

Title "IL-17A BINDING PEPTIDES AND MEDICAL USES THEREOF"

The present invention relates to IL-17A binding peptides, inhibitors of the binding of IL-17A to the IL-17AR receptor and thereby of the formation of the complex IL-17A/IL-17RA/IL17RC. Object of the invention are also bioconjugates and dimers comprising the above peptides, pharmaceutical compositions and medical uses of the above peptides, bioconjugates and dimers.

Background of the invention

Human cytotoxic T lymphocyte-associated antigen 8 (CTLA8), named also Interleukin 17 (IL-17), was first cloned in 1993. The first biological activity described for human IL-17 was the induction of the production of Interleukin 6 (IL-6) and Interleukin 8 (IL-8) from rheumatoid arthritis synoviocytes. This finding suggested a role for IL-17 in inflammation through IL-6, and in neutrophil recruitment through IL-8 Xu S et al, Cell Mol Immunol. 2010, 164-74; Murcia RY et al, PLOS ONE 2016, 11(5): e0154755doi:10.1371/journal.pone.0154755).

It was later found that this molecule, later named IL-17A, is part of a larger family which includes five additional members, namely IL-17B to F. IL-17F shares the greatest homology (about 56%) with the first discovered IL-17, IL-17A, while IL-17E displays the lowest sequence conservation (about 16%). The members of IL-17 family exert their functions binding to their receptors in the form of homodimers, with the exception of IL-17A and IL-17F which may also act as heterodimers (Goepfert A et al, Sci Rep. 2017, 7 (1), 8906).

The most widely investigated cytokine of this family, IL-17A, plays an essential role in host defense against microbial infections and it is considered the major driver for a number of inflammatory and autoimmune conditions. Pathological production of IL-17A leads to excessive inflammation and evident tissue damage.

In particular, through induction of a variety of molecules including cytokines, chemokines, acute phase proteins, anti-microbial peptides, mucins, and matrix metalloproteinases, IL-17A can amplify cascades of events that lead to neutrophil recruitment, inflammation and host defense. Although IL-17A is the signature cytokine produced by T helper 17 (Th17) cells, IL-17A, as other IL-17 family cytokines, has multiple sources ranging from immune cells to nonimmune cells.

IL-17B, IL-17C, and IL-17D are also considered pro-inflammatory cytokines but their role is not fully known. IL-17E, also known as IL-25, has the lowest homology and is involved in Th2 cell responses against parasites and allergy. CCL20 drives the recruitment of Th17 and dendritic cells to the inflammatory site. In turn, Th17 cells are activated thus producing inflammatory mediators and leading to chronic inflammation.

The cytokines belonging to IL-17 family signal via their related receptors and activate downstream pathways that include NF κ B, MAPKs and C/EBPs to induce the expression of antimicrobial peptides, cytokines and chemokines. The proximal adaptor Act1 is a common mediator during the signaling of all IL-17 cytokines, and it is involved in IL-17-mediated host defense and in IL-17-driven autoimmune conditions.

The IL-17 receptor family consists of five members, IL-17RA, RB, RC, RD and RE, all of which, like their ligands, share sequence homology.

IL-17RA is ubiquitously expressed on a wide range of tissues and cell types and binds to IL-17-A, C, E and F. Receptor signaling occurs through heterodimeric receptors formed of a common IL17-RA subunit and a second subunit that depends on the ligand and regulates signaling specificity. Upon stimulation with the ligand, IL-17RA forms a heterodimeric receptor complex with IL-17RB (for IL-17E), IL-17RC (for IL-17A and IL-17F) or IL-17RE (for IL-17C). It is proposed that the binding of ligand to the first IL-17RA receptor subunit promotes the second binding event, thus inducing the formation of a heterodimeric receptor

complex. In particular, the signal of IL-17A and IL-17F is mediated by the complex between IL-17RA and IL-17RC. IL-17F binds to IL-17RA with about 100 to 1000 times lower affinity than IL-17A, while the binding affinity for IL-17RC is comparable between the two cytokines (Onishi RM et al, Immunology 2010, 129(3), 311-321; Gu C et al, Cytokine 2013, 64(2), 477-485).

IL-17A in humans plays a pivotal role in various autoimmune and inflammatory conditions, such as rheumatoid arthritis, multiple sclerosis, psoriasis, Crohn's disease, systemic lupus erythematosus, asthma, Behçet's disease, and hyper IgE syndrome (Fujino S et al Gut, 2003, 52, 65-70; Shabgah AG et al, Postepy Dermatol Allergol 2014, 31 (4), 256–261). Furthermore, IL-17A blockade has shown preclinical and clinical efficacy in ankylosing spondylitis and rheumatoid arthritis (Liu S et al, Nature-Scientific Reports 2016, doi:10.1038/srep26071; Lubberts E et al, Arthritis Rheum 2004, 50, 650-659).

Also, IL-17A has been shown to be involved in ocular diseases, and in particular in the pathogenesis of ocular surface and corneal diseases, such as dry eye disease (DED), viral and bacterial keratitis. Antibodies developed to neutralize IL-17A have shown promising results in reducing the severity of these diseases (Garbutcheon-Singh KB et al, Curr Eye Res, 2018, DOI:10.1080/02713683.2018.1519834).

DED is an inflammatory and autoimmune ophthalmic disease of the tear system and ocular surface that results in discomfort, visual disturbance and tear film impairment. DED is one of the most common cause of acquired visual impairment in adult population (Stern ME et al, Mucosal Immunol 2010, 3(5), 425-442; Stevenson W et al, Arch Ophthalmol 2012, 130(1), 90-100, Parul Singh , Parul Singh 2012, Hah, Chung et al. 2017). The disease involves an immune and inflammatory process that affects the ocular surface and, in severe cases, may lead to blindness. Current treatment of DED is mainly symptomatic, consisting in ocular

lubricants and non-specific anti-inflammatory agents such as corticosteroids, cyclosporine A, and tacrolimus.

IL-17A is associated with damage to the corneal epithelial barrier function, which is the most sight threatening complication of DED. An increase in Th17 cells is reported in DED patient ocular tissues that induces an increase in IL-6, TGF- β , IL-23 and IL-17A concentrations on the ocular surface, as well as increased concentration of IL-17 in tears, and number of Th17 cells on the ocular surface of experimental DED models. In addition, it has also been demonstrated that *in vivo* neutralization of IL-17A results in a markedly attenuated induction and severity of disease (De Paiva CS et al, Mucosal Immunol. 2009; 2(3): 243–253, Chauhan et al, Mucosal Immunol , 2009, 2(3), 243–253; Chauhan SK et al, Mucosal Immunol 2009, 2(4), 375–376; Chauhan, El Annan et al. 2009, De Paiva, Chotikavanich et al. 2009, de Paiva, Huang et al. 2014, Subbarayal, Chauhan et al. 2016).

IL-17A has also been implicated in psoriasis. Psoriasis is a chronic inflammatory disease. It manifests itself as dry, raised, red skin lesions (plaques) covered with silvery scales. Numerous clinical phenotypes exist (i.e. plaque, guttate, pustular, inverse), with disease severity ranging from a few scattered plaques to extensive body surface involvement. Individuals with psoriasis have an increased risk of developing other chronic and serious diseases such as psoriatic arthritis, metabolic syndrome, cardiovascular diseases and depression. A central role of IL-17A in the pathophysiology of psoriasis has been demonstrated (Zeichner JA et al J Clin Aesthet Dermatol 2016, 9 (6 Suppl 1), S3–S6). In psoriasis, expression of IL-17 mRNA is higher in lesional compared with nonlesional skin. Additionally, IL-17A levels are significantly correlated to disease severity (Arican O et al. Mediators Inflamm 2005, 2005, 273–279, Takahashi K et al. Clin Exp Dermatol 2010, 35, 645–649). Blockade of IL-17A has been shown to reduce keratinocyte hyperproliferation, T-

cell infiltration into the dermis, and mRNA expression of key disease-propagating genes (Krueger JG et al, J Allergy Clin Immunol 2012, 130, 145–154).

Anti-IL-17A antibodies secukinumab (AIN457, CosentyxTM), a fully human IgG1k anti-IL-17A mAb, and ixekizumab (LY2439821), a humanized IgG4 antibody, were tested in clinical trials in psoriasis and approved for the treatment of moderate to severe psoriasis. During clinical trials, both antibodies were able to reduce the severity of the disease by at least 75% (PASI75) in 80% of the patient population. Moreover, current advanced clinical trials have shown promising results also for treatment of ankylosing spondylitis and psoriatic arthritis. Other antibodies are now in clinical trials for the same indications.

The above evidence strongly supports the development of molecules able to target IL-17A and inhibit its signaling for the treatment of the above pathologies. Until recently, targeting of IL17-A and its receptors has remained the domain of antibodies. The reason for the preference for antibodies is that cytokines, as IL-17A, constitute a protein-protein interaction (PPI) target difficult to target, so far considered undruggable. In fact, PPI interfaces are generally flat and lack deep subpockets and grooves that are usually necessary to bind Small Molecular Weight (SMW) molecules. Despite this, in recent years new research identified a few SMW IL-17A antagonists able to bind IL-17A and prevent its interaction with IL-17RA receptor, and thus inhibit IL-17A pathway activation (Espada A et al. J Med Chem 2016, 59(5), 2255-2260; Ting JP et al PLoS One 2018, 13(1), e0190850; Liu S et al, Scientific reports, 6:26071, doi: 10.1038/srep26071). Among these, a peptide of sequence IHVTIPADLWDWINK, which was named High Affinity Peptide (HAP) has been described (Liu S et al, Scientific reports, 6:26071, doi: 10.1038/srep26071).

However, there is still the need of identifying and characterizing new molecules able to bind with high affinity to IL-17A and prevent IL-17A pathway activation for the development of new therapeutic options for the treatment of disorders involving IL-17A/IL-17RA axis.

SUMMARY OF THE INVENTION

The present inventors have surprisingly found peptides able to bind to a specific site on the N-terminal portion of IL-17A and thereby to inhibit the interaction with IL-17RA and the formation of the IL-17A/IL-17RA/IL17RC complex.

The inhibition of said interaction blocks the IL-17A signaling pathway. The peptides according to the invention are therefore able to reduce TH17-related inflammation and the subsequent damage observed in inflammatory and autoimmune diseases where these cells and IL-17A exert a pivotal role.

As will be shown in the experimental section, the peptides of the invention have physical-chemical properties that make them particularly suitable for topical treatment of ophthalmic and dermatological diseases.

Said peptides are useful to design innovative and specific topical treatment of diseases dependent on an excessive production or activity of IL-17A.

Objects of the present invention are peptides able to inhibit IL-17A binding to IL-17RA, dimers and bioconjugates, pharmaceutical compositions comprising said peptides, dimers or bioconjugates and the use of the above in the prevention and/or treatment of autoimmune and inflammatory diseases depending on IL-17A.

Brief description of the figures

Figure 1 shows some dose-response curves obtained in the IL-17RA-IL17RC dimerization assay described in Example 5 of with representative IL-17A binding peptides according to the invention. The percentage of inhibition of IL-17RA/IL17RC dimerization induced by IL-17A obtained by treatment with different peptides is reported.

Figure 2 shows the activity of the IL-17A binding peptide of SEQ ID N.18 on secretion of IL6, IL-17A and IL23 by human differentiated and activated TH17 cells, measured as described in

Example 6. The concentration of the different cytokines in the supernatant of TH17 cells with or without (control) peptide of SEQ ID N.18 is reported.

Figure 3 shows the activity of the IL-17A binding peptide of SEQ ID N.18 on secretion of Metalloproteinase 3 by human differentiated and activated TH17 cells, measured as described in Example 6. The concentration of Metalloproteinase 3 in the supernatant of TH17 cells with or without (CONTROL) peptide of SEQ ID N.18 is reported.

Figure 4 shows viability of human TH17 cells after 24h, in the presence and absence (control) of the peptide of SEQ ID N 18, as described in Example 6.

Figure 5 shows the binding site on IL-17A of the IL-17A peptides according to the invention.

Figure 6 shows the sensograms obtained in the experiment of Example 9 with the peptide of SEQ ID N 2 (upper panel) or SEQ ID N 1 (lower panel).

Figure 7 shows the value of the affinity constant at different concentrations of the peptide of SEQ ID N 2 (upper panel) or SEQ ID N 1 (lower panel), obtained in the experiment of Example 9.

Figure 8 shows the level of expression of IL-8 measured by real-time PCR as described in Example 10 in HCEC cells not treated (vehicle) or treated with the peptide of SEQ ID N. 2 (panel A) or with the peptide HAP (SEQ ID N. 1) (Panel B). The error bars represent the standard deviation. T-test was performed as statistical analysis. P-value $* < 0,05$, $** < 0,005$, $*** < 0,0005$.

Figure 9 shows the amount of IL-6 measured by real-time PCR as described in Example 10 in HCEC cells not treated (vehicle) or treated with the peptide of SEQ ID N. 2 (panel A) or with the peptide HAP (SEQ ID N. 1) (Panel B). The error bars represent the standard deviation. T-test was performed as statistical analysis. P-value $* < 0,05$, $** < 0,005$, $*** < 0,0005$.

Figure 10 shows the amount of TNF- α measured by real-time PCR as described in Example 10, in HCEC cells not treated (vehicle) or treated with the peptide of SEQ ID N. 2 (panel A) or

with the peptide HAP (SEQ ID N. 1) (Panel B). The error bars represent the standard deviation. T-test was performed as statistical analysis. P-value $* < 0,05$, $** < 0,005$, $*** < 0,0005$.

Definitions

Unless otherwise defined, all terms of art, notations and other scientific terminology used herein are intended to have the meanings commonly understood by those persons skilled in the art to which this disclosure pertains. In some cases, terms with commonly understood meanings are defined herein for clarity and/or for ready reference; thus, the inclusion of such definitions herein should not be construed to represent a substantial difference over what is generally understood in the art.

The term "pharmaceutically acceptable excipient" refer to substances other than the active pharmaceutical ingredient (API) that have been appropriately evaluated for safety and are intentionally included in a drug delivery system. Pharmaceutically acceptable excipients are well known in the prior art and are disclosed, for example in the Handbook of Pharmaceutical Excipients, seventh edition 2013, which is included here for reference (Rowe, Sheskey et al. 2012).

Excipients are normally classified according to the function that they have in the final pharmaceutical composition. Preferably, suitable excipients according to the present invention are for example diluent, adsorbent, glidant, binder, lubricant, surfactant, disintegrating, preservatives, antioxidant or mixtures thereof.

