and incubated overnight (16-18 hrs) at 4°C. The next day all reagents from the set were brought to the room temperature (RT) before use. The plate was washed 4 times with minimum 300 μ L Wash Buffer (1x PBS, 0,05% Tween 20) per well. The residual buffer in the following washing was removed by blotting the plates against the absorbent paper. Next 200 μ L of the 1x Assay Diluent A (5x Assay Diluent A diluted in PBS pH = 7.4) was added for 1 h to block non-specific binding. While the plate was being blocked, all samples and standards (mandatory for each plate) were prepared. Standards and samples were run in triplicates. 1 mL of the top standard 250 pg/mL was prepared in 1x Assay Diluent A (1x AD) from the TNF α stock solution (55 ng/ mL). The six two-fold serial dilutions of the 250 pg/mL top standard were performed, with the human TNF α standard concentration: 250 pg/mL, 125 pg/mL, 62.5 pg/mL, 31.2 pg/mL, 15.6 pg/mL, 7.8 pg/mL and 3.9 pg/mL, respectively. 1x AD serves as the zero standard (0 pg/mL). After blocking the plate, washing was performed and 100 μ L standards and samples were assayed in triplicates and incubated for 2 h in RT. Samples were not diluted, the whole supernatant from the THP-1 cells was assayed. After washing, 100 μ L of the Detection Antibody was applied to each well, diluted 1:200 in 1x AD, and incubated for 1 hour. Plate was washed and followed by 30 minutes incubation with 100 μ L of Avidin-HRP solution per well, diluted 1:1000 in 1x AD. The final washing was performed 5 times with at least 30 seconds interval between the washings, to decrease the background. Next 100 μ L of the freshly mixed TMB Substrate Solution (10 mL per plate, 5 mL of each from 2 substrates provided in the set) was applied and left in the dark for 15 min. It needs to be observed to prevent signal saturation, positive wells turned blue. After incubation in the dark the reaction was stopped with

100 μ L of 2N H₂SO₄ per well. Positive wells turned yellow. Absorbance was read at 450 nm and 570 nm (background) within 30 minutes. The data were analyzed in the Microsoft Excel 2010 program.

5 Example 2: Effect of peptides on cytokine and transcription factor mRNA level measurements by QPCT

Cell culture

THP-1 cells were cultured in RPMI medium supplemented with 10% fetal bovine serum 2 mM glutamine, 100 U/ml penicillin, 100 μ g/ml streptomycin and used before passage 10.
10 Cells were cultured in a humidified atmosphere in 95% air, 5% CO₂ at 37°C.

RNA isolation

RNAs from THP-1 cells were isolated using RNeasy[®] Plus Mini Kit (Qiagen, DK) according to the manufacturer's protocol. Quality and integrity of isolated RNA samples was controlled by determining A₂₆₀/A₂₈₀, A₂₆₀/A₂₃₀ absorbance ratios and 28S/18S rRNA ratios
15 followed by rigorous DNase I (Ambion[®] TURBO DNA-free™) treatments.

Quantitative real-time RT-PCR

500ng total RNA was used for cDNA synthesis using iScript™ cDNA synthesis kit (Bio-Rad, CA USA) according to the instructions of the manufacturers. Real-time Q-PCR analysis was performed using a LightCycler 480 cycler (Roche Diagnostics, DK). 2 μ L of cDNA (from a
20 total 20 μ L reaction volume) was used in a 20 μ L reaction. The real-time Q-PCR reactions contained 10 μ L SybrGreen 2x Master Mix (Roche Diagnostics, DK), 2 μ L forward primer (5pmol/ μ L), 2 μ L reverse primer (5pmol/ μ L) and 4 μ L water. After initial denaturation at 95°C for 10 minutes, PCR amplifications were performed for 45 cycles. The primer sequences used in this study are shown in Table 1. The crossing point (CP) for each transcript was
25 measured and defined at constant fluorescence level in Light Cycler 480 software. The mRNA levels for the test gene were normalized to the *RPL13a* or *RPL37A* value and relative quantification was determined using the Δ Ct model presented by PE Applied Biosystems (Perkins Elmer, Foster City, CA USA). For quantitative real-time RT-PCR analysis, standard deviations were calculated and a T-test was employed to compare
30 expression levels. *P*-values ≤ 0.05 were considered statistically significant.

Target gene/primer name	Primer sequence 5'-3'
IL-2 β forward	GTGGCAATGAGGATGACTTGTTTC
IL-2 β reverse	TAGTGGTGGTCGGAGATTCGTA
IL-6 forward	AGCCACTCACCTCTTCAGAAC

IL-6 reverse	GCCTCTTTGCTGCTTTCACAC
IL-10 forward	GTGATGCCCCAAGCTGAGA
IL-10 reverse	CACGGCCTTGCTCTTGT
TNF-alpha forward	CTGCTGCACTTTGGAGTGAT
TNF-alpha reverse	AGATGATCTGACTGCCTGGG
NF-κB forward	TGAGTCCTGCTCCTTCCA
NF-κB reverse	GCTTCGGTGTAGCCCATT
RPL13a forward	CATCGTGGCTAAACAGGTACTG
RPL13a reverse	GCACGACCTTGAGGGCAGCA
RPL37A forward	ATTGAAATCAGCCAGCACGC
RPL37A reverse	AGGAACCACAGTGCCAGATCC

Treatment of cells/induction of cytokines

Pro-and anti-inflammatory cytokine gene expression was analyzed in un-differentiated THP-1 cells, designed as THP-1 monocytes. LPS is widely used as a potent and prototypical inducer of cytokine production in innate immunity which begins with the orchestration of monocytes. Pathogen associated molecular patterns (PAMPs), like lipopolysaccharide (LPS), play a pivotal role in initiation of variety of host responses caused by infection with Gram-negative bacteria. Such action leads to systemic inflammatory response, for instance up-regulation of pro-and anti- inflammatory cytokines, resulting in secretion of cytokine proteins into the blood stream.

THP-1 cells (1.0×10^6) were cultured in a 24-well tissue culture plate (Corning). Cells were cultured with stimulant LPS at $1\mu\text{g}/\text{ml}$ with or without indicated peptides (at the indicated concentrations) for 4h. LPS and peptides concentrations were chosen according to our preliminary optimization studies. RPMI 1640 medium containing 10% fetal bovine serum, 2 mM glutamine, 100 U/ml penicillin, 100 $\mu\text{g}/\text{ml}$ streptomycin was used as a control. To investigate gene expression and cytokine secretion cells were harvested at 4h time point, while cell-free culture supernatants were collected and stored at -80°C . The time point of 4h has been chosen based on the previously published gene expression and cytokine secretion kinetics of THP-1 monocytes stimulated with LPS¹. The experiments were performed by two independent biological replications, started from a new batch of cells.

1. Wasaporn Chanput, Jurriaan Mes, Robert A.M. Vreeburg, Huub F.J. Savelkoul and Harry J. Wichers. Transcriptional profiles of LPS-stimulated THP-1 monocytes and macrophages: a tool to study inflammation modulating effects of food-derived compounds. *Food Funct.*, 2010, 1, 254-261.

Example 3

Inflammatory shock as a consequence of LPS release remains a serious clinical concern. In humans, inflammatory responses to LPS result in the release of cytokines and other cell mediators from monocytes and macrophages, which can cause fever, shock, organ failure and death. Here we present data that show that pretreatment of cells with INF F#2 results in a decrease in the release of cytokines including pro-inflammatory cytokines such as TNFalpha and IL-6. Therefore, treatment of patients, in the risk of developing sepsis, with INF F#2 could act beneficially to decrease production of proinflammatory cytokines and hereby lessen the risk of developing shock, organ failure and death. See figure 8.

References

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Claims

1. An immune suppressive domain for use as a medicament.
- 5 2. The immune suppressive domain according to any of the preceding claims, wherein said domain is from a virus.
3. The immune suppressive domain according to any of the preceding claims, wherein said domain is derived from an enveloped RNA virus.
- 10 4. The immune suppressive domain according to any of the preceding claims, wherein said domain is located in a fusion protein.
- 15 5. The immune suppressive domain according to any of the preceding claims, wherein said domain is selected among the sequences 1 to 287 and the sequences of Table 1, preferably seq. id. 287.
- 20 6. The immune suppressive domain according to any of the preceding claims, wherein said domain is located in the hydrophobic alpha helix N-terminal of the transmembrane domain in the fusion protein of a virus, preferably excluding HIV, Ebola og retrovirus.
7. The immune suppressive domain according to any of the preceding claims, wherein said domain is located in enveloped RNA viruses with type I fusion mechanism.
- 25 8. The immune suppressive domain according to any of the preceding claims, wherein said domain is from enveloped RNA viruses with type II fusion mechanism or other non-type I fusion mechanism.
- 30 9. The immune suppressive domain according to any of the preceding claims, wherein said domain is the fusion peptide of an envelope protein.

10. The immune suppressive domain according to any of the preceding claims, wherein said domain is the fusion peptide of a virus.

11. The immune suppressive domain according to any of the preceding claims, wherein said domain is the fusion peptide of an enveloped RNA virus.

12. The immune suppressive domain according to any of the preceding claims, wherein said domain is from an influenza virus.

13. The immune suppressive domain according to any of the preceding claims, subject to the proviso, that:

said immune suppressive domain is different from immunosuppressive domains obeying the conditions of:

- i) being from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus;
- ii) being located in the linker between the two heptad repeat structures just N-terminal of the transmembrane domain in the fusion protein; and
- iii) including at least some of the first 22 amino acids located N-terminal to the first cysteine residue of the two well conserved cystein residues, located between 4 and 6 amino acid residues from one another and further located just N-terminal of the transmembrane spanning domain of the fusion protein.

14. The immune suppressive domain according to any of the preceding claims, subject to the proviso, that:

said immune suppressive domain is different from immunosuppressive domains obeying the conditions of:

- i) being from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus; and
- ii) being located in the linker between the two heptad repeat structures just N-terminal of the transmembrane domain in the fusion protein.

15. The immune suppressive domain according to any of the preceding claims, wherein said immune suppressive domain is different from immunosuppressive domains from a virus selected among the group consisting of gammaretrovirus, HIV and filovirus.

16. The immune suppressive domain according to any of the preceding claims, wherein the domain is obtainable from the sequences of Table 1 or the sequences seqid 1 to seqid 287, by at least one mutation, deletion or insertion.

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17. The immune suppressive domain according to claim 16, wherein the total number of mutations, deletions or insertions is selected among 1, 2, 3 and 4.