The terms "approximately" and "about" herein refers to the range of the experimental error, which may occur in a measurement.

The terms "comprising", "having", "including" and "containing" are to be construed open-ended terms (i.e. meaning "including, but not limited to") and are to be considered as providing support also for terms as "consist essentially of", "consisting essentially of", "consist of" or "consisting of".

The terms “consist essentially of”, “consisting essentially of” are to be construed as semi-closed terms, meaning that no other ingredients which materially affects the basic and novel characteristics of the invention are included (optional excipients may thus be included).

The terms “consists of”, “consisting of” are to be construed as closed terms.

The term “bioconjugate” as used herein refers to a conjugate formed by a stable covalent link between different molecules, preferably two molecules, optionally linked by means of a spacer, at least one of which is a biomolecule.

The term “biomolecule” as used herein refers to molecules of biological origin. The term includes macromolecules, such as carbohydrates, lipids and proteins or small natural products. For the purpose of the present invention “biomolecules” are preferably selected from ascorbic acid, capric acid, capronic acid, N-Acetyl-Glucosamine (also referred to as NAG), N-Acetylmuramic acid (also referred to as NAM), hyaluronic acid, alginic acid, chitin, (GalNAc)₂, Gal-alpha1,3-GalNAc or trigalacturonic acid

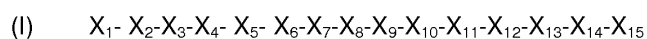
The definition “conservative substitution” herein refers to a conservative replacement (also called a conservative mutation or a conservative substitution) is an amino acid replacement that changes a given amino acid to a different amino acid with similar biochemical properties (Simon French 1983).

Description of the invention

The present inventors have identified a number of peptides that are able to bind with high affinity to IL-17A and inhibit its interaction with the ILRA receptor. These compounds act as inhibitors of IL-17A signaling.

Accordingly, a first object of the present invention is a peptide, able to inhibit IL-17A binding to ILRA, having the aminoacid sequence of either:

formula (I):



wherein, independently from each other:

X₁ is I, V, D, K, W, A, G, L or P;

X₂ is H, M, K, N, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, H, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is W, Y, F or Q or it is absent;

X₁₁ is D, E or N or it is absent;

X₁₂ is W, F, V, H or Y or it is absent;

X₁₃ is I, V, F, E, K, A, G, L, P or Y or its absent;

X₁₄ is N, R, E, F, Q or D or it is absent;

X₁₅ is K, R, E, F, V, W, H or D or it is absent;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1) or a 12-14 aminoacid long C-terminal truncated sequence thereof IHVTIPADLWDWIN, IHVTIPADLWDWI or IHVTIPADLWDW;

or formula (II):

(II) a_n-DLSAVCWAFPWDPECH-b_{n'},

wherein, independently from each other:

a, b are selected from A, R, N, D, C, E, Q, G, H, I, L, K, M, F, P, S, T, W, Y or V;

n = integer from 0 to 3;

n' = integer from 0 to 3.

Preferably, in formula (II) each of the aminoacids different from a or b can be replaced with a conservative substitution.

A preferred peptide of formula (II) is DLSAVCWAFPWDPECH (SEQ ID N. 41).

Particularly preferred are the peptides of formula (I).

According to a preferred embodiment, in said peptide of formula (I):

X₁ is I, V, D, K or W;

X₂ is H, M, K or N;

X₃ is V or F;

X₄ is T, Q, H, V or Y;

X₅ is I or F;

X₆ is P or G;

X₇ is A or Q;

X₈ is D, E, N;

X₉ is L, V, F or W;

X₁₀ is W, Y, F or it is absent;

X₁₁ is D, E, N or it is absent;

X₁₂ is W, F, V or it is absent;

X₁₃ is I, V, F or it is absent;

X₁₄ is N, R, E, F or it is absent;

X₁₅ is K, R, E, F, V, W or it is absent;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1) or a 12-14 aminoacid long C-terminal truncated sequence thereof IHVTIPADLWDWIN, IHVTIPADLWDWI or IHVTIPADLWDW.

According to an alternative preferred embodiment, in said peptide of formula (I):

X₁ is I, V, A, G, L, or P;

X₂ is H, M, K, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is W, Y, F or Q or it is absent;

X₁₁ is D, E or N or it is absent;

X₁₂ is W, F, H or Y or it is absent;

X₁₃ is I, V, F, E, K, A, G, L, P or Y or its absent;

X₁₄ is N, R, E, Q or D or it is absent;

X₁₅ is K, R, E, V, W, H or D or it is absent;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1) or a 12-14 aminoacid long C-terminal truncated sequence thereof IHVTIPADLWDWIN, IHVTIPADLWDWI or IHVTIPADLWDW.

Preferably, in the above peptide of formula (I) all aminoacids X₁ to X₁₅ are present and the above described peptides of formula (I) have a 15 aminoacid sequence. Preferably, in the peptides of formula (I) having a sequence of less than 15 aminoacids, when one aminoacid is absent, also all aminoacids at the N terminal of said aminoacid are absent. For example, if aminoacid X₁₀ is absent, also aminoacids X₁₁ to X₁₅ are absent.

Particularly preferred peptides of formula (I) are those wherein X₁ is V.

A particular preferred peptide having X₁ as V is the peptide of SEQ ID N 2.

As will be demonstrated in the experimental section, the present inventors have found that the peptide of SEQ ID N 2, where the first aminoacid Isoleucin in the peptide HAP of SEQ ID N.1 has been replaced by a Valine, surprisingly shows strikingly different functional and chemical-physical properties as well as improved tolerability compared to HAP.

In particular, as demonstrated in the Examples, the peptide shows improved chemical-physical properties, that are particularly advantageous for topical and ophtalmic use, a better permeability and an increased affinity for IL-17A compared to the corresponding peptide of SEQ ID N 1. Also, the inventors have found that the peptide HAP, independently from its activity on IL-17A signaling, exerts a direct toxicity effect on corneal cells by inducing the expression of inflammatory cytokines. Surprisingly, the peptide of SEQ ID N. 2 does not show this effect and therefore is characterized by an improved tolerability compared to HAP.

Preferably, in the above peptide of formula (I):

X₁ is I, V or L;

X₂ is H, M, R, K or E;

X₃ is V, F or I;

X₄ is T, Q, S, Y or N;

X₅ is I, F or V;

X₆ is P;

X₇ is A, Q, or L;

X₈ is D, E, or Q;

X₉ is L, W, F, V or I;

X₁₀ is W, Y or F;

X₁₁ is D, E or N;

X₁₂ is W or F;

X₁₃ is I, V, F or L;

X₁₄ is N, R, Q or E;

X₁₅ is K, R, H or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

X₁ is I or V;

X₂ is H, M or R,

X₃ is V or F;

X₄ is T or Q;

X₅ is I, F or V;

X₆ is P or G;

X₇ is A or Q;

X₈ is D or E;

X₉ is L;

X₁₀ is W or Y;

X₁₁ is D or E;

X₁₂ is W;

X₁₃ is I or V;

X₁₄ is N, R or E;

X₁₅ is K, R or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

X₁ is I or V;

X₂ is H or M,

X₃ is V;

X₄ is T;

X₅ is I;

X₆ is P;

X₇ is A;

X₈ is D;

X₉ is L, W, F, V or I;

X₁₀ is W or Y;

X₁₁ is D or E;

X₁₂ is W;

X₁₃ is I or V;

X₁₄ is N, R or E;

X₁₅ is K, R or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

X₁ is I, V, A, G, L, or P;

X₂ is M, K, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is Y, F or Q;

X₁₁ is D, E or N;

X₁₂ is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L or P;

X_2 is M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L or P;

X_2 is H, M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L or P;

X_2 is M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

Or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is W, Y, F or Q;

X₁₁ is E or N;

X₁₂ is W, F, H or Y;

X₁₃ is V, F, E, K, A, G, L, P or Y;

X₁₄ is N, R, E, Q or D;

X₁₅ is K, R, E, V, W, H or D;

or

X₁ is I, V, A, G, L, or P;

X₂ is H, M, K, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is Y, F or Q;

X₁₁ is E or N;

X₁₂ is W, F, H or Y;

X₁₃ is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is R, E, Q or D;

X_{15} is R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is R, E, Q or D;

X_{15} is R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is R, E, Q or D;

X_{15} is R, E, V, W, H or D.

Particularly preferred peptides of formula (I) among those described above are those wherein X_1 is V.

As will be demonstrated in the experimental section, when the first aminoacid in the peptide of formula (I) is a valine, the peptide surprisingly shows chemical-physical properties particularly advantageous for topical and ophthalmic use and an increased affinity for IL-17A.

Preferably, in the above peptide of formula (I) all aminoacids X_1 to X_{15} are present.

Preferred individual peptides of formula (I) according to the present invention are listed in Table 1 below.

Table 1

SEQ ID N.	Sequence
SEQ ID N. 2	VHVTIPADLWDWINK
SEQ ID N. 3	IMVTIPADLWDWINK
SEQ ID N. 4	VMVTIPADLWDWINK
SEQ ID N. 5	IHVTIPADLWDWINK
SEQ ID N. 6	IHVTIPADLYDWINK
SEQ ID N. 7	IHVTIPADLYEWINK
SEQ ID N. 8	IHVTIPADLWDWVVK
SEQ ID N. 9	IHVTIPADLWDWIRK
SEQ ID N. 10	IHVTIPADLWDWINR
SEQ ID N. 11	IHVTIPADLWDWIEK
SEQ ID N. 12	IHVTIPADLWDWINE
SEQ ID N. 13	IHVTIPADLYEWINK
SEQ ID N. 14	IHVTIPADLWDWVRR
SEQ ID N. 15	IHVTIPADLWDWVEE
SEQ ID N. 16	VMVTIPADLYEWINK

SEQ ID N. 17	VMVTIPADLYEWIRR
SEQ ID N. 18	VMVTIPADLYEWIEE
SEQ ID N. 42	IMVTIPADLYEWIEE
SEQ ID N. 111	VHVTIPAELEWVRR
SEQ ID N. 112	VHFTIPADLEWVRR
SEQ ID N. 113	VHVQIPADLEWVRR
SEQ ID N. 114	VHVTFPADLEWVRR
SEQ ID N. 115	VHVTIPQDLEWVRR
SEQ ID N. 116	VHVTIPANLEWVRR
SEQ ID N. 117	VHVTIPADFEWVRR
SEQ ID N. 118	VHVTIPADLYEWVRR
SEQ ID N. 119	VHVTIPADLWNWVRR
SEQ ID N. 120	VHVTIPADLEWFVRR
SEQ ID N. 121	VHVTIPADLEWFRR
SEQ ID N. 122	VHVYIPAELEWVRR
SEQ ID N. 123	VHVTIPAEWWEWVRR
SEQ ID N. 124	VHFTFPQDLEWVRR
SEQ ID N. 125	VHFTFPQDFEWVRR
SEQ ID N. 126	VHFTIPQDLYEWVRR
SEQ ID N. 127	VHFTFPQDLWNWVRR
SEQ ID N. 128	VHFTFPQDLWEFVRR
SEQ ID N. 129	VHFTFPQDLEWFRR
SEQ ID N. 130	VHFQFPADLEWVRR
SEQ ID N. 131	VHFQFPADFEWVRR
SEQ ID N. 132	VHFQFPADLYEWVRR

SEQ ID N. 133	VHFQFPADLWNWVRR
SEQ ID N. 134	VHFQFPADLWEFVRR
SEQ ID N. 135	VHFQFPADLWEWFRR
SEQ ID N. 136	VHFQFPQDWWWEVRR
SEQ ID N. 137	VHFQIPQDWWWEVRR
SEQ ID N. 138	VHFQFPQDWEVRR
SEQ ID N. 139	VHFQFPQDWWNVRR
SEQ ID N. 140	VHFQFPQDLWEFVRR
SEQ ID N. 141	VHFQFPQDWWWEFRR
SEQ ID N. 142	VHFTIPADFEWFRR
SEQ ID N. 143	VHVQIPADFEWFRR
SEQ ID N. 144	VHVTFPADLWEWFRR
SEQ ID N. 145	VHV TIPQDFWEWFRR
SEQ ID N. 146	VHFTIPQDWWWEVRR
SEQ ID N. 147	VHFTFPQDLYNVRR
SEQ ID N. 148	VHFTFPQDLYNFVRR
SEQ ID N. 149	VHV TIPADLYNFFRR
SEQ ID N. 150	VHFQFPQDLWEVRR
SEQ ID N. 151	VHFTIPQDLYNWRR
SEQ ID N. 152	VHFTIPADLYNFVRR
SEQ ID N. 153	VHFQIPQDLYNFFRR
SEQ ID N. 154	VHFQFPQEYWNWFRR
SEQ ID N. 155	VRFQFGQEYWNFFRR
SEQ ID N. 158	AHVTIPADLWDWINK
SEQ ID N. 159	GHVTIPADLWDWINK

SEQ ID N.160	LHVTIPADLWDWINK
SEQ ID N. 161	PHVTIPADLWDWINK
SEQ ID N. 162	IRVTIPADLWDWINK
SEQ ID N. 163	IKVTIPADLWDWINK
SEQ ID N. 164	IEVTIPADLWDWINK
SEQ ID N. 165	IQVTIPADLWDWINK
SEQ ID N.166	IYVTIPADLWDWINK
SEQ ID N. 167	IHATIPADLWDWINK
SEQ ID N. 168	IHGTIPADLWDWINK
SEQ ID N. 169	IHLTIPADLWDWINK
SEQ ID N. 170	IHPTIPADLWDWINK
SEQ ID N. 171	IHITIPADLWDWINK
SEQ ID N. 172	IHYTIPADLWDWINK
SEQ ID N. 173	IHWTIPADLWDWINK
SEQ ID N. 174	IHFTIPADLWDWINK
SEQ ID N. 175	IHVSIPADLWDWINK
SEQ ID N. 176	IHVIYIPADLWDWINK
SEQ ID N. 177	IHVNIIPADLWDWINK
SEQ ID N. 178	IHVQIPADLWDWINK
SEQ ID N. 179	IHVTAPADLWDWINK
SEQ ID N. 180	IHVTGPADLWDWINK
SEQ ID N. 181	IHVTLIPADLWDWINK
SEQ ID N. 182	IHVTPPADLWDWINK
SEQ ID N. 183	IHVTVIPADLWDWINK
SEQ ID N. 184	IHVTFPADLWDWINK