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18. The immune suppressive domain according to claim 16, wherein the total number of mutations, deletions or insertions is more than 4.

19. The immune suppressive domain according to any of the preceding claims, whereby the obtained immune suppressive domain have abrogated immunosuppressive properties for use in a vaccine against Porcine Reproductive and Respiratory Syndrom (PRRS).

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20. The immune suppressive domain according to any of the preceding claims for use in surgery, prophylaxis, therapy, or a diagnostic method.

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21. The immune suppressive domain according to any of the preceding claims, wherein the domain is selected among the group consisting of seqid 4 and seqid 119 to seqid 126.

22. The immune suppressive domain according to any of the preceding claims, wherein the domain is homologous to seqid 4.

25

23. The immune suppressive domain according to any of the preceding claims, which is a peptide, such as a synthetic and/or monomeric peptide.

24. The immune suppressive domain according to any of the preceding claims, cross-linked to at least one additional immunosuppressive peptide.

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25. The immune suppressive domain according to any of the preceding claims, connected to at least one additional immunosuppressive peptide to form a dimer.
- 5 26. The immune suppressive domain according to claim 25, wherein said dimer is homologous and comprises at least two immunosuppressive peptides with SEQ ID NO. 4, which are cross-linked by a disulfide bond, N-terminal to N-terminal or C-terminal to C-terminal.
- 10 27. The immune suppressive domain according to claim 25, wherein said dimer is homologous and comprises at least two immunosuppressive peptides selected from SEQ ID NO. 119 to seqid 126, which are cross-linked by a disulfide bond, N-terminal to N-terminal or C-terminal to C-terminal.
- 15 28. The immune suppressive domain according to any of the preceding claims, connected to at least one additional immunosuppressive peptide to form a heterologous dimer.
29. The immune suppressive domain according to any of the preceding claims, connected to at least two additional immunosuppressive peptides to form a multimer.
- 20 30. The immune suppressive domain according to any of the preceding claims, wherein said immunosuppressive peptides comprises one or more modifications.
- 25 31. The immune suppressive domain according to claim 30, wherein said modifications are selected from the group consisting of chemical derivatizations, L-amino acid substitutions, D-amino acid substitutions, synthetic amino acid substitutions, deaminations and decarboxylations.
- 30 32. The immune suppressive domain according to any claims 30 or 31, wherein the peptides or proteins have increased resistance against proteolysis compared to peptides or proteins not comprising said at least one modification.

33. The immune suppressive domain or an immune suppressive peptide according to any of the preceding claims, for use in diagnostics and/or treatment and/or prevention and/or amelioration of disease.

5 34. The immune suppressive domain for a use according to any of the preceding claims, wherein the subject is a human or an animal.

35. The immune suppressive domain for a use according to any of the preceding claims, for use on an organ.

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36. The immune suppressive domain for a use according to any of the preceding claims, for immune suppression.

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37. The immune suppressive domain for a use according to any of the preceding claims, for the preparation or treatment of transplantation patients.

38. The immune suppressive domain for a use according to any of the preceding claims, comprising treatment and/or prevention and/or amelioration of an autoimmune or inflammatory disease.

20

39. The immune suppressive domain for a use according to any of the preceding claims, comprising prophylaxis or treatment of a condition selected among Acute disseminated encephalomyelitis (ADEM), Addison's disease, Agammaglobulinemia, Alopecia areata, Amyotrophic Lateral Sclerosis, Ankylosing Spondylitis, Antiphospholipid syndrome, Antisynthetase syndrome, Atopic allergy, Atopic dermatitis, Autoimmune aplastic anemia, Autoimmune cardiomyopathy, Autoimmune enteropathy, Autoimmune hemolytic anemia, Autoimmune hepatitis, Autoimmune inner ear disease, Autoimmune lymphoproliferative syndrome, Autoimmune peripheral neuropathy, Autoimmune pancreatitis, Autoimmune polyendocrine syndrome, Autoimmune progesterone dermatitis, Autoimmune thrombocytopenic purpura, Autoimmune urticaria, Autoimmune uveitis, Balo disease/Balo concentric sclerosis, Behçet's disease, Berger's disease, Bickerstaff's encephalitis, Blau syndrome, Bullous pemphigoid, Cancer, Castleman's disease, Celiac disease, Chagas disease, Chronic inflammatory demyelinating polyneuropathy, Chronic recurrent multifocal osteomyelitis, Chronic obstructive pulmonary disease, Churg-Strauss syndrome, Cicatricial pemphigoid, Cogan syndrome, Cold agglutinin disease, Complement

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component 2 deficiency, Contact dermatitis, Cranial arteritis, CREST syndrome, Crohn's disease, Cushing's Syndrome, Cutaneous leukocytoclastic angiitis, Dego's disease, Dercum's disease, Dermatitis herpetiformis, Dermatomyositis, Diabetes mellitus type 1, Diffuse cutaneous systemic sclerosis, Dressler's syndrome, Drug-induced lupus, Discoid lupus erythematosus, Eczema, Endometriosis, Enthesitis-related arthritis, Eosinophilic fasciitis, Eosinophilic gastroenteritis, Epidermolysis bullosa acquisita, Erythema nodosum, Erythroblastosis fetalis, Essential mixed cryoglobulinemia, Evan's syndrome, Fibrodysplasia ossificans progressiva, Fibrosing alveolitis, Gastritis, Gastrointestinal pemphigoid, Glomerulonephritis, Goodpasture's syndrome, Graves' disease, Guillain-Barré syndrome (GBS), Hashimoto's encephalopathy, Hashimoto's thyroiditis, Henoch-Schonlein purpura, Herpes gestationis, Hidradenitis suppurativa, Hughes-Stovin syndrome, Hypogammaglobulinemia, Idiopathic inflammatory demyelinating diseases, Idiopathic pulmonary fibrosis, Idiopathic thrombocytopenic purpura, IgA nephropathy, Inclusion body myositis, Chronic inflammatory demyelinating polyneuropathy, Interstitial cystitis, Juvenile idiopathic arthritis, Kawasaki's disease, Lambert-Eaton myasthenic syndrome, Leukocytoclastic vasculitis, Lichen planus, Lichen sclerosus, Linear IgA disease (LAD), Lou Gehrig's disease, Lupoid hepatitis, Lupus erythematosus, Majeed syndrome, Ménière's disease, Microscopic polyangiitis, Miller-Fisher syndrome, Mixed connective tissue disease, Morphea, Mucha-Habermann disease, Multiple sclerosis, Myasthenia gravis, Myositis, Narcolepsy, Neuromyelitis optica, Neuromyotonia, Occular cicatricial pemphigoid, Opsoclonus myoclonus syndrome, Ord's thyroiditis, Palindromic rheumatism, PANDAS (pediatric autoimmune neuropsychiatric disorders associated with streptococcus), Paraneoplastic cerebellar degeneration, Paroxysmal nocturnal hemoglobinuria (PNH), Parry Romberg syndrome, Parsonage-Turner syndrome, Pars planitis, Pemphigus vulgaris, Pernicious anaemia, Perivenous encephalomyelitis, POEMS syndrome, Polyarteritis nodosa, Polymyalgia rheumatica, Polymyositis, Primary biliary cirrhosis, Primary sclerosing cholangitis, Progressive inflammatory neuropathy, Psoriasis, Psoriatic arthritis, Pyoderma gangrenosum, Pure red cell aplasia, Rasmussen's encephalitis, Raynaud phenomenon, Relapsing polychondritis, Reiter's syndrome, Restless leg syndrome, Retroperitoneal fibrosis, Rheumatoid arthritis, Rheumatic fever, Sarcoidosis, Schizophrenia, Schmidt syndrome, Schnitzler syndrome, Scleritis, Scleroderma, Serum Sickness, Sjögren's syndrome, Spondyloarthropathy, Still's disease, Stiff person syndrome, Subacute bacterial endocarditis (SBE), Susac's syndrome, Sweet's syndrome, Sydenham chorea, Sympathetic ophthalmia, Systemic lupus erythematosus, Takayasu's arteritis, Temporal arteritis, Thrombocytopenia, Tolosa-Hunt syndrome, Transverse myelitis, Ulcerative colitis, Undifferentiated connective tissue disease, Undifferentiated spondyloarthropathy, Urticarial vasculitis, Vasculitis, Vitiligo, and Wegener's granulomatosis.

40. The immune suppressive domain for a use according to any of the preceding claims, for the treatment or prevention of acute or chronic inflammation

41. The immune suppressive domain for a use according to any of the preceding claims, for the treatment or prevention of a disorder associated with inflammation.

42. The immune suppressive domain for a use according to any of the preceding claims, for the treatment or prevention of a disorder selected among Acne vulgaris, Allergy, Allergic rhinitis, Asthma, Atherosclerosis, Autoimmune disease, Celiac disease, Chronic prostatitis, Glomerulonephritis, Hypersensitivities, Inflammatory bowel diseases, Pelvic inflammatory disease, Reperfusion injury, Rheumatoid arthritis, Sarcoidosis, Transplant rejection, Vasculitis, interstitial cystitis, Cancer, Depression, Myopathies, and Leukocyte defects.

43. The immune suppressive domain for a use according to any of the preceding claims, comprising prophylaxis or treatment of sepsis.

44. The immune suppressive domain for a use according to any of the preceding claims, comprising prophylaxis or treatment of asthma.

45. The immune suppressive domain for a use according to any of the preceding claims, comprising prophylaxis or treatment of allergy.

46. A use of an immune suppressive domain for the manufacture of a medicament for immune suppression.

47. The use of an immune suppressive domain for the manufacture of a medicament for the preparation or treatment of transplantation patients.

48. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of an autoimmune or inflammatory disease.

49. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition selected among Acute disseminated encephalomyelitis (ADEM), Addison's disease, Agammaglobulinemia, Alopecia areata, Amyotrophic Lateral Sclerosis, Ankylosing Spondylitis, Antiphospholipid syndrome, Antisynthetase syndrome, Atopic allergy, Atopic dermatitis, Autoimmune aplastic anemia,

Autoimmune cardiomyopathy, Autoimmune enteropathy, Autoimmune hemolytic anemia,
 Autoimmune hepatitis, Autoimmune inner ear disease, Autoimmune lymphoproliferative
 syndrome, Autoimmune peripheral neuropathy, Autoimmune pancreatitis, Autoimmune
 polyendocrine syndrome, Autoimmune progesterone dermatitis, Autoimmune
 5 thrombocytopenic purpura, Autoimmune urticaria, Autoimmune uveitis, Balo
 disease/Balo concentric sclerosis, Behçet's disease, Berger's disease, Bickerstaff's
 encephalitis, Blau syndrome, Bullous pemphigoid, Cancer, Castleman's disease, Celiac
 disease, Chagas disease, Chronic inflammatory demyelinating polyneuropathy, Chronic
 10 recurrent multifocal osteomyelitis, Chronic obstructive pulmonary disease, Churg-Strauss
 syndrome, Cicatricial pemphigoid, Cogan syndrome, Cold agglutinin disease, Complement
 component 2 deficiency, Contact dermatitis, Cranial arteritis, CREST syndrome, Crohn's
 disease, Cushing's Syndrome, Cutaneous leukocytoclastic angiitis, Dego's disease,
 Dercum's disease, Dermatitis herpetiformis, Dermatomyositis, Diabetes mellitus type 1,
 15 Diffuse cutaneous systemic sclerosis, Dressler's syndrome, Drug-induced lupus, Discoid
 lupus erythematosus, Eczema, Endometriosis, Enthesitis-related arthritis, Eosinophilic
 fasciitis, Eosinophilic gastroenteritis, Epidermolysis bullosa acquisita, Erythema nodosum,
 Erythroblastosis fetalis, Essential mixed cryoglobulinemia, Evan's syndrome,
 Fibrodysplasia ossificans progressiva, Fibrosing alveolitis, Gastritis, Gastrointestinal
 pemphigoid, Glomerulonephritis, Goodpasture's syndrome, Graves' disease, Guillain-
 20 Barré syndrome (GBS), Hashimoto's encephalopathy, Hashimoto's thyroiditis, Henoch-
 Schonlein purpura, Herpes gestationis, Hidradenitis suppurativa, Hughes-Stovin syndrome,
 Hypogammaglobulinemia, Idiopathic inflammatory demyelinating diseases, Idiopathic
 pulmonary fibrosis, Idiopathic thrombocytopenic purpura, IgA nephropathy, Inclusion
 body myositis, Chronic inflammatory demyelinating polyneuropathy, Interstitial cystitis,
 25 Juvenile idiopathic arthritis, Kawasaki's disease, Lambert-Eaton myasthenic syndrome,
 Leukocytoclastic vasculitis, Lichen planus, Lichen sclerosus, Linear IgA disease (LAD), Lou
 Gehrig's disease, Lupoid hepatitis, Lupus erythematosus, Majeed syndrome, Ménière's
 disease, Microscopic polyangiitis, Miller-Fisher syndrome, Mixed connective tissue disease,
 Morphea, Mucha-Habermann disease, Multiple sclerosis, Myasthenia gravis, Myositis,
 30 Narcolepsy, Neuromyelitis optica, Neuromyotonia, Occular cicatricial pemphigoid,
 Opsoclonus myoclonus syndrome, Ord's thyroiditis, Palindromic rheumatism, PANDAS
 (pediatric autoimmune neuropsychiatric disorders associated with streptococcus),
 Paraneoplastic cerebellar degeneration, Paroxysmal nocturnal hemoglobinuria (PNH),
 Parry Romberg syndrome, Parsonage-Turner syndrome, Pars planitis, Pemphigus vulgaris,
 35 Pernicious anaemia, Perivenous encephalomyelitis, POEMS syndrome, Polyarteritis
 nodosa, Polymyalgia rheumatica, Polymyositis, Primary biliary cirrhosis, Primary sclerosing
 cholangitis, Progressive inflammatory neuropathy, Psoriasis, Psoriatic arthritis, Pyoderma
 gangrenosum, Pure red cell aplasia, Rasmussen's encephalitis, Raynaud phenomenon,
 Relapsing polychondritis, Reiter's syndrome, Restless leg syndrome, Retroperitoneal
 40 fibrosis, Rheumatoid arthritis, Rheumatic fever, Sarcoidosis, Schizophrenia, Schmidt
 syndrome, Schnitzler syndrome, Scleritis, Scleroderma, Serum Sickness, Sjögren's
 syndrome, Spondyloarthropathy, Still's disease, Stiff person syndrome, Subacute bacterial
 endocarditis (SBE), Susac's syndrome, Sweet's syndrome, Sydenham chorea, Sympathetic

ophthalmia, Systemic lupus erythematosus, Takayasu's arteritis, Temporal arteritis, Thrombocytopenia, Tolosa-Hunt syndrome, Transverse myelitis, Ulcerative colitis, Undifferentiated connective tissue disease, Undifferentiated spondyloarthropathy, Urticarial vasculitis, Vasculitis, Vitiligo, and Wegener's granulomatosis.

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50. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition selected among acute or chronic inflammation.

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51. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of a condition associated with inflammation.

15

52. The use of an immune suppressive domain according to claim 51, for the manufacture of a medicament for prophylaxis or treatment of a condition selected among Acne vulgaris, Allergy, Allergic rhinitis, Asthma, Atherosclerosis, Autoimmune disease, Celiac disease, Chronic prostatitis, Glomerulonephritis, Hypersensitivities, Inflammatory bowel diseases, Pelvic inflammatory disease, Reperfusion injury, Rheumatoid arthritis, Sarcoidosis, Transplant rejection, Vasculitis, interstitial cystitis, Cancer, Depression, Myopathies, and Leukocyte defects.

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53. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of Sepsis.

54. The use of an immune suppressive domain for the manufacture of a medicament for prophylaxis or treatment of asthma.

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55. The use of an immune suppressive domain for the manufacture of a medicament for the prophylaxis or treatment of allergy.

56. A method for the preparation of a pharmaceutical composition comprising the steps of:

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a. Providing one or more immunosuppressive peptides selected from Seqid 1 to segid 287, preferably seq. id. 287, and optionally cross-linking said one or more immunosuppressive peptides;

b. Optionally providing a carrier;

c. Providing a substance;

d. Mixing the provided one or more peptides with any carrier of optional step b. and the substance of step d. to obtain the pharmaceutical composition.

5 57. The method of claim 56, wherein said substance of step c. is selected from the group consisting of creams, lotions, shake lotions, ointments, gels, balms, salves, oils, foams, shampoos, sprays, aerosols, transdermal patches and bandages.

58. A pharmaceutical composition obtainable according to claim 56 or 57.

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59. A pharmaceutical composition comprising an immune suppressive domain as an active substance.

15 60. The pharmaceutical composition according to claim 58 - 59, wherein said immune suppressive domain is selected among the immune suppressive domains of any of the claims 1 - 45.

61. The pharmaceutical composition according to any of the claims 58 - 60, further comprising at least one carrier.

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62. The pharmaceutical composition according to claim 61, wherein said at least one carrier is a non-protein carrier and/or a protein carrier.

25 63. A use of the composition according to any of the claims 58 - 62, for treatment of a disease by IV injection.

64. The use of the composition according to any of the claims 58 - 62, for treatment of a disease by direct injection at a site of inflammation.

30 65. The use of the composition according to any of the claims 58 - 62, for treatment of a disease by inhalation.

66. The use of the composition according to any of the claims 58 - 62, for treatment of a disease by oral delivery.

5 67. The use of the composition according to any of the claims 58 - 62, for treatment of a disease by anal delivery.

10 68. The use of the composition according to any of the claims 58 - 62, for treatment of a condition selected among a skin disease, Psoriasis, Arthritis, Asthma, Sepsis and inflammatory bowel disease.

69. The use of the composition according to any of the claims 58 - 62, for administration in a way selected among IV, IP, and IM.

15 70. The use of the composition according to any of the claims 58 - 62, for treatment of Arthritis wherein the composition is injected directly at site of inflammation.

20 71. The use of the composition according to any of the claims 58 - 62, for treatment of a condition selected among Gastrointestinal hyperresponsiveness, Food Allergy, Food intolerance and inflammatory bowel disease, wherein the composition is delivered orally.

72. The use of the composition according to any of the claims 58 - 62, for treatment Asthma where the composition is delivered by inhalation.

25 73. The use of the composition according to any of the claims 58 - 62, for coating of nanoparticles and biomaterials.

74. The use of the composition according to any of the claims 58 - 62, to aid in suppressing any immune response to nanoparticles or biomaterials.

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75. The use of the composition according to any of the claims 58 - 62, to increase the half-life of nanoparticles or biomaterials *in vivo* in the patient.
- 5 76. A vaccine comprising an immune suppressive domain, optionally mutated, for systemic immune suppression.
77. A vaccine comprising an immune suppressive domain selected among Seqid 275 to 287, preferably seq. id. 287, against PRRS.
- 10 78. A vaccine comprising a peptide, obtained by performing at least one mutation, insertion or deletion of an immune suppressive domain selected among Seqid 275 to 287, preferably seq. id. 287.
- 15 79. A vaccine against PRRS comprising a mutated immunosuppressive domain according to seqid 275 to seqid 287, preferably seq. id. 287, subject to the proviso that the immunosuppressive properties of said domain have been abrogated.
80. Peptide having the sequence of the Immune Suppressive Domain according to any of the claims 1 - 45.
- 20 81. Peptide having the sequence of the Immune Suppressive Domain according to any of the claims 1 - 45, modified by a number of point mutations selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.
- 25 82. Peptide having the sequence of the Immune Suppressive Domain according to any of the claims 1 - 45, modified by a number of point deletions selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.
- 30 83. Peptide having the sequence of the Immune Suppressive Domain according to any of the claims 1 - 45, modified by a number of point insertions selected among 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

84. Peptide according to any of the claims 80 - 83, capable of an inhibition selected among at least 5% inhibition of T-lymphocyte proliferation, at least 10%, at least 20%, such as at least 30%, at least 40%, at least 50%, such as at least 60%, such as at least 70% inhibition of T-lymphocyte proliferation, at least 75% inhibition of T-lymphocyte proliferation, at least 80%, such as at least 85%, at least 90%, such as at least 95%, at least 97%, such as at least 99%, and at least 100% inhibition of T-lymphocyte proliferation.

85. Peptide according to any of the claims 80 -84, capable of suppressing the immune response in an animal, preferably according to the TPA model.

86. Use of a peptide according to any of the claims 80 - 85, for a use selected among a use of any of the preceding claims.

87. A method of treatment of an indication selected among the indications of claims 38 - 55 and the viral infections of Table 1 comprising administration of an effective amount of an entity selected among the Immune Suppressive Domains of claims 1 - 45, the compositions of claims 58 - 62, and the peptides of claims 80 - 85.