SEQ ID N. 185	IHVTYPADLWDWINK
SEQ ID N. 186	IHVTIAADLWDWINK
SEQ ID N. 187	IHVTIGADLWDWINK
SEQ ID N. 188	IHVTILADLWDWINK
SEQ ID N. 189	IHVTIVADLWDWINK
SEQ ID N. 190	IHVTIADLWDWINK
SEQ ID N. 191	IHVTINADLWDWINK
SEQ ID N. 192	IHVTIPGDLWDWINK
SEQ ID N. 193	IHVTIPLDLWDWINK
SEQ ID N. 194	IHVTIPDLWDWINK
SEQ ID N. 195	IHVTIPVDLWDWINK
SEQ ID N. 196	IHVTIPIDLWDWINK
SEQ ID N. 197	IHVTIPNDLWDWINK
SEQ ID N. 198	IHVTIPQDLWDWINK
SEQ ID N. 199	IHVTIPAQLWDWINK
SEQ ID N. 200	IHVTIPAYLWDWINK
SEQ ID N. 201	IHVTIPADAWDWINK
SEQ ID N. 202	IHVTIPADGWDWINK
SEQ ID N. 203	IHVTIPADPWDWINK
SEQ ID N. 204	IHVTIPADVWDWINK
SEQ ID N. 205	IHVTIPADIWDWINK
SEQ ID N. 206	IHVTIPADLHDWINK
SEQ ID N. 207	IHVTIPADLFDWINK
SEQ ID N. 208	IHVTIPADLWNWINK
SEQ ID N. 209	IHVTIPADLWDHINK

SEQ ID N. 210	IHVTIPADLWDFINK
SEQ ID N. 211	IHVTIPADLWDYINK
SEQ ID N. 212	IHVTIPADLWDWENK
SEQ ID N. 213	IHVTIPADLWDWKNK
SEQ ID N. 214	IHVTIPADLWDWANK
SEQ ID N. 215	IHVTIPADLWDWGNK
SEQ ID N. 216	IHVTIPADLWDWLNK
SEQ ID N. 217	IHVTIPADLWDWPNK
SEQ ID N. 218	IHVTIPADLWDWFNK
SEQ ID N. 219	IHVTIPADLWDWYNK
SEQ ID N. 220	IHVTIPADLWDWIQK
SEQ ID N. 221	IHVTIPADLWDWIDK
SEQ ID N. 222	IHVTIPADLWDWINH
SEQ ID N. 223	IHVTIPADLWDWIND
SEQ ID N. 224	VHVTVPQELWEWVRR
SEQ ID N. 225	VHVTVPQELFEWVRR
SEQ ID N. 226	VHVTVPQELYEWVRR
SEQ ID N. 227	VHVTVPQELWEWVEE
SEQ ID N. 228	VHVTVPQELFEWVEE
SEQ ID N. 229	VHVTVPQELYEWVEE
SEQ ID N. 230	VHVSIPQELWEWVRR
SEQ ID N. 231	VHVSVPQELWEWVRR
SEQ ID N. 232	VHVSVPQELYEWVRR
SEQ ID N. 233	VRVTIPQELWEWVRR
SEQ ID N. 234	VRVTVPQELYEWVRR

SEQ ID N. 235	VRVTVPQELWEWVRR
SEQ ID N. 236	VHVTVPQEIEWVRR
SEQ ID N. 237	VHVTIPQEIEWVRR
SEQ ID N. 238	VHFTVPQELIEWVRR
SEQ ID N. 239	VKISVPADLWDWINK
SEQ ID N. 240	LRISVPADLWDWINK
SEQ ID N. 241	LRIYVPADLWDWINK
SEQ ID N. 242	VRGYVPADLWDWINK
SEQ ID N. 243	VRAYVPADLWDWINK
SEQ ID N. 244	VRLYVPADLWDWINK
SEQ ID N. 245	VRIYLPADLWDWINK
SEQ ID N. 246	IHVTIPLEIFEWLQH
SEQ ID N. 247	IHVTIPLEIFEWAQH
SEQ ID N. 248	IHVTIPLEIFEWLQR
SEQ ID N. 249	IHVTIPLEVFEWLQH
SEQ ID N. 250	IHVTIPGEIFEWLQH
SEQ ID N. 251	VRFSVPQEIEWVRR
SEQ ID N. 252	LRISVPLEIFEWLQH
SEQ ID N. 253	LRGSVPLEIFEWLQH
SEQ ID N. 254	VKISVPLEIFEWLQH
SEQ ID N. 255	VEFNFPQQVYEWFD
SEQ ID N. 256	VEFNFPQQVYEWVRR
SEQ ID N. 257	TWYVFNEQHQEYVRK

Other peptides inhibitor of IL-17A according to the invention are those of Table 1A

Table 1A:

SEQ ID N. 156	VPGAGVPGAGIHVTI
SEQ ID N. 157	VPGAGVPGAGIHVTIPA

Further aminoacid sequences may be added at the N- or C- terminal of the peptides according to the first object of the invention.

According to a preferred embodiment, the above described peptides of formula (I) or (II) are bound at their N- and/or C-terminal to a further aminoacid sequence, Sequence A, having the aminoacid sequence of formula (III)

(III) $Y_1-Y_2-Y_3-Y_4-Y_5-Y_6-Y_7-Y_8-Y_9-Y_{10}-Y_{11}-Y_{12}-Y_{13}-Y_{14}-Y_{15}-Y_{16}$

wherein:

Y_1 is A, T, V, K, R, I, L, X or G;

Y_2 is R, W, P, E, Q or A;

Y_3 is K, W, G, T, I, R or P;

Y_4 is K, T, E, W, A, R, D, G, X or F;

Y_5 is A, E, T, G, W, I, R, P or V;

Y_6 is A, W, E, R, G, P or absent;

Y_7 is K, S, W, T, F, R, V, G or absent;

Y_8 is A, Q, W, R, G or absent;

Y_9 is N, G or absent;

Y_{10} is R or absent;

Y_{11} is R or absent;

Y_{12} is M or absent;

Y_{13} is K or absent;

Y_{14} is W or absent;

Y₁₅ is K or absent;

Y₁₆ is K or absent.

Preferably, in the sequence of formula (III), when an aminoacid is absent, also the aminoacids at the N terminal of said aminoacids are absent. For example, if aminoacid Y₆ is absent, also aminoacids Y₇ to Y₁₆ are absent.

Preferred sequences of formula (III) according to the present invention are listed in Table 2 below.

Table 2

SEQUENCE ID	Sequence
SEQ ID N. 44	ARKKAACA
SEQ ID N. 45	TWWTEWSQ
SEQ ID N. 46	TWWETWW
SEQ ID N. 47	VPGWG
SEQ ID N. 48	KETWWETW
SEQ ID N. 49	VPKGK
SEQ ID N. 50	VPGAG
SEQ ID N. 51	RQIKIWFQNRMRMKWKK
SEQ ID N. 52	RRRRRRRR
SEQ ID N. 53	VPGDG
SEQ ID N. 54	VPGXG
SEQ ID N. 55	IPGG
SEQ ID N. 56	AVGVP
SEQ ID N. 57	IPGXG
SEQ ID N. 58	IPGVG
SEQ ID N. 59	LPGXG

SEQ ID N. 60	LPGVG
SEQ ID N. 61	VAPGVG
SEQ ID N. 62	XPGVG
SEQ ID N. 63	GVGVPGVG
SEQ ID N. 64	VPFGVGAG
SEQ ID N. 65	VPGGVPGG

Accordingly, a second object of the invention is a peptide having an aminoacid sequence comprising, preferably consisting of, the sequence of the peptide of formula (I) or (II) according to the first object of the invention and at the C- and/or N- terminal of said sequence a Sequence A as above described.

The aminoacid sequence Sequence A may be bound to both the N- and C- terminal of the peptide of formula (I) or (II). In such a case, the two aminoacid sequences Sequence A bound to the N- and to C- terminal of said peptide may be the same or different.

Alternatively, the aminoacid sequence Sequence A may be bound either to the N- or to the C- terminal of the peptide.

Preferred individual peptides according to this object of the invention are listed in Table 3 below.

Table 3

SEQ ID N.	Sequence
SEQ ID N. 21	VMVTIPADLYEWIEEARKKAACA
SEQ ID N. 22	VMVTIPADLYEWIEEGGTWWTEWSQ
SEQ ID N.23	VMVTIPADLYEWIEETWWETWW
SEQ ID N. 24	VMVTIPADLYEWIEEVPGWG
SEQ ID N. 25	VMVTIPADLYEWIEEGGKETWWETW

SEQ ID N. 26	VMVTIPADLYEWIEEVPKGK
SEQ ID N. 27	VMVTIPADLYEWIEEVPGAG
SEQ ID N. 28	VMVTIPADLYEWIEERQIKIWFQNRMRKWK
SEQ ID N. 31	ARKKAAKAVMTIPADLYEWIEE
SEQ ID N. 32	GGTWWTEWSQVMVTIPADLYEWIEE
SEQ ID N. 33	GGKETWWETWVMVTIPADLYEWIEE
SEQ ID N. 34	VPGWGVMVTIPADLYEWIEE
SEQ ID N. 35	VPGAGVMVTIPADLYEWIEE
SEQ ID N. 36	VPKGVMVTIPADLYEWIEE
SEQ ID N. 37	VMVTIPADLYEWIEEVPGAGVPGAG
SEQ ID N. 38	VPGAGVPGAGVMVTIPADLYEWIEE
SEQ ID N. 39	VPGDGVMVTIPADLYEWIEE
SEQ ID N. 40	VMVTIPADLYEWIEEVPGDG

In an embodiment alternative to the above, said peptides of formula (I) or (II) according to the first object of the invention may be bound at their N- and/or C-terminal to an aminoacid sequence $(A)_m$, wherein A is an aminoacid selected from R, K, G, E, Q or A, preferably R, K, G, E or A, and m is an integer between 1 and 10.

The aminoacid sequence $(A)_m$ may be bound to both the N- and C- terminal of the peptide of formula (I) or (II). In such a case, the two aminoacid sequences $(A)_m$ attached to the N- and to the C-terminal of said peptide have may be the same or different.

Alternatively, the aminoacid sequence $(A)_m$ may be attached either to the N- or the C-terminal of said peptide.

Accordingly, a third object of the invention is a peptide having an aminoacid sequence that comprises, preferably consists of, the sequence of the peptide according to the first object of

the invention and at the C- and/or N- terminal of said sequence a sequence (A)_m as above defined.

Preferred individual peptides according to this embodiment of the invention are listed in Table 4 below.

Table 4

SEQ ID N.	Sequence
SEQ ID N. 19	VMVTIPADLYEWIEERRRRRR
SEQ ID N. 20	VMVTIPADLYEWIEERRR
SEQ ID N. 29	RRRRRRRRVMVTIPADLYEWIEE
SEQ ID N. 30	VMVTIPADLYEWIEERRRRRRRR
SEQ ID N. 43	IMVTIPADLYEWIEEQ

In a particular embodiment, said peptides of formula (I) or (II) are bound to both a sequence Sequence A and a sequence (A)_m. In this case, said peptides are bound at their N- and/or C-terminal to an aminoacid sequence (A)_m, as defined above, which is bound at its N- and/or C-terminal to an aminoacid sequence Sequence A, as described above.

Accordingly, a fourth object of the invention is a peptide having an aminoacid sequence that comprises, preferably consists of, the sequence of the peptide according to the first object of the invention, at the C- and/or N- terminal of said sequence a sequence (A)_m as above described and at the C- and/or N- terminal of said sequence (A)_m a Sequence A as above described.

According to a preferred embodiment of the peptide according to any of the above objects of the invention, said peptide is bound at the C- and/or N-terminal to a protective cap group, able to prevent degradation.

Any protective cap group customary in the art may be used.

Preferably, the protective cap group bound to a C-terminal is selected from amides, preferably N-alkyl amides, aldehydes, esters, preferably methyl and ethyl esters, p-Nitroanilide, 7-Amino-4-methylcoumarin.

Preferably, the protective group cap bound to a N-terminal is selected from acetyl, formyl, pyroglutamyl, fatty acids, urea, carbamate sulfonamide, alkylamine.

Preferably, the above peptides are bound to the protective cap group at the N-terminal only. More preferably said peptides are bound to the protective cap group at the N-terminal only and the protective cap group is acetyl.

It is particularly advantageous to prepare dimers of the above described peptides according any of the different objects of the invention, preferably of the peptides of formula (I) or (II) according to the first object of the invention, in order to increase binding affinity and inhibitor activity.

In accordance with the above, preferably the peptides according to the different objects of the invention above described, preferably of the peptides of formula (I) or (II) according to the first object of the invention, more preferably the peptides of formula (I) according to the first object of the invention, are present in form of dimers.

Accordingly, a fifth object of the present invention is a dimer formed by two peptides according to any of the above objects of the invention. Preferably said peptides are peptides of formula (I) or (II) according to the first object of the invention, more preferably they are peptides of formula (I) according to the first object of the invention.

Preferably, said dimer is a homodimer, wherein the two peptides forming the dimer have an identical sequence. Preferably, in said dimer, the peptides are linked by means of a spacer molecule, preferably a polyethylene glycol spacer.

Preferably, according to this embodiment, polyethylene glycol is linked to the N-terminal of the peptides according to the invention or to the aminoacids X₄, X₇ or X₁₄ of two peptides of formula (I).

According to a further embodiment, in the absence of a protective group cap, the peptides according to the different objects of the invention are bound, preferably at their C- and/or N-terminal, to a biomolecule to form a bioconjugate. Preferably, said biomolecule is selected from capric acid, capronic acid, ascorbic acid, NAG-NAM, NAG, NAM, hyaluronic acid, alginic acid, chitin, (GalNAc)₂, Gal-alpha1,3-GalNAc and trigalacturonic acid.

The biomolecule is bound to the peptide either to add a specific function to the peptide or to modulate the physical chemical properties of the peptide. For example, ascorbic acid provides an antioxidant activity to the peptide, capronic acid favors the anchoring of the peptide to the cell membrane.

Accordingly, a sixth object of the invention is a bioconjugate comprising, preferably consisting of, a peptide according to the different objects of the invention, preferably a peptide of formula (I) or (II) according to the first object of the invention, more preferably a peptide of formula (I) according to the first object of the invention, and at least a biomolecule, as above described.

Preferably, in said bioconjugate, said biomolecule is bound to the N- and/or C- terminal of said peptide.