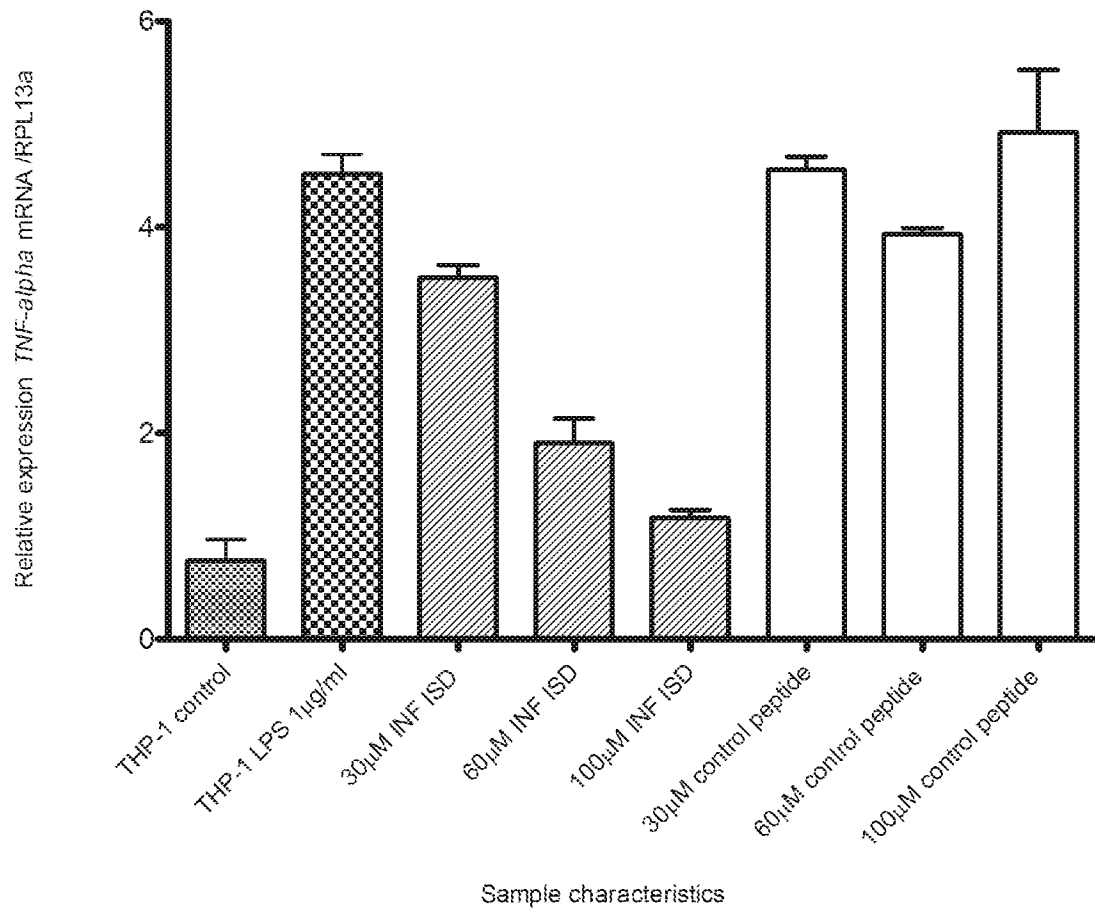


Fig. 1

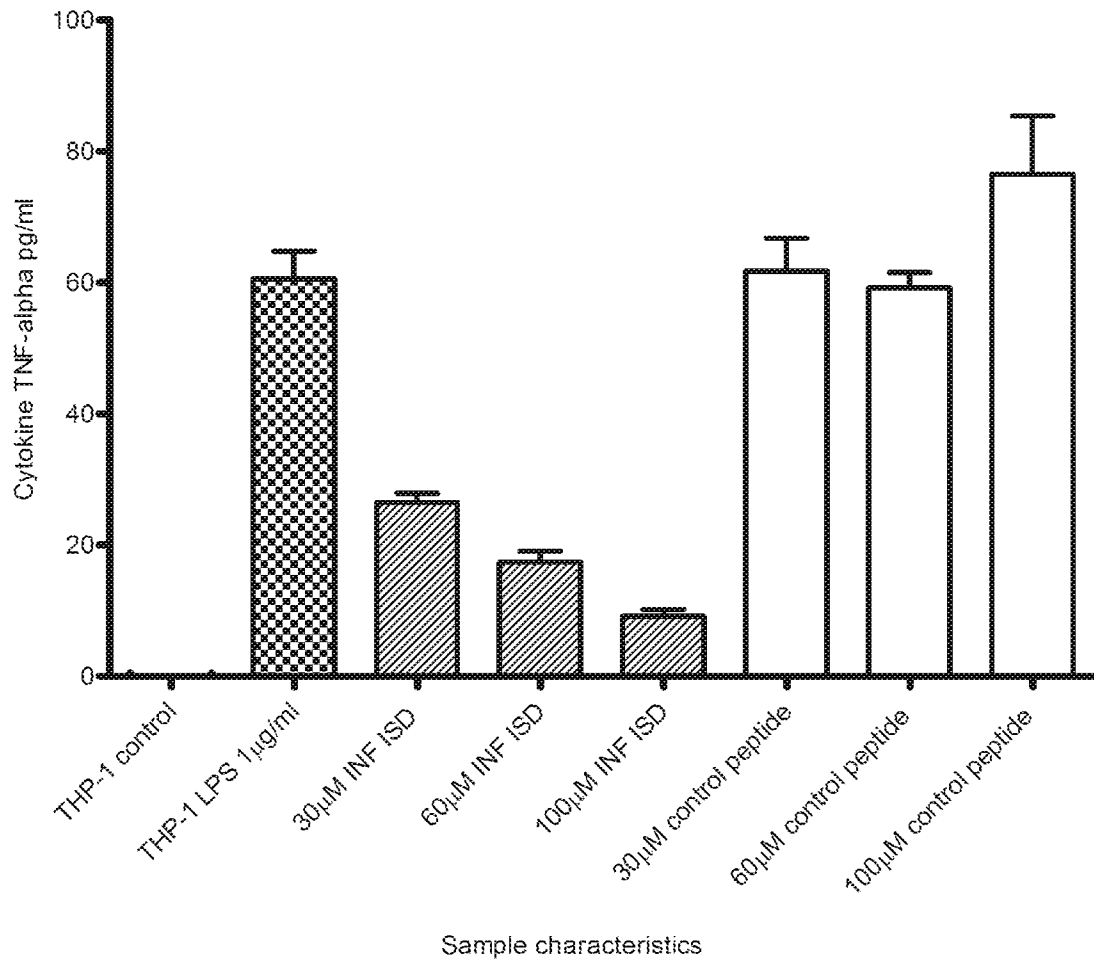


Fig. 2

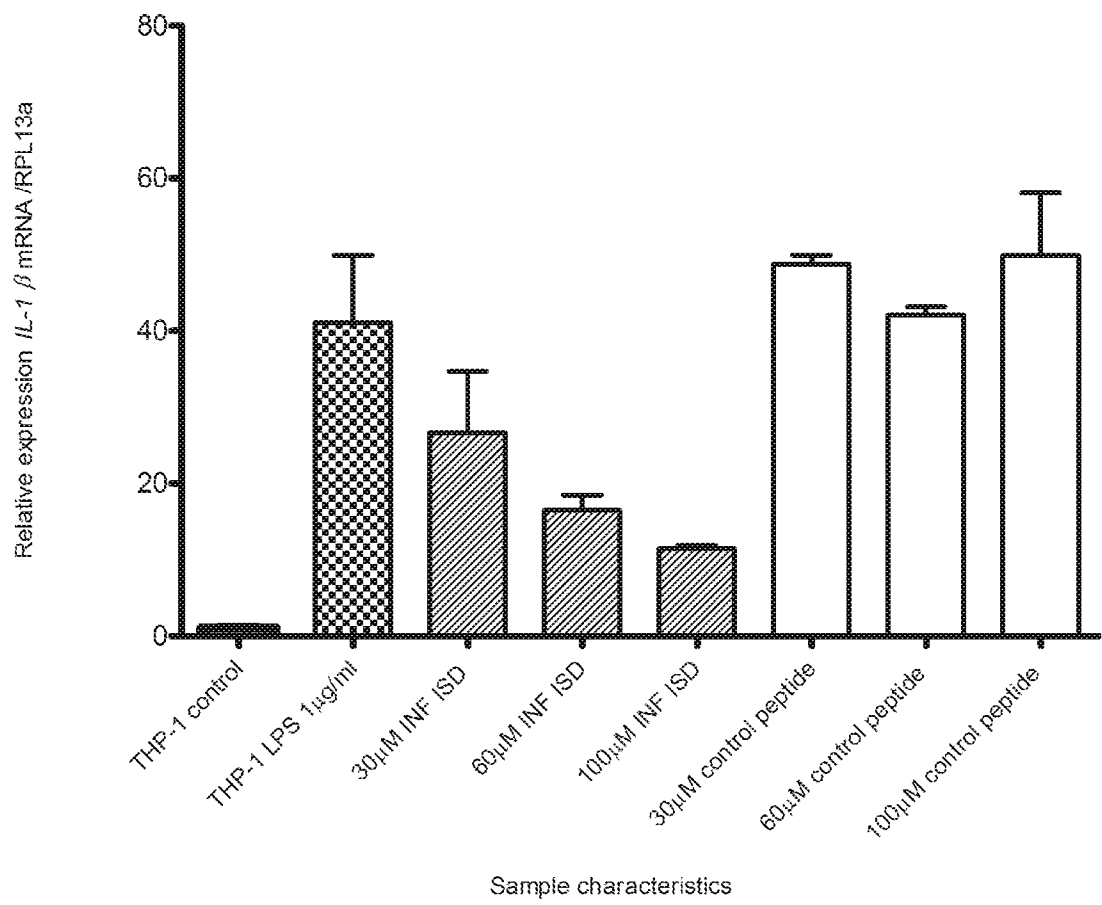


Fig. 3

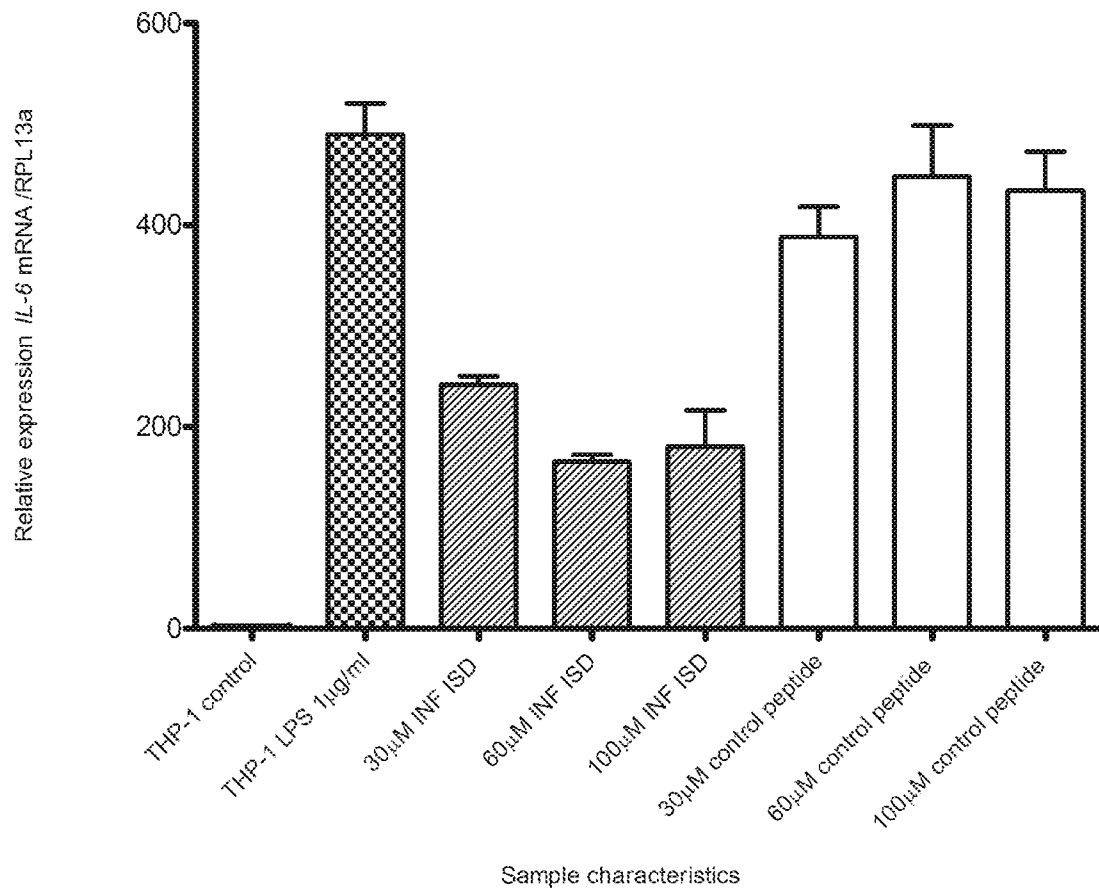


Fig. 4

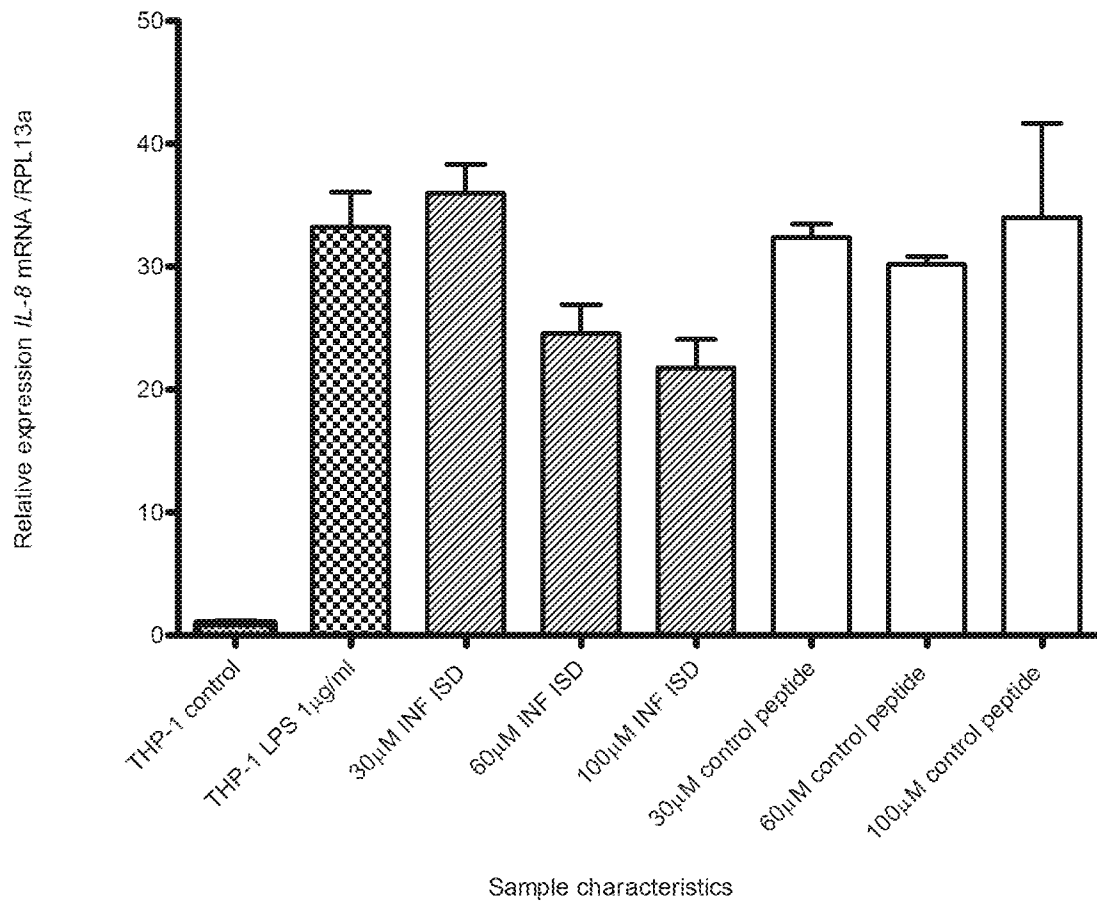


Fig. 5

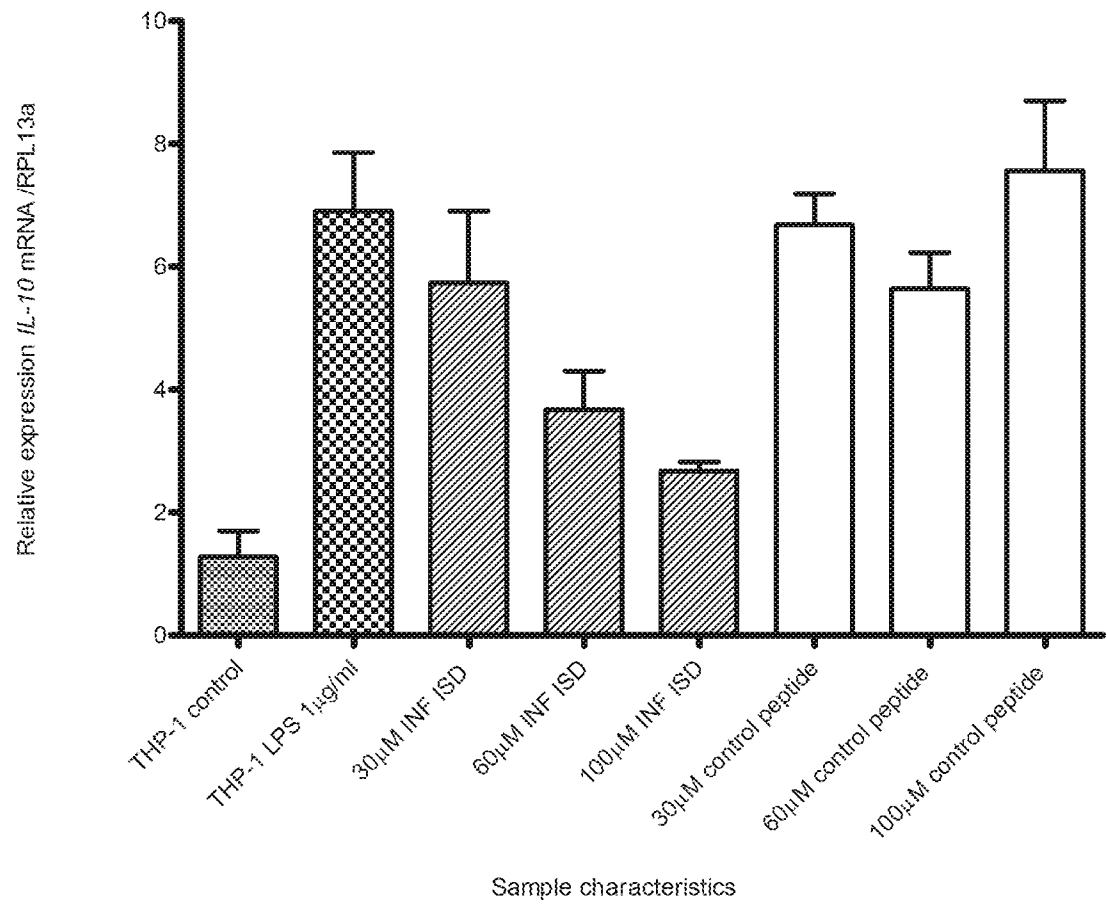


Fig. 6

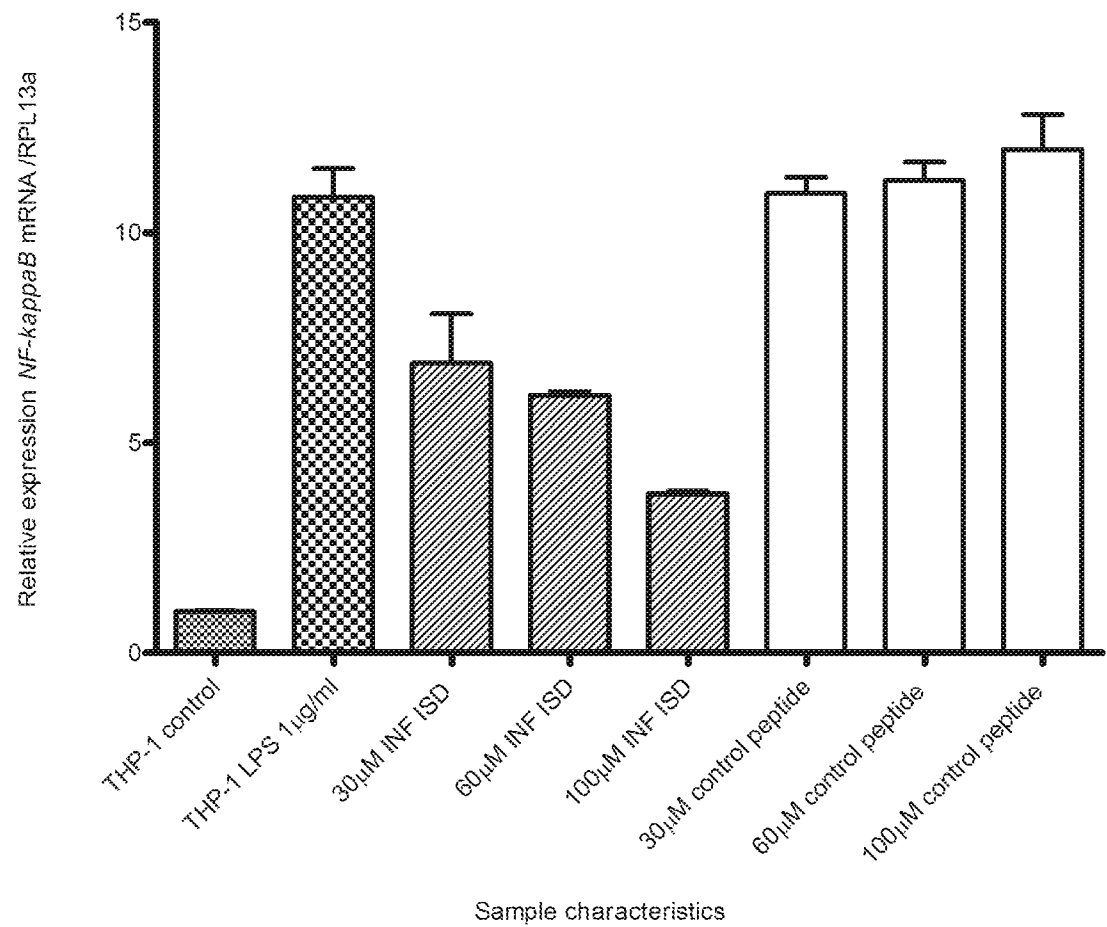


Fig. 7

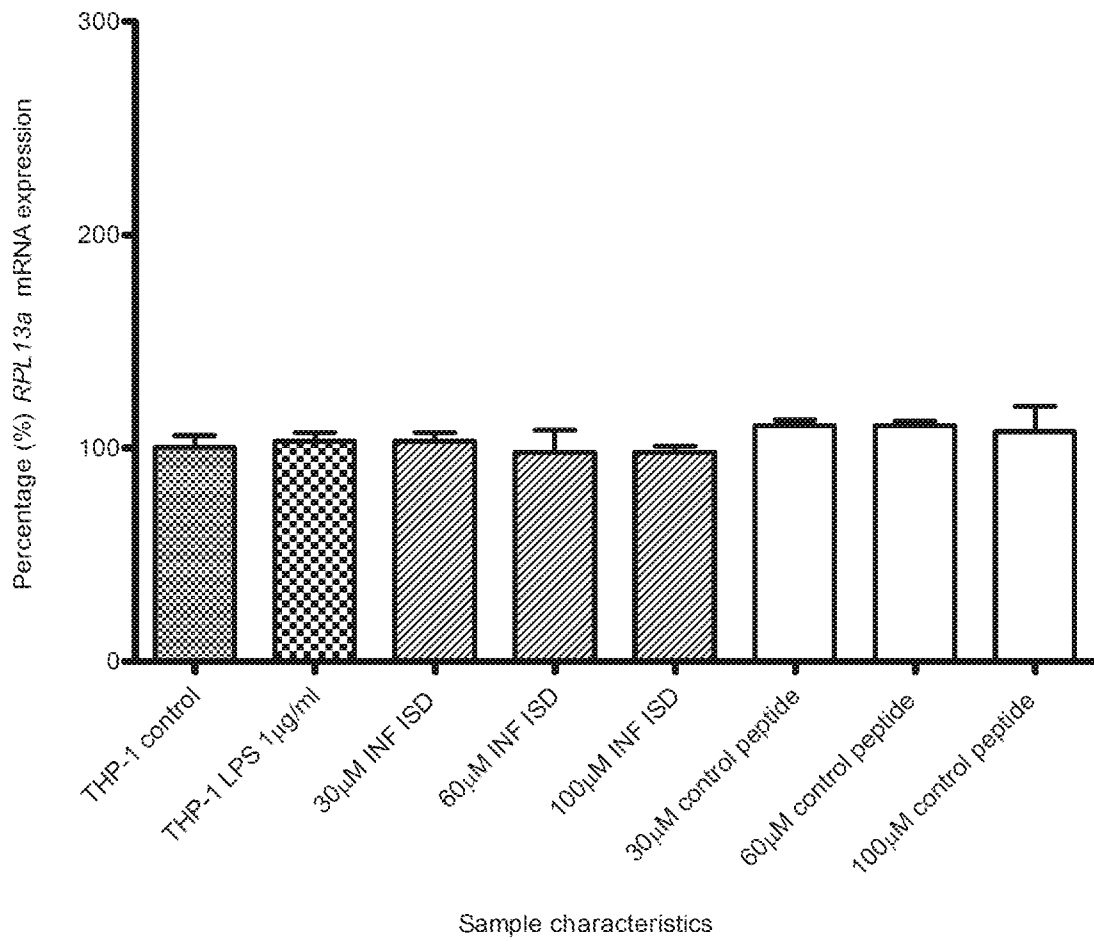


Fig. 8

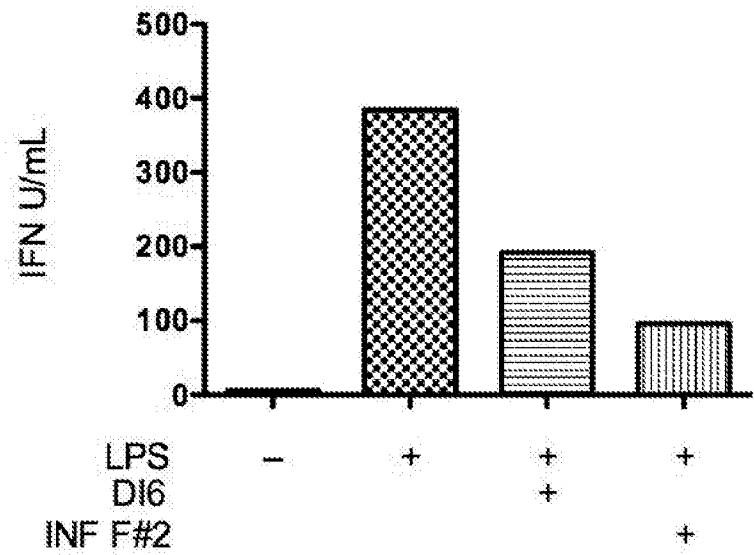