Preferred bioconjugates according to this embodiment are listed in Table 5 below.

Table 5

Bioconjugate name	Sequence
Bio-1	NAM-IMVTIPADLYEWIEE
Bio-2	IMVTIPADLYEWIEEQ-NAG
Bio-3	NAG-NAM- IMVTIPADLYEWIEE

Bio-4	capric acid- IMVTIPADLYEWIEE
Bio-5	Ascorbic acid - IMVTIPADLYEWIEE

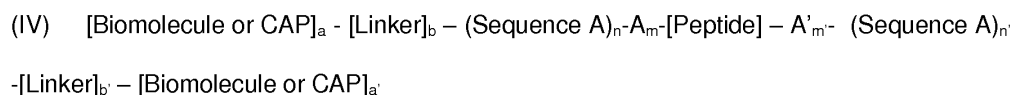
According to one embodiment, in the above bioconjugate the above biomolecule or protective cap group are bound directly to the N and/or C-terminal of the peptide.

According to one embodiment, said biomolecule is bound to both the N- and C- terminal of the peptide. In such a case, the two biomolecules bound to the N and to the C terminal of said peptide may be the same or different.

According to an alternative embodiment, said biomolecule is bound to either the N- or the C-terminal of the peptide.

According to an alternative embodiment, the above biomolecule or protective cap group are linked to the N- and/or C terminal of the peptide by means of a linker. Preferably, said linker is selected from 4-aminobutyric acid, beta-alanine, 2-aminoethoxy-acetic acid, 5-aminovaleric acid, 6-aminocaproic acid, 8-Amino-3,6-dioxaoctanoic acid, 12-amino-4,7,10-trioxadodecanoic acid, 15-amino-4,7,10,13-tetraoxapenta-decanoic acid and trioxatridecan-succinamic acid. Preferably, when the linker is attached on one amino acid Lysine, said linker is selected from NHS-ester, isocyanates, benzoyl fluorides or carbamates.

In accordance with to the different embodiments described above, the present invention relates to a compound comprising or consisting of the IL-17A binding peptide of formula (I) or (II) above described, and having the following formula (IV):



wherein, independently from each other:

a = 0 or 1;

b = 0 or 1;

$a' = 0$ or 1 ;

$b' = 0$ or 1 ;

$m = 0$ to 10 ;

$m' = 0$ to 10 ;

$n = 0$ or 5 ;

$n' = 0$ or 5 ,

and

Peptide is the polypeptide according to formula (I) or formula (II);

A or A' is one amino acid selected from R, K, G, E or A repeated m or m' times;

and Sequence A comprises the sequence of formula (III) above described.;

Biomolecule is, independently from each other, capronic acid, ascorbic acid, NAG-NAM, NAG, NAM, hyaluronic acid, alginic acid, chitin, (GalNAc)₂, Gal- α 1,3-GalNAc or trigalacturonic acid;

CAP is, independently from each other, amide, aldehyde, ester, p-Nitroanilide, 7-Amino-4-Methylcoumarin, acetyl, formyl, pyroglutamyl or a fatty acid;

Linker is, independently from each other, 4-aminobutyric acid, beta-alanine, 2-aminoethoxy-acetic acid, 5-aminovaleric acid, 6-aminocaproic acid, 8-Amino-3,6-dioxaoctanoic acid, 12-amino-4,7,10-trioxadodecanoic acid, 15-amino-4,7,10,13-tetraoxapenta-decanoic acid or trioxatridecan-succinamic acid.

According to a preferred embodiment, said Sequence A is attached to the N-terminal or to the C-terminal of the peptide of formula (I) or (II).

Some examples of the possible compounds according to the present invention are reported here below, but all the other possible combination comprised in the formula (IV) can be present:

- [Biomolecule or Cap] - [Linker] - (Sequence A) -A-[Peptide]-;

- [Biomolecule or Cap] - (Sequence A) -A-[Peptide]-;
- [Biomolecule or Cap] - -A-[Peptide]-;
- [Biomolecule or Cap] -[Peptide]-;
- -[Peptide] - A_m- (Sequence A)_n- [Biomolecule or Cap]_a;
- -[Peptide] - A_m- [Biomolecule or Cap]_a;
- -[Peptide]- [Biomolecule or Cap]_a;

According to a preferred embodiment, the biomolecule in formula (IV) of the present invention is selected from ascorbic acid, capronic acid, NAG or NAM.

According to a further preferred embodiment the Cap according to the present invention is a C-ter modification selected from amides, preferably N-alkyl amides, aldehydes, esters, preferably methyl and ethyl esters, p-Nitroanilide, 7-Amino-4-Methylcoumarin or N-ter modification selected from acetyl, formyl, pyroglutamyl, fatty acids, preferably capronic acid, urea, carbamate, sulfonamide or alkylamine, preferably said Cap is selected from amides, fatty acids as capronic acid and acetyl.

According to the present invention, said linker, biomolecule or Cap in formula (IV) can be the same or different each other.

In a further preferred embodiment of the present invention the Linker of formula (IV) is selected from 4-aminobutyric acid, beta-alanine, 2-aminoethoxy-acetic acid, 5-aminovaleric acid or trioxatridecan-succinamic acid.

Preferably, when the linker is attached on one amino acid Lysine, said linker is selected from NHS-ester, isocyanates, benzoyl fluorides or carbamates.

A seventh object of the present invention is a pharmaceutical composition comprising said peptide, dimer or a bioconjugate according to the objects of the invention, as described above, and at least one pharmaceutically acceptable excipient.

The pharmaceutical composition of the present invention can be formulated in a form that is

suitable for topical or ophthalmic administration.

Preferably, when the administration of the pharmaceutical composition of the invention is performed by topical route, the pharmaceutical form is selected from cream, ointment, gel, salve, solution, washing, suspension, drops, buffer (buffer solution), suspension, eye drops, drops, spray, wipe, or powder, preferably it is selected from cream, gel, spray, or ointment.

Among the ophthalmic administration, the pharmaceutical form is preferably selected from eye drops, ophthalmic gels, ointments, wash, wipe, spray or cream.

According to a particular embodiment the peptides or bioconjugates of the present invention are administered locally by using microparticles or nanoparticles.

According to the invention, the pharmaceutical composition of the present invention can be administered to animals and humans, defined as adults and as "paediatric population", wherein with the term "paediatric population" is indicated the part of the population from birth to eighteen years of age.

An eighth object of the present invention is the above described peptide, dimer or bioconjugate according to the invention for use in the treatment and/or prevention of an inflammatory and autoimmune disease.

A ninth object of the invention is a method for the treatment and/or prevention of an inflammatory and autoimmune disease, comprising administering to a patient in need thereof a therapeutically effective amount of the above described peptide, dimer or bioconjugate according to the invention.

Preferably, said inflammatory and autoimmune disease is selected from rheumatoid arthritis, multiple sclerosis, Crohn's disease, systemic lupus erythematosus, asthma, Behçet's disease, hyper IgE syndrome, ankylosing spondylitis, psoriasis, psoriatic arthritis, rheumatoid arthritis, keratoconjunctivitis sicca, vernal keratoconjunctivitis, stromal herpetic keratitis, corneal allograft rejection, corneal infections, preferably herpes virus and Pseudomonas

aeruginosa keratitis, and dry eye disease. More preferably said disease is an autoimmune ophthalmic or dermatological disease, even more preferably it is dry eye disease or psoriasis.

All of the above specified diseases and medical conditions have in common that their origin and/or symptoms are IL-17A and/or Th-17-related.

More specifically for the latter, dry eye disease (DED), a highly prevalent condition that includes a wide spectrum of ocular surface disorders, ocular mucosal inflammation is a peculiar characteristic potentially leading to vision loss if uncontrolled, due to inflammation-induced corneal ulceration and scarring. In the progression of DED, pathogenic immune cells, predominantly Th17 cells continuously migrate to the ocular mucosal surface and secrete pro-inflammatory mediators, including IL17, causing ocular surface inflammation and epitheliopathy.

The peptides, dimers or bioconjugates of the invention are conveniently and preferably administered topically as eye drops or ophthalmic gels and ointments.

In a further embodiment, the peptide, dimer or bioconjugate for use according to the present invention, are administered as the only active principle or in combination with further active principles, and/or in combination with medical devices for the symptomatic treatment of ophthalmic conditions including but not limited to DED, e.g. ocular lubricants or "artificial tears", topical re-epithelizing agents, therapeutic contacts lenses and punctum plugs.

Preferably, said further active principle is an adjuvant, immunosuppressive agent, immunomodulating agent or anti-inflammatory agent.

For example, the IL-17A binding peptide of the present invention may be used in combination with DMSO.

According to a preferred embodiment, the IL-17A binding peptide of the present invention may be used in combination with immunosuppressive monoclonal antibodies, such as

monoclonal antibodies with affinity to leukocyte receptors, selected from MHC, CD2, CD3, CD4, CD7, CD8, CD25, CD28, CD40, CD45, CD58, CD80, CD86 or their ligands; other immunomodulatory compounds, preferably a recombinant binding molecule having at least a portion of the extracellular domain of CTLA4 or a mutant thereof, an at least extracellular portion of CTLA4 or a mutant thereof joined to a non-CTLA4 protein sequence, e.g. (e.g. CTLA4Ig, designated ATCC 68629) or a mutant thereof, e.g. LEA29Y; adhesion molecule inhibitors, LFA-I antagonists, ICAM-I or -3 antagonists, VCAM-4 antagonists or VLA-4 antagonists.

In a further preferred embodiment the IL-17A binding peptide of the present invention is used in combination with DMARD (disease-modifying antirheumatic drug), preferably Gold salts, sulphasalazine, anti- malarias, methotrexate, D-penicillamine, azathioprine, mycophenolic acid, cyclosporine A, tacrolimus, sirolimus, minocycline, leflunomide, glucocorticoids; a calcineurin inhibitor, preferably cyclosporin A or FK 506; a modulator of lymphocyte recirculation, preferably FTY720 and FTY720 analogs; a mTOR inhibitor, preferably rapamycin, 40-O-(2- hydroxyethyl)-rapamycin, CCI779, ABT578, AP23573 or TAFA-93; an ascomycin having immuno-suppressive properties, preferably ABT-281, ASM981; corticosteroids; cyclophosphamide; azathioprene; methotrexate; leflunomide; mizoribine; mycophenolic acid; mycophenolate mofetil; 15-deoxyspergualine or an immunosuppressive homologue, analogue or derivative thereof; or a chemotherapeutic agent, preferably paclitaxel, gemcitabine, cisplatin, doxorubicin or 5-fluorouracil; anti-TNF agents, preferably monoclonal antibodies to TNF, preferably infliximab, adalimumab, CDP870, or receptor constructs to TNF-RI or TNF-RII, preferably Etanercept, PEG-TNF-RI; blockers of proinflammatory cytokines, IL-1 blockers, preferably Anakinra or IL-1 trap, AAL160, ACZ 885, IL-6 blockers; inhibitors or activators of proteases, preferably metalloproteases, anti-IL-15 antibodies, anti-IL-6 antibodies, anti-IL-23 antibodies, anti-IL-22 antibodies, anti-IL-21

antibodies, anti-IL-12 antibodies, anti-IFN-gamma antibodies, anti-IFN-alpha antibodies, anti-CD20 antibodies, anti-inflammatory agents, preferably aspirin or an anti-infectious agent.

Naturally, this list of agents for co-administration is not limiting nor complete.

A further object of the present invention is one the peptides listed in Table 6 for use in the treatment and/or prevention of an inflammatory and autoimmune disease described above.

Table 6.

SEQ ID N.	SEQUENCE
SEQ ID N. 1	IHVTIPADLWDWINK
SEQ ID N. 66	IVVTMPADLWDWIK
SEQ ID N. 67	IVVTMPADLWDWIRA
SEQ ID N. 68	IVVTMPADLWDWIRK
SEQ ID N. 69	IVVTMPADLWDWIAA
SEQ ID N. 70	IVVTMPADLWDWARA
SEQ ID N. 71	IVVTMPADLWAWIRA
SEQ ID N. 72	IVVTMPADLADWIRA
SEQ ID N. 73	IVVTMPADAWDWIRA
SEQ ID N. 74	IVVTMPADLWDWIRA
SEQ ID N. 75	IVVTAPADLWDWIRA
SEQ ID N. 76	IVVAMPADLWDWIRA
SEQ ID N. 77	IAVTMPADLWDWIRA
SEQ ID N. 78	AVVTMPADLWDWIRA
SEQ ID N. 79	IHVTMPADLWDWIRA
SEQ ID N. 80	IQVTMPADLWDWIRA
SEQ ID N. 81	IRVTMPADLWDWIRA
SEQ ID N. 82	ITVTMPADLWDWIRA

SEQ ID N. 83	IWVTMPADLWDWIRA
SEQ ID N. 84	IYVTMPADLWDWIRA
SEQ ID N. 85	IVVTIPADLWDWIRA
SEQ ID N. 86	IVVTLPADLWDWIRA
SEQ ID N. 87	IVVTVPADLWDWIRA
SEQ ID N. 88	IVVTMPADLWDWIMA
SEQ ID N. 89	IVVTMPADLWDWINA
SEQ ID N. 90	IVVTMPADLWDWIQA
SEQ ID N. 91	IVVTIPADLWDWIRA
SEQ ID N. 92	IVVTLPADLWDWIRA
SEQ ID N. 93	IHVTIPADLWDWINK
SEQ ID N. 94	IHVTIPADLWDWIN
SEQ ID N. 95	IHVTIPADLWDWI
SEQ ID N. 96	DSSAVCWAFPHHPLCHMKAT
SEQ ID N. 97	ADADMCWFFPTSPWCH
SEQ ID N. 98	DLSAVCWAFPWDPECHM
SEQ ID N. 99	DSSAVCWAFPYLPECH
SEQ ID N. 100	DISAVCWAFPDPPECH
SEQ ID N. 101	AYECPRLEYDMFGALHCLPS
SEQ ID N. 102	CPRLEYDMFGALHCL
SEQ ID N. 103	CLDLQYDPWGALHCI
SEQ ID N. 104	CFDLQYDPWGALHCI
SEQ ID N. 105	CLDLQYDMFGALHCV
SEQ ID N. 106	CLDLVYDPWGALHCI
SEQ ID N. 107	CWVLEYDMFGALHCR

SEQ ID N. 108	CWALEYDMFGYLHCR
SEQ ID N. 109	CWVLEYDMFGFLHCR
SEQ ID N. 110	CWVLEYDMFGYLHCR

The amount and mode of administration of the peptides according to the present invention will vary depending upon the particular peptide inhibitor of the invention, the individual patient group or patient, the presence of further medically active compounds and the nature and severity of the condition being treated.