Fig. 9

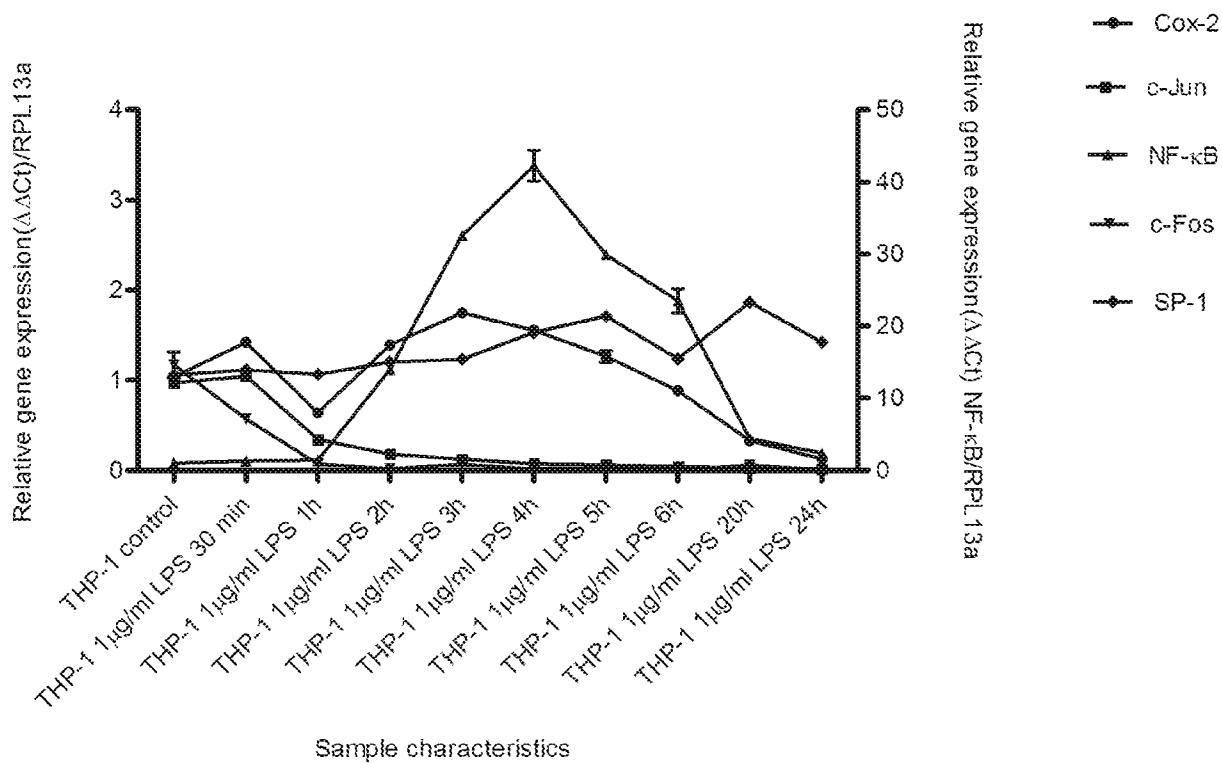


Fig. 10

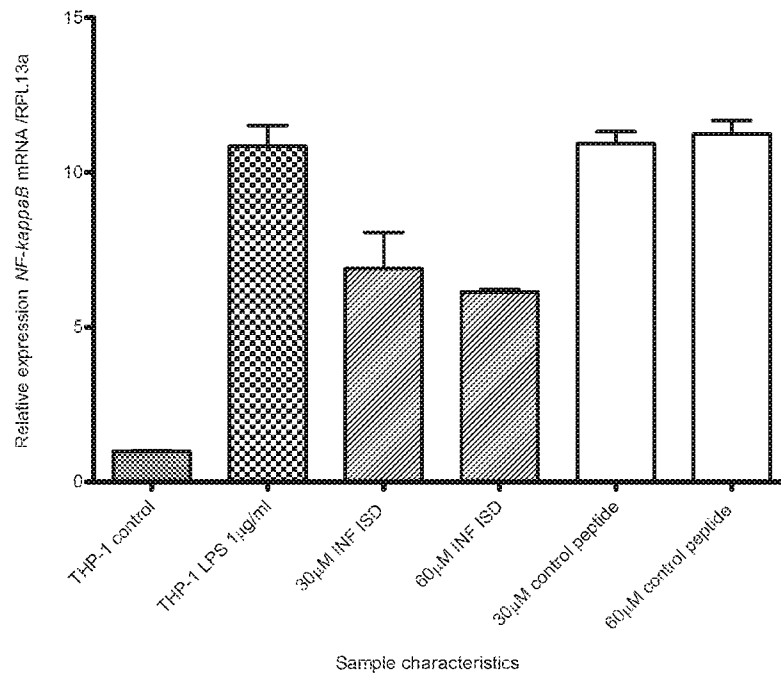


Fig. 11

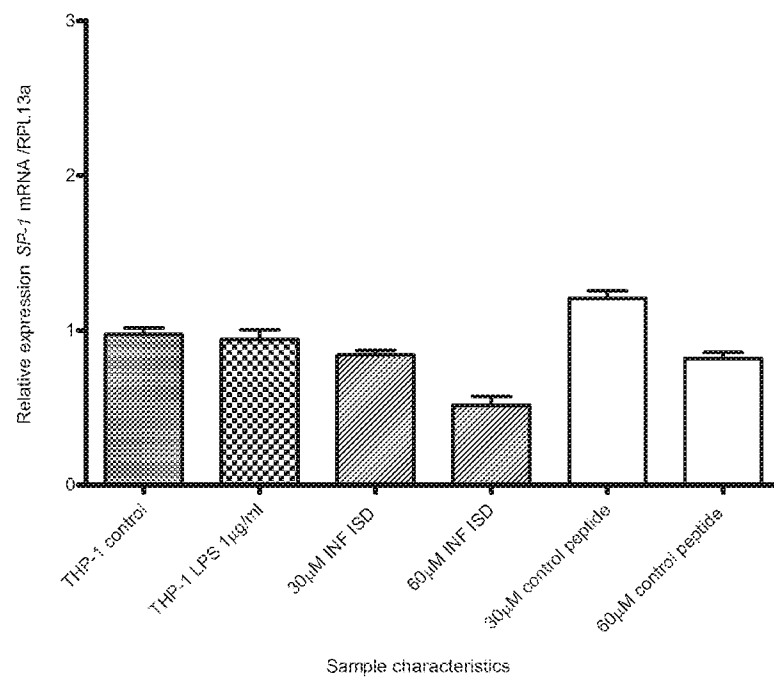


Fig. 12

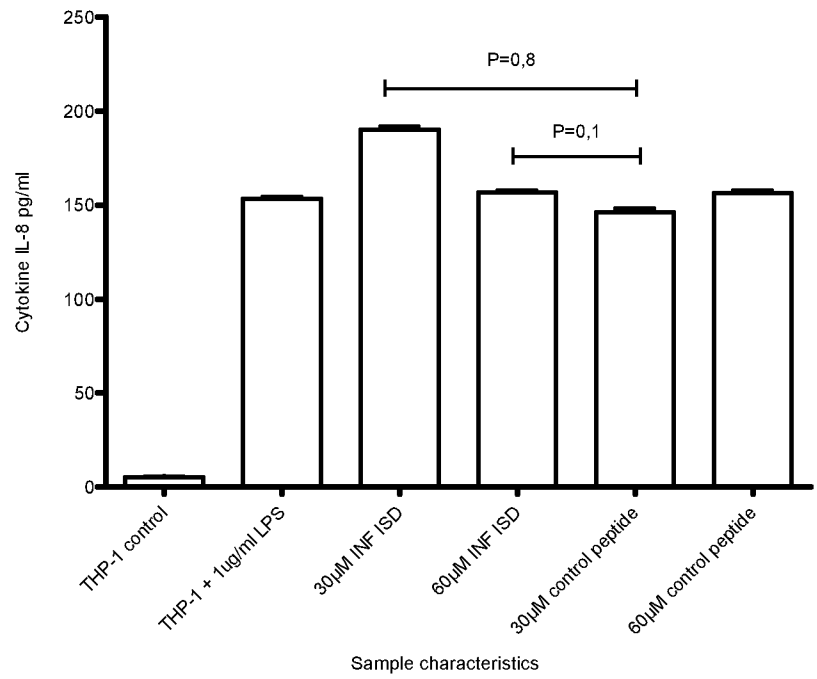


Fig. 13

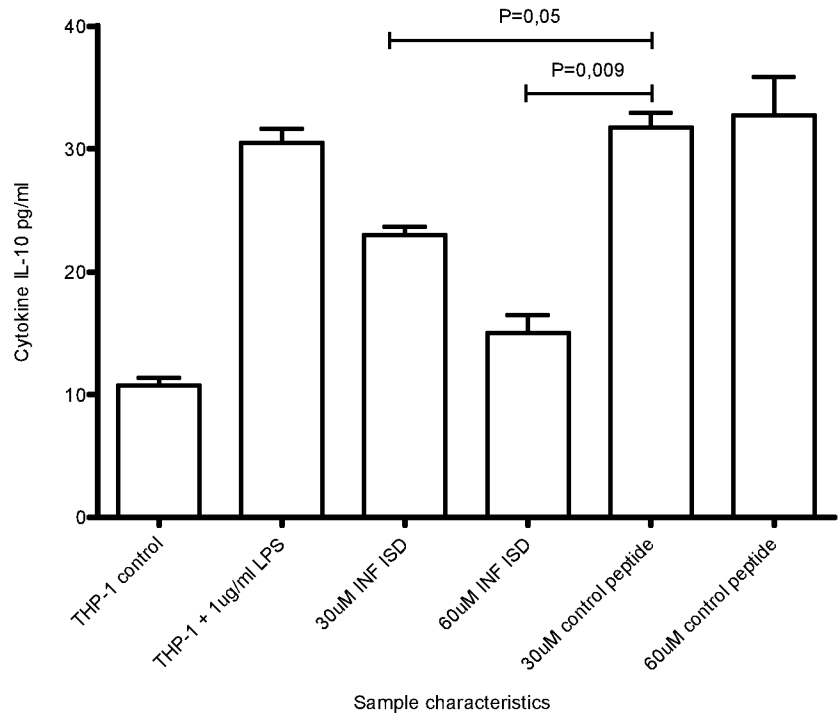


Fig. 14

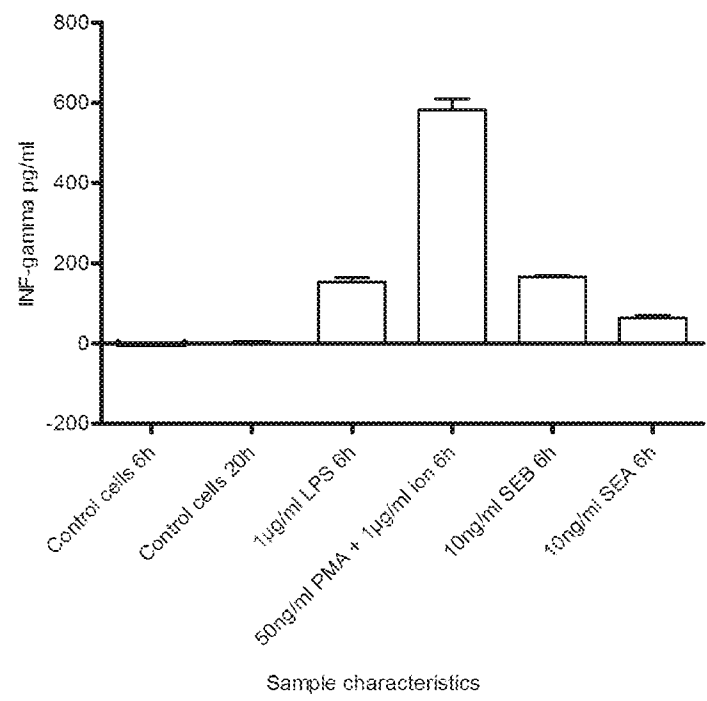


Fig. 15

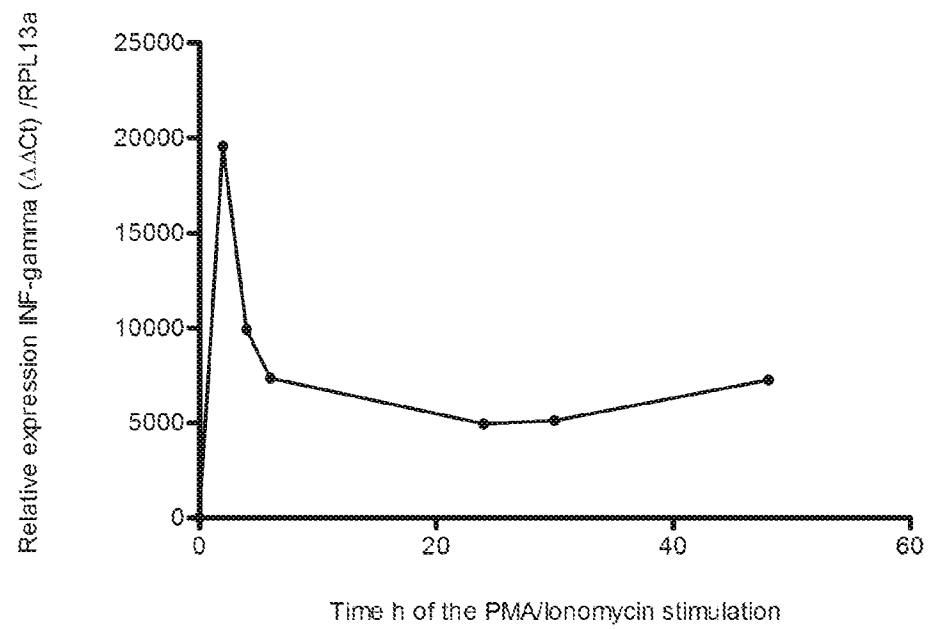


Fig. 16

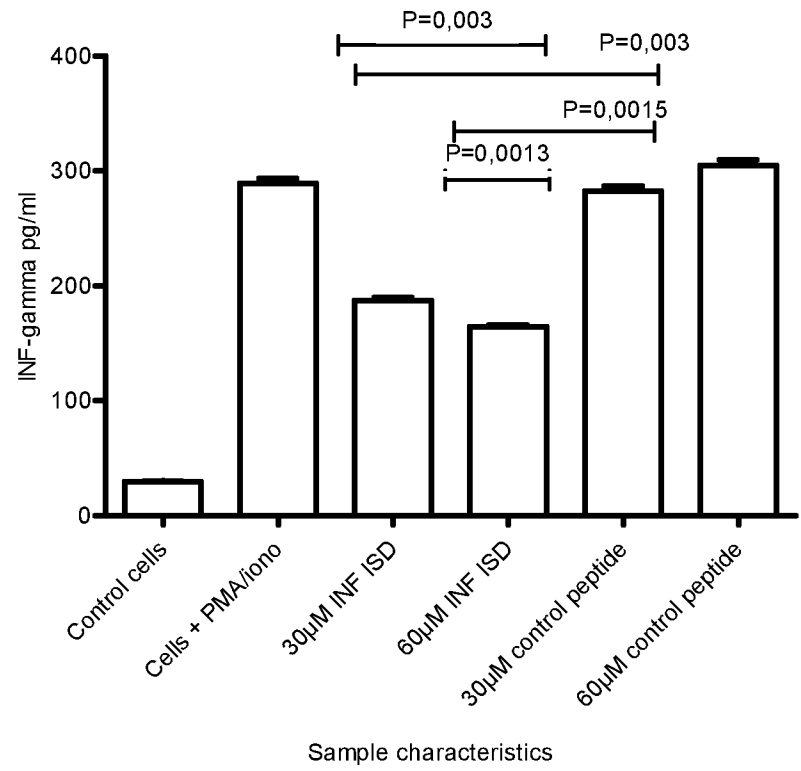