According to a preferred embodiment, the prophylactic and/or therapeutic use dosages is of about 5-50 µg/ml, preferably of about 10-25 µg/ml

Preferably, the frequency of administration for prophylactic and/or therapeutic uses lies in the range of about once to twice daily applications, preferably once.

The invention is further described by way of illustration in the following examples, none of which are to be interpreted as limiting the scope of the invention as outlined in the appended claims.

Examples

Example 1 Peptides synthesis & purification:

We have developed a homology model of IL-17A by use of crystallographic data available (PDB 5h13, PDB 5vb9 and PDB 4hsa) (Liu et al. Nat Commun 2013, 4, 1888, Liu et al. Sci Rep 2016, 6: 30859, Liu et al. Sci Rep 2016, 6, 26071, Ting, Tung et al. Plos One 2018, 13(1): e01908502018). In our models we have also recreated the loops unresolved in the crystals and optimized models through a molecular dynamics simulation performed with Desmond software, as implemented in Schrodinger Maestro macromodel suite. All molecular simulations were run for 1 microsecond to guarantee the system stability.

Based on structure and properties of IL-17A α -pocket, different peptide sequences have been designed so as to obtain i) a stable secondary and tertiary conformation that engages IL-17A with an optimized protein binding site occupancy, and ii) physical-chemical properties suitable for topical use in ophthalmic and dermatological pathologies (Liu et al. Nat Commun 2013, 4, 1888, Espada et al J Med Chem 2016, 59(5), 2255-2260).

Additionally, we optimized the interactions ligand-IL-17A by the introduction of hydrogen bonds and optimization of hydrophobic interactions.

a. Fmoc-Based Solid-Phase Peptide Synthesis

All the chemicals were purchased and used without further purification.

Peptides of SEQ ID N. 1 to 43 and 111-257 of Table 1 were prepared by manual or automatic solid-phase peptide synthesis, on Rink Amide-MBHA resin as the solid support, as described below and with N-terminal amine capped with acetyl group.

The Fmoc (9-fluorenylmethoxycarbonyl) group used for N α -protection was cleaved by 8 min treatment with 20% piperidine in dimethylformamide (DMF) followed by a further treatment with the same reagent for 10 min. After Fmoc cleavage, the peptide-resin complex was washed with DMF ($\times$ 6). The next residue was then incorporated through the use of 1-[bis(dimethylamino)methylene]-1H-1,2,3-triazolo[4,5-b]pyridinium-3-oxid hexafluorophosphate (HATU) / N,N-diisopropylamine (DIPEA) coupling protocol [Fmoc-amino acid (3 equiv), HATU (3 equiv), and DIPEA (6 equiv)]. After gentle stirring (1 hr) and washing with DMF ($\times$ 6), part of the peptide-resin was analyzed by Kaiser test. On completion of the assembly, the peptide-resin was washed with DMF ($\times$ 3), dichloromethane (DCM) ($\times$ 4) and then dried *in vacuo*.

Cleavage and Deprotection

The peptide was cleaved from the resin and, when necessary, deprotected by using as cleavage solution a mixture of trifluoroacetic acid/ 1,2-ethanedithiol/ thioanisole/ phenol/

H₂O/ triisopropylsilane in the ratio 68.5/ 10/ 10/ 5/ 3.5/ 1, v/v. 3 ml of cleavage solution was used per 100 mg of resin. Complete deprotection was achieved under stirring for 4 hours at 30°C. Following the cleavage reaction, the peptide in the mixture was precipitated in cold diethyl ether and dried in vacuo at 50°C.

b. Disulfide Bond Formation in peptide 41

Disulfide bond formation in peptide of SEQ ID N. 41 of Table 1 was obtained by incubation of the peptide in a mixture DMSO/H₂O (20/80, v/v), which was monitored by RP-HPLC, MS and free sulfhydryl detection (DTNB method).

c. Purification by Preparative RP-HPLC and Purity Assessment by Analytical HPLC

The crude peptide samples were purified by preparative RP-HPLC (Agilent) using a C18 column (10 µm, 100 Å, 50 × 250 mm). A solvent system consisting of solvent A (0.1 % TFA, 2 % CH₃CN in water) and solvent B (90 % CH₃CN/H₂O) at a flow rate of 25 mL/min was used for elution, and the absorbance was detected at 220 nm. The solvent was removed by lyophilization. The final products were characterized by MALDI-TOF-MS, and the purity of the material assessed by analytical RP-HPLC (C18-250 mm × 4.6 mm I.D., flow rate of 1 mL/min), and the absorbance was detected at 220 nm.

Example 2: Preparation of NAM and/or NAG bioconjugated peptides BIO-1, BIO-2 and BIO-3

The bioconjugated peptides BIO-1, BIO-2 and BIO-3 were prepared by a conjugation reaction of peptide 42 or 43 according the following procedures.

1. Preparation of Donor and Acceptor

All reactions were performed under N₂ atmosphere. NMR spectra were run on a Bruker 400 MHz instrument. HPLC-UV analysis were obtained on an Agilent 1260 Infinity System, equipped with a G1311B Agilent 1260 quaternary pump, G1329B Agilent 1260 autosampler, G1315C Agilent 1260 diode array detector, and G1316A Agilent 1260 column thermostat

modules. A Phenomenex GEMINI C18 150 × 4.6 mm² (5 µm) column was used. The mobile phase A was MilliQ water with 0.05% TFA, and B was HPLC grade acetonitrile with 0.05% TFA at a flow rate of 1.0 mL/min. The HPLC system was coupled to an Agilent Quadrupole 6120 LC/MS mass spectrometer operated in positive ion mode. Ions were generated using an electrospray ionization ion source. Acquisition data were processed with Agilent Chemstation Software.

a. Synthesis of 1-(2,2,2-Trichloroacetimino)2-deoxy-3-O-acetyl-4,6-Obenzylidene-2-(2,2,2-tri-chloroethoxycarbonylamino)-α-D-glucopyranoside (Donor)

Trichloroethoxycarbonyl chloride (2,1 mL, 15,3 mmol) was added dropwise at room temperature to a vigorously stirred solution of D-glucosamine hydrochloride (3 g, 13,9 mmol) and NaHCO₃ (3,5 g, 41,7 mmol) in water (30 mL). The mixture was stirred for 2 h, then neutralized with 1 M HCl, concentrated, and dried in vacuo. 2-deoxy-2-(2,2,2-trichloroethoxycarbonylamino)-α-D-glucopyranoside (intermediate A) was obtained.

The crude product obtained was directly used for the next reaction step without further purification.

In details, zinc chloride (1,9 g, 13,9 mmol) was added to a solution of intermediate A (4,9 g, 13,9 mmol) in benzaldehyde (24 mL) and molecular sieves, 4 Å (4 Å MS, 600 mg). After stirring overnight at room temperature, saturated aq NaHCO₃ (30 mL) and diethyl ether (90 mL) were added and the reaction mixture was stirred for 15 min. The formed precipitate was filtered, washed with water, diethyl ether, and dried. The residue was dissolved in pyridine (13 mL) cooled to 0 °C, treated with acetic anhydride (6.4 mL, 68 mmol) and stirred overnight at room temperature, then the solution was concentrated with toluene, cooled to 0 °C and extracted with DCM and saturated aq NaHCO₃ (3x), then washed with a saturated NaCl solution. The combined organic layers were dried, concentrated, and the crude purified by Isolera (EtPet/EtOAc) to give 1,3-di-O-acetyl 2-deoxy-4,6-O-benzylidene-2-(2,2,2-

trichloroethoxycarbonylamino)- α -D-glucopyranoside (intermediate B), as a white solid (3,05 g, 41,7% yield).

Morpholine (1,2 mL, 13.9 mmol) was then added to a solution of intermediate B (3.05 g, 5.8 mmol) in dry ethyl acetate (EtOAc) (12.2 mL). After stirring overnight at room temperature the reaction mixture was quenched with 3N HCl solution (3.5 mL) and then stirred for 20 min. Extracted with EtOAc and washed with water, saturated aq NaHCO₃ and a saturated NaCl solution, dried, and concentrated. The crude was purified by Isolera (EtPet/EtOAc) to give 2-deoxy-3-O-acetyl-4,6-O-benzylidene-2-(2,2,2-trichloroethoxycarbonylamino)- α -D-glucopyranoside (intermediate C) as a white solid (2,2 g, 78.4%). To a solution of intermediate C (2,2 g, 4,54 mmol) in dry DCM (44 mL), Cs₂CO₃ (680 mg, 2.1 mmol) and CCl₃CN (4,4 mL, 43,8 mmol) were added. The reaction mixture was stirred for 2 h at room temperature, then filtered over celite and concentrated to give 1-(2,2,2-Trichloroacetimino)-2-deoxy-3-O-acetyl-4,6-O-benzylidene-2-(2,2,2-trichloroethoxycarbonylamino)- α -D-glucopyranoside (Donor) as a light yellow solid (2,2 g, 77%).

b. Synthesis of 1,6-Di-O-benzyl 2-deoxy-3-O-((R)-10-ethoxycarbonyl-ethyl)-2-(2,2,2-trichloroethoxycarbonylamino)- α -D-glucopyranoside (Acceptor)

Allyl chloroformate (6.6 mL, 62,2 mmol) was added dropwise at room temperature to a vigorously stirred solution of D-glucosamine hydrochloride (12,2 g, 56,6 mmol) and NaHCO₃ (14,3 g, 169,7 mmol) in water (61 mL). The mixture was stirred for 2 h, then neutralized with 1M HCl, concentrated, and dried *in vacuo*. Crude 2-deoxy-2-(allyloxycarbonylamino)- α -D-glucopyranoside (Intermediate D) was obtained. The product was used for next reaction step without further purification. Intermediate D (14,9 g, 56,6 mmol) was dissolved in benzyl alcohol (89 mL), and acetyl chloride (15,4 mL, 215,2 mmol) was added dropwise at 0 °C. After stirring for 3 h at 80 °C the reaction mixture was quenched with cold saturated aq

NaHCO₃ (20 ml) and stirred for additional 30 min. Cold water and diethyl ether were added and the reaction mixture was stirred for 30 min. The two phases were separated, and the aqueous phase was concentrated, and dried in vacuo. 30 ml of water and 200 ml of ethyl ether were added until the formation of a precipitate that was filtered and washed several times with cold diethyl ether (until no traces of benzyl alcohol were detected. Benzyl 2-deoxy-2-(allyloxycarbonylamino)-α-D-glucopyranoside (intermediate E) was obtained as a white solid (11 g, 55%) and directly used for next reaction step without further purification. Zinc chloride (4,2 g, 31,1 mmol) was added to a solution of intermediate E (11 g, 31,1 mmol) in benzaldehyde (55 mL) and 4 Å MS (4,9 g). After 2h, more zinc chloride (4,2 g, 31,1 mmol) was added. After stirring overnight at room temperature, the reaction mixture was treated with saturated aq NaHCO₃ (70 mL), petroleum ether (420 mL), and stirred for 10 min. The precipitate was filtered, washed with petroleum ether and dissolved in DCM. The organic solution was extracted with saturated aq NaHCO₃, water, and a saturated NaCl solution dried and concentrated. The crude was purified by Isolera (DCM/EtOAc) to give Benzyl 2-deoxy-4,6-O-benzylidene-2-(allyloxycarbonylamino)-α-D-glucopyranoside (intermediate F) as a white solid (2.75 g, 20%).

To a solution of intermediate F (2.75 g, 6,2 mmol) in dry DCM (40.6 mL), cooled to 0 °C, sodium hydride (NaH, 348.8 mg, 8,7 mmol, 60% oil dispersion) was added, and the mixture stirred for 30 min at room temperature. The mixture was then treated with neat (-)-ethyl (S)-2-trifluoromethanesulfonyl propionate dropwise and stirred for 2 h at room temperature. The reaction mixture was quenched by addition of ice, and extracted with DCM. The organic solution was washed with saturated aq NaHCO₃, a saturated NaCl solution, dried and concentrated. The residue was purified by Isolera (DCM/EtOAc) to give benzyl 2-deoxy-3-O-((R)-10-ethoxycarbonyl-ethyl)-4,6-O-benzylidene-2-(allyloxy-carbonylamino)-α-D-glucopyranoside (intermediate G) as a white solid (2,35 g, 69,7%).

Tetrakis(triphenylphosphine) palladium (1,5 g, 1,3mmol) and acetic acid (AcOH, 0.385 mL, 6,725 mmol) were added to a solution of the intermediate G (2.35g, 4,34mmol) in dry DCM (42,7 mL). The reaction mixture was stirred at room temperature for 15 min and then 2,2,2-trichloroethyl chloroformate (TrocCl, 1.224mL, 8,895 mmol) was added dropwise, and the resulting solution stirred for 1 h at room temperature. The reaction mixture was quenched with saturated aq NaHCO₃, extracted with DCM, washed with H₂O and a saturated NaCl solution. After concentration *in vacuo*, the residue was dissolved in diethyl ether (100ml) and insoluble materials filtered off. The organic phase was dried, concentrated, and purified by Isolera (Cyclohexane/AcOEt) to give benzyl 2-deoxy-3-O-((R)-10-ethoxycarbonylethyl)-4,6-O-benzylidene-2-(2,2,2-tri-chloroethoxycarbonylamino)-α-D-glucopyranoside (intermediate H) as a white solid (2,3g, 83,7%).

To a solution of intermediate H (2.4g, 3,8mmol) in dry CH₃CN (38 mL) at 0 °C a solution of Me₃N-BH₃ (332mg, 4,55mmol) in CH₃CN (2.2 mL) was added, followed by a solution of BF₃-OEt₂ (2.89mL, 23,4mmol) in CH₃CN (8 mL) added dropwise. After stirring for 3 h at 0°C, the mixture was quenched with cold saturated aq NaHCO₃ (30 mL), diluted with EtOAc (350ml), and washed with saturated aq NaHCO₃ (100ml), 5% citric acid (4x50ml), saturated aq NaHCO₃ (50 mL), and a saturated NaCl solution (40 mL). The organic layer was dried, concentrated, and the crude was purified by Isolera (Cyclohexane/AcOEt) to give 1,6-di-O-benzyl 2-deoxy-3-O-((R)-10-ethoxycarbonylethyl)-2-(2,2,2-trichloroethoxy-carbonylamino)-α-D-glucopyranoside (Acceptor), as a colorless foam (1,2 g, 49,8%).