Fig. 17

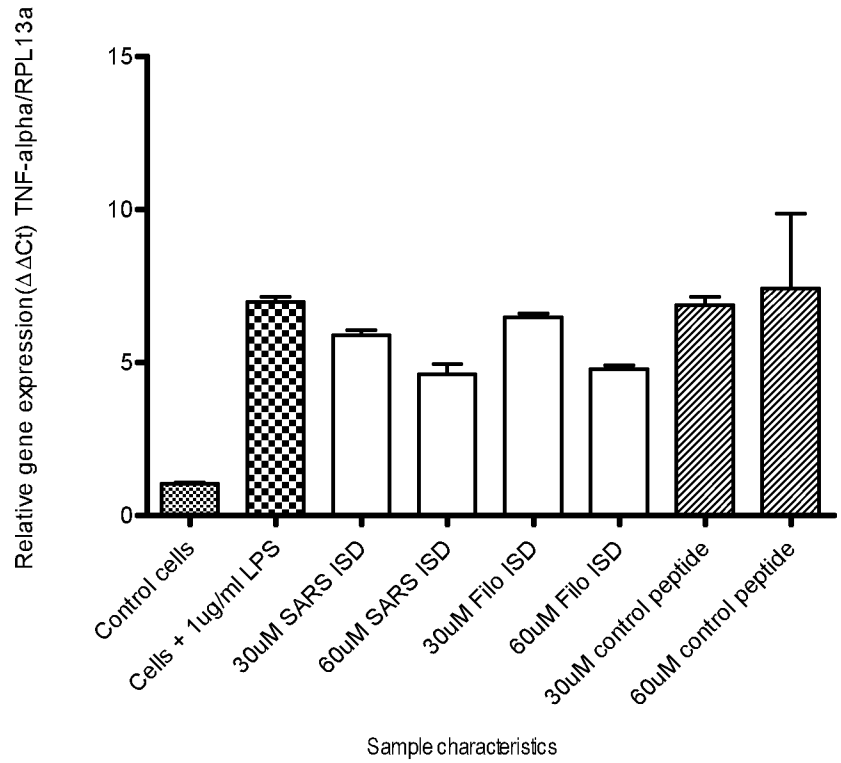


Fig. 18

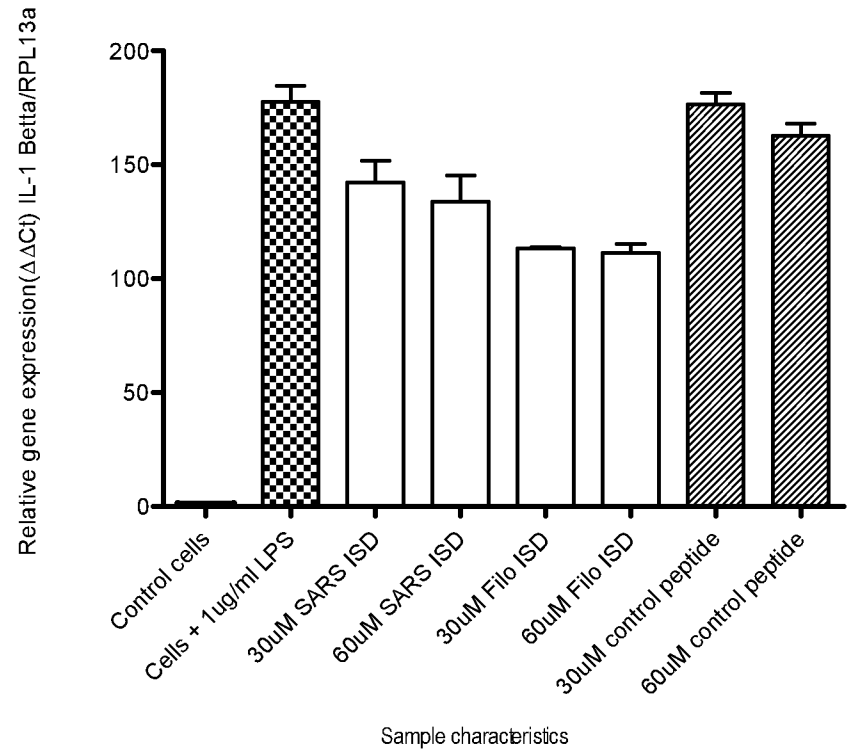


Fig. 19

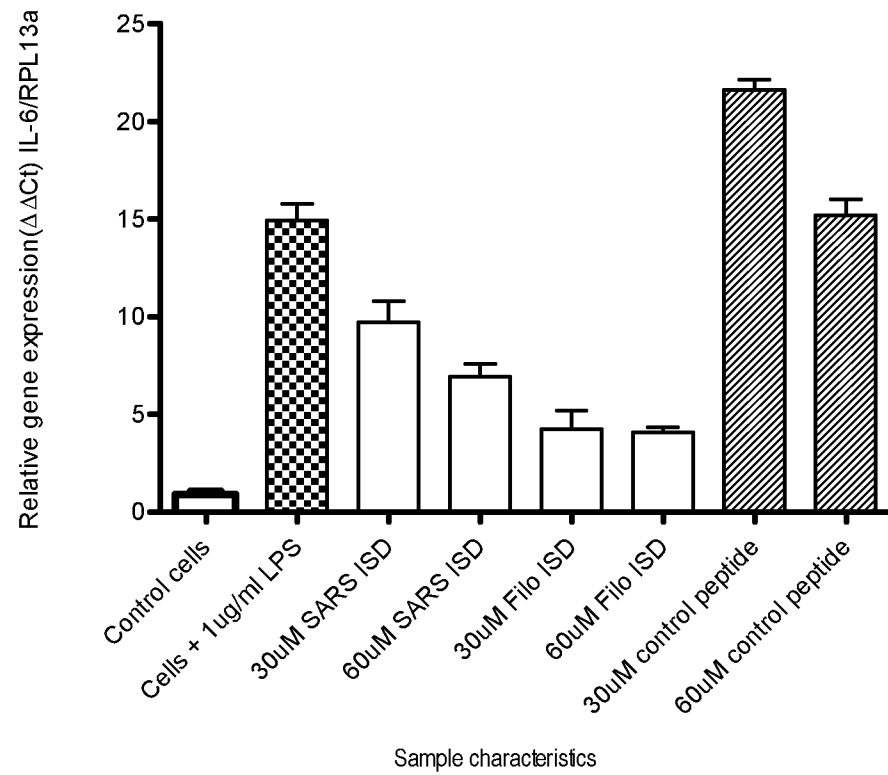


Fig. 20

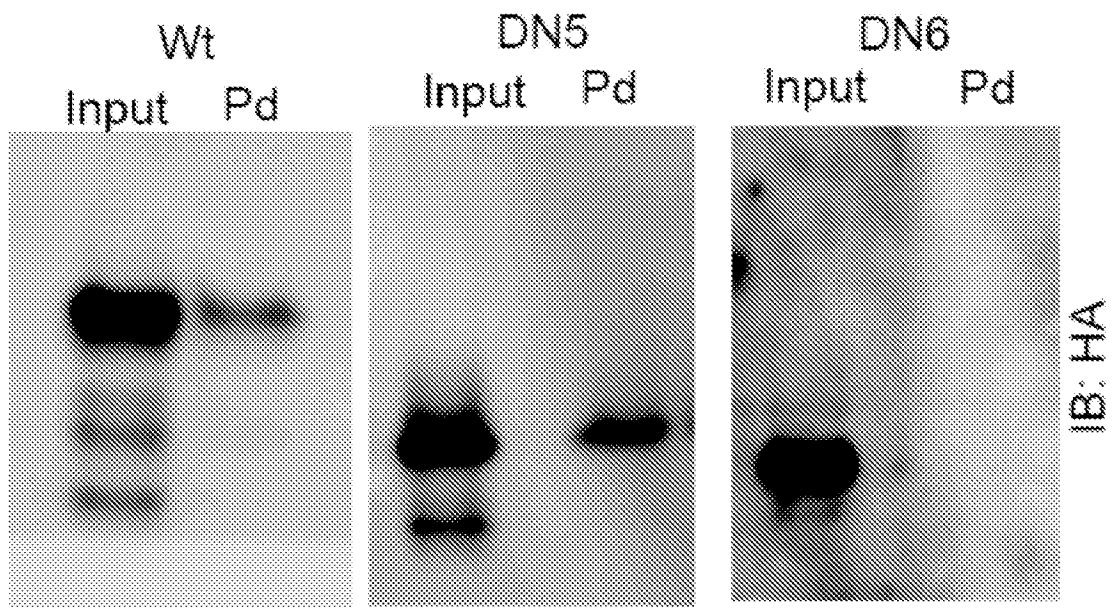


Fig. 21