2. Synthesis of NAG-NAM conjugated peptide BIO-3

Donor (1.6g, 2,6mmol) and Acceptor (1.1g, 1,73mmol), suspended in dry DCM (55 mL) with 4 Å molecular sieves (200 mg), were treated with Trimethylsilyl trifluoromethanesulfonate (TMSOTf, 188μL, 1,04mmol) at -15 °C. After stirring for 20 min, more 0.75eq of Donor and 0.3 eq of TMSOTf were added. After stirring for 20 min, more 0.75eq of Donor and 0.3 eq of

TMSOTf were added. The mixture was then quenched with cold saturated aq solution of NaHCO_3 (15 mL) and extracted with DCM (60 mL). The organic layer was washed with saturated aq NaHCO_3 and a saturated NaCl solution, dried and concentrated. The residue was purified by Isolera reverse phase (H_2O / ACN neutral phases) to give benzyl 6-O-benzyl-4-O-[2-deoxy-3-O-acetyl-4,6-Obenzylidene-2-(2,2,2-trichloroethoxycarbonylamino)-b-D-glucopyranosyl]-2-deoxy-3-O-[(R)-1'-ethoxycarbonyl ethyl]-2-(2,2,2-trichloroethoxycarbonylamino)-a-D-glucopyranoside (intermediate L), as a white foam (1.2g, 62,9%).

A solution of intermediate L (1.2g, 1,09mmol) and zinc-copper couple (3.12g, 24,2mmol) in a mixture $\text{AcOH}/\text{Ac}_2\text{O}/\text{THF}$ 1:1:1 (12 mL) was stirred for 4 h at room temperature. The reaction mixture was filtered over celite, washed with EtOAc, and concentrated. The crude was concentrated and purified by column chromatography (Cyclohexane/AcOEt) to give benzyl 6-O-benzyl-4-O-[2-deoxy-3-O-acetyl-4,6-Obenzylidene-2-acetyl-amino-b-D-glucopyranosyl]-2-deoxy-3-O-[(R)-10-ethoxycarbonylethyl]-2-acetyl-amino-a-D-glucopyranoside (intermediate M) as a white solid (560mg, 0,67mmol, 61,6%). HPLC-MS (ESI+) m/z: $\text{C}_{44}\text{H}_{54}\text{N}_2\text{O}_{14}+\text{Na}$: 857.3472. Found: 857.6124.

To a solution of intermediate M (91 mg, 0.109 mmol) in $\text{THF}/1,4\text{-dioxane}/\text{H}_2\text{O}$ 4:2:1 (2.8 mL) was added $\text{LiOH}\cdot\text{H}_2\text{O}$ (56 mg, 1.34 mmol). After stirring for 2 h at room temperature, the reaction mixture was filtered over Dowex H+ (freshly activated with 1N HCl). The residue was purified by diaion HP-20 column chromatography (2 x 7 cm) previously washed with water, MeOH and water. Column was eluted first with H_2O (50 mL) and then with MeOH (30 mL). The alcohol fractions were concentrated to give benzyl 6-O-benzyl-4-O-[2-deoxy-4,6-O-benzylidene-2-acetyl-amino-b-D-glucopyranosyl]-2-deoxy-3-O-[(R)-10-ethoxycarbonylethyl]-2-acetyl-amino-a-D-glucopyranoside (intermediate N), as a whitish solid (57.4 mg, 69%). Mp 102–105 °C, $^1\text{H NMR}$ (600 MHz, CD_3OD) δ 7.51–7.27 (m, 15H, ArH), 5.59 (s, 1H, CHPh),

5.36 (d, J 3.1 Hz, H-1), 4.85 (m) H₂O, H-10, ½ CH₂Ph), 4.66–4.57 (m, 3H, J 12.1 Hz, CHCH₃, CH₂-Ph), 4.46 (d, 1H, J 12.2 Hz, ½ CH₂Ph), 4.29 (dd, 1H, J 10.3 Hz, J 5.0 Hz, H-60b), 4.07 (t, 1H, J 9.6 Hz, H-30), 3.95 (t, 1H, J 9.1 Hz, H-4), 3.82–3.77 (m, 2H, H-6b, H-3), 3.72–3.62 (m, 3H, H-60a, H-5, H-6a), 3.55–3.40 (m, 3H, H-20, H-40, H-2), 3.30–3.27 (m, 1H, H-50), 1.98 (s, 3H, COCH₃), 1.96 (s, 3H, COCH₃), 1.37 (d, J 6.9 Hz, 3H, CHCH₃). HPLC-MS (ESI+) m/z: C₄₀H₄₈N₂O₁₃+Na: 787.3054 Found: 787.7830.

The peptide of SEQ ID N. 42 was coupled to compound N in the conditions used for aminoacid coupling and the resulting bioconjugate was cleaved from the solid support by treatment with trifluoroacetic acid (1% solution in DCM). The resulting bioconjugate (0.026 mmol) was dissolved in acetic acid (8 mL), and Pd(OH)₂/C (58 mg) was added. The resulting mixture was stirred at room temperature for 6 h under hydrogen atmosphere. The mixture was filtered over celite and concentrated to give the bioconjugate BIO-3 in quantitative yield.

The bioconjugate was cleaved from the resin and the last residue deprotected by using as cleavage solution a mixture of trifluoroacetic acid/ 1,2-ethanedithiol/ thioanisole/ phenol/ H₂O/ triisopropylsilane in a ratio of 68.5/10/10/5/3.5/1, v/v. 3 ml of cleavage solution was used per 100 mg of resin. Complete deprotection was achieved after 4 hours at 30°C. Following the cleavage reaction, the crude peptide was precipitated by addition of cold diethyl ether and dried *in vacuo* at 50°C.

The crude bioconjugate was purified by preparative RP-HPLC (Agilent) using a C18 column (10 µm, 100 Å, 50 × 250 mm). A solvent mixture consisting of solvent A (0.1 % TFA, 2 % CH₃CN in H₂O) and solvent B (90 % CH₃CN/H₂O) at a flow rate of 25 mL/min was used for elution, and the absorbance detected at 220 nm. The solvent was removed by lyophilization and the final products characterized by MALDI-TOF-MS. The purity of the purified material was assessed by analytical RP-HPLC (C18-250 mm × 4.6 mm I.D., flow rate of 1 mL/min), and the absorbance was detected at 220 nm.

3. Synthesis of NAG and NAM Bioconjugates BIO-1 and BIO-2

Synthesis of NAM-Peptide and Peptide-NAG were performed starting from the peptide anchored resin (Example 1), wherein the peptide was the peptide of SEQ ID N. 42 (for BIO-1) or the peptide of SEQ ID N. 43 (for BIO-2), respectively, and Donor and Acceptor were the molecules described above according to the procedure described in Swaminathan et al., Proc Natl Acad Sci USA. 2006, 17;103 (3):684-9.

Example 3: Synthesis of Capric Acid Bioconjugate BIO-4

Peptides capped with Capric Acid were synthesized according to the procedure described in Example 1 by using a N-terminal amine capped with Capric Acid.

Example 4: Synthesis of Ascorbic Acid Bioconjugate BIO-5

5,6-O-isopropylidene-L-ascorbic acid (iASA) was synthesized by Jung's method (Jung, M. E.; Shaw, T. J. J. Am. Chem. Soc. 1980, 102, 6304). For the activation, CDI (10 eq.) was added to the peptide anchored resin for 2 h. Activation of N-terminal amine of peptide, after cleavage from the resin, was confirmed by RP-HPLC using the following conditions: A to B (A: 0.1% TFA in H₂O, B: 0.1% TFA in CH₃CN; from 0% to 60% B over 30 min, at a flow rate of 1.0 mL/min); detection, UV 230 nm. Next, iASA was introduced to the activated peptide anchored resin. The product was separated from the resin by treating with 50% TFA/DCM (v/v) for 1 h. The resin was filtered, the filtrate was concentrated in high vacuum, and precipitated with cold diethyl ether. The structure of the resulting bioconjugate BIO-5 was confirmed by LC/MS using 0.1% formic acid/methanol as eluent at a flow rate of 250 µL/min over 30 min, and monitored at 230 nm.

Example 5: IL-17RA/IL17RC dimerization assay in response to IL-17A

The peptides of Table 7 were tested for their ability to inhibit the binding of IL-17A to its receptor and the subsequent interaction of IL-17RA and IL17RC.

Interleukin receptor RA and RC dimerization assay (DiscoverX) was used to measure the interaction of the receptor chains IL-17RA and IL17RC upon activation by IL-17A in the absence or presence of the peptides of Table 7.

In the PathHunter® Cytokine Receptor Assay, one cytokine receptor chain is tagged with a small peptide epitope ProLink (PK) and the other chain is tagged with Enzyme Acceptor (EA). Ligand binding induces dimerization of the two receptors, facilitating complementation of PK and EA fragments. This interaction generates an active unit of b-galactosidase, which is detected using a chemoluminescent substrate. PathHunter cell lines were expanded from freezer stocks according to standard procedures. Cells were seeded in a total volume of 20 µL into white walled, 384-well microplates and incubated for the appropriate time prior to testing. For agonist activity inhibition, cells were incubated with sample to induce response. Intermediate dilution of sample stocks was performed to generate 5X sample in assay buffer. 5 µL of 5X sample was added to cells and incubated at 37°C or room temperature for 60 minutes. Vehicle concentration was 1%. 5 µL of 6X EC₈₀ agonist (IL-17A) in assay buffer was added to the cells and incubated at 37°C for 6 to 16 hours depending on the assay. 1. Assay signal was generated through a single addition of 12.5 or 15 µL (50 % v/v) of PathHunter Detection reagent cocktail for agonist (IL-17A) and (peptides of table 7) assays respectively, followed by a one hour incubation at room temperature. For some assays, activity was detected using a high sensitivity detection reagent (PathHunter Flash Kit) to improve assay performance. In these assays, an equal volume of detection reagent (25 or 30uL) was added to the wells, followed by a one hour incubation at room temperature. Microplates were read following signal generation with a PerkinElmer Envision™ instrument for chemiluminescent signal detection. Compound activity was analyzed using CBIS data analysis suite (ChemInnovation, CA). % Inhibition = $100\% \times (1 - (\text{mean RLU of test sample} - \text{mean RLU of vehicle control}) / (\text{mean RLU of EC80 control} - \text{mean RLU of vehicle control}))$.

As reported in Table 7 below, all tested molecules were found active in inhibiting IL-17RA/IL17RC dimerization thus inhibiting the IL-17A pathway activation showing a IC₅₀ value in the mid nanomolar range.

Table 7

SEQUENCE	NAME	IC ₅₀ in IL-17RA/IL7RC dimerization assay
SEQ ID N. 1		<0.2 µM
SEQ ID N. 2		<0.2 µM
SEQ ID N. 3		<0.4 µM
SEQ ID N. 4		<0.1 µM
SEQ ID N. 5		<0.1 µM
SEQ ID N. 6		<0.4 µM
SEQ ID N. 7		<0.1 µM
SEQ ID N. 8		<0.2 µM
SEQ ID N. 9		<0.3 µM
SEQ ID N. 10		<0.4 µM
SEQ ID N. 11		<0.4 µM
SEQ ID N. 12		<0.2 µM
SEQ ID N. 13		<0.4 µM
SEQ ID N. 14		<0.4 µM
SEQ ID N. 15		<0.4 µM
SEQ ID N. 16		<0.4 µM
SEQ ID N. 17		<0.4 µM
SEQ ID N. 18		<0.4 µM
SEQ ID N. 19		< 1 µM

SEQ ID N. 20		< 1 μ M
SEQ ID N. 21		< 1 μ M
SEQ ID N. 22		< 1 μ M
SEQ ID N.23		< 1 μ M
SEQ ID N. 24		< 1 μ M
SEQ ID N. 25		< 1 μ M
SEQ ID N. 26		< 1 μ M
SEQ ID N. 27		< 1 μ M
SEQ ID N. 28		< 1 μ M
SEQ ID N. 29		< 1 μ M
SEQ ID N. 30		< 1 μ M
SEQ ID N. 31		< 1 μ M
SEQ ID N. 32		< 1 μ M
SEQ ID N. 33		< 1 μ M
SEQ ID N. 34		< 1 μ M
SEQ ID N. 35		< 1 μ M
SEQ ID N. 36		< 1 μ M
SEQ ID N. 37		< 0.2 μ M
SEQ ID N. 38		< 0.2 μ M
SEQ ID N. 39		< 0.2 μ M
SEQ ID N. 40		< 0.2 μ M
SEQ ID N. 41		< 1 μ M
SEQ ID N. 111		<0.5 μ M
SEQ ID N. 112		<0.5 μ M
SEQ ID N. 113		<0.5 μ M

SEQ ID N. 114		<0.5 μ M
SEQ ID N. 115		<0.5 μ M
SEQ ID N. 116		<0.5 μ M
SEQ ID N. 117		<0.5 μ M
SEQ ID N. 118		<0.5 μ M
SEQ ID N. 119		<0.5 μ M
SEQ ID N. 120		<0.5 μ M
SEQ ID N. 121		<0.5 μ M
SEQ ID N. 122		<0.5 μ M
SEQ ID N. 123		<0.5 μ M
SEQ ID N. 124		<0.5 μ M
SEQ ID N. 125		<0.5 μ M
SEQ ID N. 126		<0.5 μ M
SEQ ID N. 127		<0.5 μ M
SEQ ID N. 128		<0.5 μ M
SEQ ID N. 129		<0.5 μ M
SEQ ID N. 130		<0.5 μ M
SEQ ID N. 131		<0.5 μ M
SEQ ID N. 132		<0.5 μ M
SEQ ID N. 133		<0.5 μ M
SEQ ID N. 134		<0.5 μ M
SEQ ID N. 135		<0.5 μ M
SEQ ID N. 136		<0.5 μ M
SEQ ID N. 137		<0.5 μ M
SEQ ID N. 138		<0.5 μ M

SEQ ID N. 139		<0.5 μ M
SEQ ID N. 140		<0.5 μ M
SEQ ID N. 141		<0.5 μ M
SEQ ID N. 142		<0.5 μ M
SEQ ID N. 143		<0.5 μ M
SEQ ID N. 144		<0.5 μ M
SEQ ID N. 145		<0.5 μ M
SEQ ID N. 146		<0.5 μ M
SEQ ID N. 147		<0.5 μ M
SEQ ID N. 148		<0.5 μ M
SEQ ID N. 149		<0.5 μ M
SEQ ID N. 150		<0.5 μ M
SEQ ID N. 151		<0.5 μ M
SEQ ID N. 152		<0.5 μ M
SEQ ID N. 153		<0.5 μ M
SEQ ID N. 154		<0.5 μ M
SEQ ID N. 155		<0.5 μ M
SEQ ID N. 156		<0.5 μ M
SEQ ID N. 157		<0.5 μ M
NAM-IMVTIPADLYEWIEE	BIO-1	< 1 μ M
IMVTIPADLYEWIEEQ-NAG	BIO-2	< 1 μ M
NAG-NAM- IMVTIPADLYEWIEE	BIO-3	< 1 μ M
capric acid- IMVTIPADLYEWIEE	BIO-4	< 1 μ M
Ascorbic acid - IMVTIPADLYEWIEE	BIO-5	< 1 μ M
SEQ ID N. 158		< 10 μ M

SEQ ID N. 159		< 10 μ M
SEQ ID N.160		< 10 μ M
SEQ ID N. 161		< 10 μ M
SEQ ID N. 162		< 10 μ M
SEQ ID N. 163		< 10 μ M
SEQ ID N. 164		< 10 μ M
SEQ ID N. 165		< 10 μ M
SEQ ID N.166		< 10 μ M
SEQ ID N. 167		< 10 μ M
SEQ ID N. 168		< 10 μ M
SEQ ID N. 169		< 10 μ M
SEQ ID N. 170		< 10 μ M
SEQ ID N. 171		< 10 μ M
SEQ ID N. 172		< 10 μ M
SEQ ID N. 173		< 10 μ M
SEQ ID N. 174		< 10 μ M
SEQ ID N. 175		< 10 μ M
SEQ ID N. 176		< 10 μ M
SEQ ID N. 177		< 10 μ M
SEQ ID N. 178		< 10 μ M
SEQ ID N. 179		< 10 μ M
SEQ ID N. 180		< 10 μ M
SEQ ID N. 181		< 10 μ M
SEQ ID N. 182		< 10 μ M
SEQ ID N. 183		< 10 μ M

SEQ ID N. 184		< 10 μ M
SEQ ID N. 185		< 10 μ M
SEQ ID N. 186		< 10 μ M
SEQ ID N. 187		< 10 μ M
SEQ ID N. 188		< 10 μ M
SEQ ID N. 189		< 10 μ M
SEQ ID N. 190		< 10 μ M
SEQ ID N. 191		< 10 μ M
SEQ ID N. 192		< 10 μ M
SEQ ID N. 193		< 10 μ M
SEQ ID N. 194		< 10 μ M
SEQ ID N. 195		< 10 μ M
SEQ ID N. 196		< 10 μ M
SEQ ID N. 197		< 10 μ M
SEQ ID N. 198		< 10 μ M
SEQ ID N. 199		< 10 μ M
SEQ ID N. 200		< 10 μ M
SEQ ID N. 201		< 10 μ M
SEQ ID N. 202		< 10 μ M
SEQ ID N. 203		< 10 μ M
SEQ ID N. 204		< 10 μ M
SEQ ID N. 205		< 10 μ M
SEQ ID N. 206		< 10 μ M
SEQ ID N. 207		< 10 μ M
SEQ ID N. 208		< 10 μ M

SEQ ID N. 209		< 10 μ M
SEQ ID N. 210		< 10 μ M
SEQ ID N. 211		< 10 μ M
SEQ ID N. 212		< 10 μ M
SEQ ID N. 213		< 10 μ M
SEQ ID N. 214		< 10 μ M
SEQ ID N. 215		< 10 μ M
SEQ ID N. 216		< 10 μ M
SEQ ID N. 217		< 10 μ M
SEQ ID N. 218		< 10 μ M
SEQ ID N. 219		< 10 μ M
SEQ ID N. 220		< 10 μ M
SEQ ID N. 221		< 10 μ M
SEQ ID N. 222		< 10 μ M
SEQ ID N. 223		< 10 μ M
SEQ ID N. 224		< 10 μ M
SEQ ID N. 225		< 10 μ M
SEQ ID N. 226		< 10 μ M
SEQ ID N. 227		< 10 μ M
SEQ ID N. 228		< 10 μ M
SEQ ID N. 229		< 10 μ M
SEQ ID N. 230		< 10 μ M
SEQ ID N. 231		< 10 μ M
SEQ ID N. 232		< 10 μ M
SEQ ID N. 233		< 10 μ M

SEQ ID N. 234		< 10 μ M
SEQ ID N. 235		< 10 μ M
SEQ ID N. 236		< 10 μ M
SEQ ID N. 237		< 10 μ M
SEQ ID N. 238		< 10 μ M
SEQ ID N. 239		< 10 μ M
SEQ ID N. 240		< 10 μ M
SEQ ID N. 241		< 10 μ M
SEQ ID N. 242		< 10 μ M
SEQ ID N. 243		< 10 μ M
SEQ ID N. 244		< 10 μ M
SEQ ID N. 245		< 10 μ M
SEQ ID N. 246		< 10 μ M
SEQ ID N. 247		< 10 μ M
SEQ ID N. 248		< 10 μ M
SEQ ID N. 249		< 10 μ M
SEQ ID N. 250		< 10 μ M
SEQ ID N. 251		< 10 μ M
SEQ ID N. 252		< 10 μ M
SEQ ID N. 253		< 10 μ M
SEQ ID N. 254		< 10 μ M
SEQ ID N. 255		< 10 μ M
SEQ ID N. 256		< 10 μ M
SEQ ID N. 257		< 10 μ M

In Figure 1, a dose-response profile for exemplary peptides is reported.

Example 6: Phenotypic assay in human differentiated TH17 cells and viability assay

To evaluate the effect of the peptides of the invention on the target cells responsible for inflammation in ophtalmic or dermatological pathologies, we tested the ability of the peptide of SEQ ID N. 18 to inhibit *in vitro* pro-inflammatory cytokines and metalloproteinases secretion by human Th17 cells.

Human primary CD4 T-cells were differentiated into Th17 cells *in vitro* by culturing the cells in Th17 differentiation medium for 10 days. In details, purified human peripheral blood CD4 T-cells were cultured in Th-17 differentiation medium (CellXVivo Human Th17, Tocris) per manufacturer's instructions. Briefly: 96-well tissue culture plates were coated with anti-CD3 and CD28 agonistic antibodies. Cells were counted via trypan blue exclusion and suspended at a concentration of 1E5 cells/ml in Th-17 differentiation medium. 0.2 mL of this suspension was plated into individual wells of a 96-well plate. Cells were incubated at 37°C with 5% CO₂ for 10 days, with media replaced as needed. Following 10-day Cell Differentiation, the peptides synthetized in Example 1, such as the peptide of Seq.ID No 18, were diluted to the appropriate concentration in CGM (cell growth medium, XVivo-15, Lonza). Cell plate was centrifuged at 300xg for 5 min, and Th17 differentiation medium was removed.

Following differentiation, the cells were stimulated with both an activation cocktail containing Phorbol 12-myristate 13-acetate and Ionomycin in the presence of varying concentrations of test articles.

At 24h following stimulation, culture supernatants were analyzed for expression of IL-17, IL-6, IL-23, MMP3 and examined for viability using the fluorescence viability dye, Alamar blue. The CD4 cells secreted high levels of IL-17A in response to stimulation with an activation cocktail, indicating successful differentiation into Th17 cells. Additionally, stimulated cells secreted IL-6, IL23 and MMP3.

Supernatant was removed and replaced with 200 μ L of diluted peptide or vehicle (CGM + DMSO diluted as with TI concentration) in appropriate groups. Cells were incubated with peptide test items for 1 hour before stimulation. The following stimulation solutions were generated: 10x Cell Activation Cocktail: Diluted from 500x to 10x working solution in CGM. 22 μ L of appropriate stimulants were added to wells 1 hr after TI addition. Finally, 25 μ L of Alamar blue reagent (10x) was added to each well 20 hours after stimulant (4 hrs prior to 24 hr serum collection) to determine cell viability. 24 hrs After Stimulant, Alamar blue fluorescence was measured per manufacturer's instructions. Remaining Supernatants were collected for subsequent multiplex protein analyses. Expression levels of IL-6, IL-17, and IL-23 as well as MMP3 in 24 hour stimulated culture supernatants was evaluated using a Luminex Multiplex Platform on a MAGPIX instrument.

Figures 2 and 3 show the effect of the peptide of SEQ ID N. 18. As can be seen, this peptide is able to significantly reduce the secretion of IL-17A, IL-6 and IL-23 as well as the secretion of MMP3. As shown in Figure 4 the inhibition of cytokines and metalloproteinases secretion is not due to cell viability issues since cell treatment with the peptide of SEQ.ID N. 18 for eleven days did not impair cell viability.

Example 7: Physical-chemical analysis of peptides

The physical-chemical properties of the prior art peptide HAP and of some peptides according to the invention (see table 8) have been tested as described below.

i. Methods

a. Isoelectric Point IP log D and logP

The main physicochemical properties (Isoelectric point (IP), log D (7.4) and logP) of the peptides of Table 8 below were determined by using the SiriusT3 apparatus (Sirius Analytical Instruments Ltd., East Sussex, UK) equipped with an Ag/AgCl double junction reference pH electrode, a Sirius D-PAS spectrometer and a turbidity sensing device. The pH electrode was

calibrated titrimetrically in the pH range 1.8–12.2. An overhead stirrer was used and a temperature probe (Peltier controller) monitored the temperature during the course of the titration. The titration experiments were conducted in 0.15 M KCl Ionic Strength Adjusted solution (ISA water) under a nitrogen atmosphere at a temperature of $25 \pm 1^\circ\text{C}$. All tests were performed using standardized 0.5 M KOH and 0.5 M HCl as titration reagents, for the partition coefficient tests a saturated Octanol in ISA water (5% of ISA water) was used as partition solvent. The pK_as were determined by potentiometric method by pH-metric titration. The powder (around 0.5 mg) was dissolved in 1.5 ml of ISA water and the titration was performed in triplicate in the pH range 2.0 – 12.0. Each Log P were performed in triplicate by dissolving the powder (around 1 mg) in 1 ml of ISA water followed by pH metric titration in three different percentages of octanol (in general 50%, 60%, 70%).

b. Water Solubility and Stability

General procedure for the preparation of the Stock Solutions

Each lyophilized peptide was weighed in an amber vial. A calculated volume of phosphate buffered solution at pH 7.8 was added in order to directly obtain 10 mM Stock Solutions. The recovered suspensions were stirred for 30 minutes by orbital shaker incubator at 37°C . Subsequent dilutions were performed to obtain the more diluted stock solutions for the less soluble compounds.

In order to evaluate the stability and the solubility, all the stock solutions were stored at 25°C . The title was evaluated by UHPLC-MS analysis in comparison with the standard solutions, at 3 time points: T0, 3 days, 1 week.

The chromatographic profile was evaluated for the quantitative assay while the MS spectra were detected as support in the stability studies.

General procedure for the Standard Solution preparation

Each peptide was weighed and directly diluted at 100 μ M with the phosphate buffer at pH 7.8. The solutions were stirred for 5 minutes by vortex and heated at 37°C for 20 minutes. The obtained standard solution was stored at 25°C in the dark under controlled temperature.

General procedure for the Sample preparation

A portion of the stock solutions was collected in an amber vial and diluted to 100 μ M by phosphate buffer at pH 7.8 (dilution factor, 1:100).

Instrument Method

Reversed-phase UHPLC was performed operating at a flow rate of 0.3 ml/min with a Luna Omega Polar C18 column (pore size 1.6 μ m, 2.1 x 100mm). Solvent A was 0.5% Formic Acid in water and solvent B was 0.5% Formic Acid in acetonitrile. First, samples were loaded onto the column and washed isocratically at 10% B for 3 min. Then, a gradient of 10-95% B was run over 22 min, held at 95% for 2 min, and then decreased to 10% over 1 min and held, for the pressure stabilization, for 5 min. UV Absorption was monitored by DAD (220 – 400 nm). ESI-MS ion trap was used for the monitoring of TIC.

ii. Results

All peptides tested showed stability at 25°C up to 1 week since no significant variations were found in the chromatographic profile and in the mass spectra.

The physicochemical properties of the tested peptides are displayed in Table 8 below

Table 8

PEPTIDE	IP	Log D (7.4)	logP	SOLUBILITY
SEQ ID N. 1	5.14	-3.68	-5.98	>10mM
SEQ ID N. 2	5.14	-0.56	0.99	>10mM
SEQ ID N. 3	3.90	-1.87	1.33	10 μ M
SEQ ID N. 4	3.90	-1.32	1.88	20 μ M
SEQ ID N. 5	5.19	-1.26	-0.51	1mM

SEQ ID N. 6	5.14	-3.65	-0.37	>10mM
SEQ ID N. 7	5.19	-1.41	-0.86	>10mM
SEQ ID N. 8	5.14	-4.06	-5.12	>10mM
SEQ ID N. 9	8.28	-1.08	-0.53	>10mM
SEQ ID N. 10	5.14	-3.66	0.09	>10mM
SEQ ID N. 11	4.25	-2.92	1.05	>10mM
SEQ ID N. 12	3.66	-5.24	1.31	10μM
SEQ ID N. 13	6.06	1.15	-0.49	>10mM
SEQ ID N. 14	8.99	-2.80	-5.40	>10mM
SEQ ID N. 15	3.51	1.88	1.66	50μM
SEQ ID N. 16	5.19	0.24	0.13	>10mM
SEQ ID N. 17	8.05	-3.68	-0.44	>10mM
SEQ ID N. 18	3.55	-3.79	1.89	50μM
SEQ ID N. 41	3.54	-1.94	1.24	>10mM
SEQ ID N. 19	12.49	-3.94	-8	100μM
SEQ ID N. 20	11.29	-3.69	-6.79	100μM
SEQ ID N. 21	10.6	-0.55	-4.99	>10mM
SEQ ID N. 22	4.26	-3.18	0.4	>10mM
SEQ ID N.23	4.26	-2.24	1.01	50μM
SEQ ID N. 24	5.14	2.15	2.45	<50μM
SEQ ID N. 25	4.66	-5.64	0.4	100μM
SEQ ID N. 26	8.13	0.148	0.69	>10mM
SEQ ID N. 27	5.14	0.148	0.69	>10mM
SEQ ID N. 28	12.25	-6.44	-6.36	100μM
SEQ ID N. 29	12.25	-6.44	-6.39	>10mM

SEQ ID N. 30	12.96	-3.89	-7.44	100μM
SEQ ID N. 31	12.5	-3.59	-4.9	>10mM
SEQ ID N. 32	na	-3.59	-10	<50μM
SEQ ID N. 33	4.46	-1.06	1.99	100μM
SEQ ID N. 34	5.14	-3.38	-5.43	<50μM
SEQ ID N. 35	5.14	-3.52	-5.43	>10mM
SEQ ID N. 36	8.13	-1.24	-1.09	100μM
SEQ ID N. 37	5.14	-3.9	-6.89	>10mM
SEQ ID N.38	5.14	-3.46	-5.88	>10mM
SEQ ID N. 39	4.2	-2.86	-5.36	>10mM
SEQ ID N.40	4.21	-3.5	-4.93	>10mM
SEQ ID N. 111	8.99	-0.93	-0.38	<50μM
SEQ ID N. 112	8.99	-7.295	-4.76	<50μM
SEQ ID N. 113	8.99	-3.472	-0.13	<50μM
SEQ ID N. 114	8.99	-3.591	-0.21	<50μM
SEQ ID N. 115	8.99	-3.914	-5.94	<50μM
SEQ ID N. 121	8.99	-1.474	-0.51	<50μM

As can be seen from the above, most of the peptides according to the invention have optimal physchem properties, showing a good balance between solubility and lipophilicity. The mean of LogD of the peptides was -2.64 ± 2.06 , while for most of the peptides, the solubility observed in water was very good ($> 10\text{mM}$). The properties observed make them particularly suitable to be used for ophthalmic and dermatological applications, since both hydrophobic and hydrophilic components are present in the derma and eye surface. They also explain the good permeability observed by peptides (see Example 8).

Example 8: Permeability Test

The peptides tested were the peptides of SEQ ID N. 1, SEQ ID N. 2, SEQ ID N. 7, SEQ ID N. 11, SEQ ID N. 14, SEQ ID N. 38, SEQ ID N. 111, SEQ ID N. 113, SEQ ID N. 115 and SEQ ID N. 121. They were dissolved in Cell Culture Grade Water (Coming, Manassas, VA, USA) in order to have 10 mM stock solution.

i. Methods**In vitro model**

The I-HCEC, Immortalized Human Corneal Epithelial cell line was derived from Primary Human Corneal Epithelial Cells (>99% purity). These cells are suitable for studies of human cornea in health and disease. The cells were cultured following the protocol and using the media suggested by Innoprot, Bizkaia, Spain (IM-Corneal Epithelial Cell Medium ref. P60131).

Immunofluorescence

Qualitative and quantitative techniques were developed to first confirm and quantify the barrier integrity before proceeding with drug testing. First, we performed immunofluorescence for a protein characteristic of tight junctions (ZO-1) (Sugrue SP et al., (1997) Exp Eye Res. Jan;64 (1): 11-20). The cells were seeded in coverslip coated with Collagen I 50 µg/ml (stock solution 3 mg/ml from Gibco, NY, USA) at a density of 1×10^4 cells/cm² and cultured for 14 DIV and post-confluency the media were refreshed every day. Cells were fixed in methanol at -20 °C for 10 min, rinsed with phosphate buffer solution (PBS), incubated for 10 min at room temperature (RT) in PBS containing 4% bovine serum albumin (BSA; Sigma-Aldrich), and successively incubated with the primary and secondary antibodies for 60 min each at RT. Primary antibody was goat anti-human ZO-1 (1:100, Thermo Fisher) overnight at 4 °C followed by anti-goat Alexafluor 488 (1:10000). Cells were finally counterstained with DAPI (0.5 mg/ml) (Sigma-Aldrich) for 5 min at room temperature,

mounted with Vectashield Mounting Medium (Vector Laboratories Inc, Burlingame, CA) and observed at confocal laser scanning Microscope (Leica TCS SP5, Wetzlar, Germany).

MTS assay

Cell viability was determined at 24 h using Cell Titer One Solution Cell Proliferation Assay (Promega Corporation Madison, WI, USA) a colorimetric method based on 3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium (MTS). The quantity of formazan formed, as a function of viability, was measured at 492 nm using an ELISA plate reader, Infinite F200 (Tecan, Mannedorf, Swiss). The assay was performed at 50 and 100 μ M (N=9). The results were expressed as absorbance at 492 nm.

TEER assay

The barrier integrity of corneal epithelial cultures was verified using measurement of TEER (TransEpithelial/TransEndothelial Electrical Resistance)) and permeability of paracellular permeants (e.g., mannitol, 6-carboxyfluorescein) (Ronkko S et al., (2016) Drug Deliv Transl Res 6: 660-675). TEER is a widely accepted quantitative technique to measure integrity of tight junction dynamics in cell culture models of endothelial and epithelial monolayers. TEER values are indicators of the integrity of the cellular barriers before they are evaluated for transport of drugs or chemicals. TEER measurements can be performed in real-time without cell damage and generally are based on measuring osmic resistance or measuring impedance across a wide spectrum of frequencies (Snirivasan et al., 2015 J Lab Autom. 20(2): 107-126). To perform this assay Millicell ERS-2, Electrical Resistance System by EMD Millipore (Burlington, MA, USA), was used following manufacturer's instructions. The assay was performed at 50 and 100 μ M (N=9). Results were expressed as Resistance (Ω /cm²).

Permeability test

The objective of this study was to evaluate the apparent permeability coefficient (Papp) value of the peptides across stratified human corneal epithelial cells. All peptides were tested at 50 μ M in duplicate.

In particular, human corneal epithelial cells (hCEPIC) were stratified on Transwell cell culture inserts (Coming, NY, USA). The permeation experiments were performed taking samples from receiver chambers at 5, 30, 60 minutes time points and from donor chambers at the same time points. Each aliquot collected was analyzed by HPLC instrument (Knauer) equipped with C18 Vertex Plus Column (Knauer) thermostatically controlled at 40°C. The rate (apparent permeability coefficient, Papp) of the study compounds was calculated and compared to the Papp values of the low and high permeability markers, 6-carboxyfluorescein and Rhodamine B, respectively.

The apparent permeability coefficient (Papp) was calculated according to Equation:

$$Papp = (I/A * C_0) / (dM/dt)$$

where dM/dt is the flux (nanomoles per second) across the cell layers;

A (square centimeters) is the exposed surface area of the insert membrane;

C₀ is the initial drug concentration (micromolar) in the donor compartment at t=0 (Xiang et al., Drug Metab Dispos. 2009 May;37(5):992-8).

Statistics

All groups (studied compound and rhodamine) were compared to low permeability control. All the other experiments were expressed as the mean $\pm$ S.E. and the significance were calculated by Student's t test versus control cells. Difference were considered to be statistically significant (p < 0.05) as determined by Student's t test.

ii. Results

MTS and TEER assays

In our experimental conditions, the peptides considered did not significantly affect cell viability or TEER at 50 μ M and 100 μ M test concentration.

Permeability Test

The results obtained for each peptide are shown in Table 9 below.

Table 9

Peptide N/Name	Sequence	Permeability (10^{-6} cm/sec)
SEQ ID N. 1	IHVTIPADLWDWINK	19.333
SEQ ID N. 7	IHVTIPADLWEWINK	24.252
SEQ ID N. 11	IHVTIPADLWDWIEK	28.020
SEQ ID N. 2	VHVTIPADLWDWINK	28.862
SEQ ID N. 14	IHVTIPADLWDWVRR	28.873
SEQ ID N. 38	VPGAGVPGAGIHVTIPADLWDWINK	30.417
SEQ ID N. 121	VHVTIPADLWEWFRR	47.083
SEQ ID N. 115	VHVTIPQDLWEWVRR	68.800
SEQ ID N. 113	VHVQIPADLWEWVRR	76.797
SEQ ID N. 111	VHVTIPAELEWVRR	83.698
Rhodamine B		51.26
6-carboxyfluorescein		0.61

To verify that the HCE cell culture was useful in screening the peptides, the permeability of a lipophilic transcellular marker rhodamine B was determined. As expected, rhodamine B exhibited high permeability of the HCE cell culture ($51.26 \pm 5.44 \cdot 10^{-6}$ cm/sec). Then, the permeability of 6-carboxyfluorescein was assayed and in agree with the literature (0.61 ± 0.33

10^{-6} cm/sec). This marker has a very low lipophilicity, and it permeates biological membranes only through the intercellular space.

The tested peptides showed a very good permeability towards the Immortalized Human Corneal Epithelial compared to high permeability standard, Rhodamine B. Obviously, the HCE permeability model does not include stroma or endothelium, but these layers are not critical barriers to corneal drug absorption. We found peptides with a good permeability (SEQ ID N. 2) and peptides with a higher permeability compared to Rhodamine B (SEQ ID N. 115, SEQ ID N. 113 and SEQ ID N. 111).

Example 9: Peptide-IL-17A affinity test

The peptide of the prior art HAP (SEQ ID N.1) and peptide of SEQ ID N.2 were tested for affinity for mL-17A, as described below.

a. Immobilization of mL-17A

For the immobilization of mouse IL-17A protein, amine coupling chemistry was used. On the sensorchip surface the dextran matrix was first activated with a mixture of 1-ethyl-3-carbodiimide (EDC) and N-hydroxysuccinimide (NHS) in order to obtain reactive succinimido esters. 10 µg/ml of IL17 was diluted in 10 mM acetate buffer at pH = 5.0 and then the ligand passed over the surface to allow the esters to react spontaneously with uncharged amino groups, in this way the ligand is covalently linked to dextran. Covalent immobilization of mL17 results in stable attachment of 3000 RU of ligand to the surface.

b. Characterization of the peptides/IL17 interaction

The peptides of SEQ ID N. 1 (HAP) and SEQ ID N 2 were analyzed for their ability to bind the immobilized mL-17A. The molecules were diluted at different concentrations (from 62.5 to 1000 nM) in HBS-EP buffer and injected on the sensorchip for 4 minutes and allowed to dissociate for 5 minutes. After each run, the sensorchip was regenerated by 2 M NaCl injection. Based on the sensorgrams (Fig.1, panel A) and using the BIAevaluation software,

the Scatchard analysis of the RU values at equilibrium allowed to determine an affinity constant as a function of the analyte concentration in solution (Fig. 6, panel B). The results obtained are shown in Table 10 below

Table 10

Compound	K _{dea} (nM)
SEQ ID N. 1	3700
SEQ ID N. 2	130

As shown in Table 8, the peptide of SEQ ID N. 2 binds to IL-17A with a value of affinity equal to 130 nM, while peptide of SEQ ID N. 1 binds to IL17-A with a very low affinity value (3700 nM).

In view of the results obtained in Example 8 and 9, the modification of the Isoleucin in position 1 in the HAP peptide of the prior art with a Valine, as in the peptide of SEQ ID N 2, leads to a striking difference regarding the physchemical properties, permeability and affinity for the ligand.

We summarize herein below the properties of the two peptides:

Table 11

Property	SEQ ID N. 1 (HAP)	SEQ ID N. 2
Sequence	IHVTIPADLWDWINK	VHVTIPADLWDWINK
logP	-5.98	0.99
logD (7.4)	-3.68	-0.56
Permeability (P _{app} ±SE)	19.3	28.86
SPR K _{deq} (nM)	3700	130

Table 11 shows the comparison data between peptide SEQ ID N. 1 and SEQ ID N. 2.

We found great differences in term of logP and logD (6-log and 3-log difference, respectively): this explained the higher permeable observed with SEQ ID N. 2 compared to SEQ ID N. 1 (28.8 vs 19.3). The Kd (nM) measured in the Surface plasmon resonance (SPR) assay performed on mouse IL-17A, showed that SEQ ID N. 2 was 28-fold more affine than SEQ ID N. 1.

Furthermore, molecular dynamics simulations studies were also carried out, which indicate that Valine (SEQ ID N. 2) instead of the Isoleucine (HAP) greatly stabilizes the folded structure: SEQ ID N. 2 was predicted to be 80% more stable.

Example 10: In vitro evaluation of expression of inflammatory cytokines

The peptide HAP (SEQ ID N.1) and the peptide of SEQ ID N.2 were tested *in vitro* for evaluation of their direct influence on expression of inflammatory cytokines in the cornea.

The tests were conducted on Immortalized Human Corneal Epithelial cell line (I-HCEC) (Innoprot, Bizkaia, Spain, Ref. P10871). This is derived from Primary Human Corneal Epithelial Cells (>99% purity) and is suitable for studies of human cornea in health and disease. The cells were cultured following the protocol and using the media suggested by Innoprot (IM-Corneal Epithelial Cell Medium ref. P60131). The cell medium was supplemented with 5% Fetal Bovine Serum (FBS).

Cells were seeded at 320000 cells/well 6 plate and 15000 cells/well 96 plate. When the cells reached 80% of confluence were treated with SEQ ID N. 1 and SEQ ID N. 2 compounds in dose-curve (0,01-500µM) for 24 hours.

Total RNA was isolated from 6 wells plate using Quick-Start RNeasy Mini Kit (Qiagen, cat. N° 74104) according to the manufacturer's instructions. Retro-transcription was performed using SuperScript Vilo (ref. 11755050, Life technologies) and real-time PCR using TaqMan protocol (ref. 4444557, Applied Biosystem) adapted for CFX96 Real-Time System. The

experiments were performed three times, each time in duplicate. The used probes from Thermo Fisher Scientific are: human CXCL8 (Hs00174103_m1), human IL6 (Hs00174131_m1), human TNF α (Hs99999043_m1). As housekeeping gene was used GAPDH (probe Hs02758991_g1).

IL-8, IL-6 and TNF- α expression in I-HCEC was evaluated after treatment for 24 hours with different concentration of the peptide of SEQ ID N. 1 or SEQ ID N. 2 (0.01, 0.1, 1, 10, 100, 500 μ M). Untreated I-HCEC were used as negative control (Vehicle).

The results show that the compound SEQ ID N. 2 does not change the expression of any of the measured inflammatory cytokines (Fig. 8A, 9A and 10A), while the treatments with 500 μ M of the compound SEQ ID N. 1 significantly induce the expression of the two inflammatory cytokines IL-6 and TNF α (Fig. 9B and 10B).

The data obtained demonstrate that peptide of SEQ ID N. 1 has a direct pro-inflammatory activity and induces significantly the expression of IL-6 and TNF- α inflammatory cytokines by HCEC, with an increase of 10 and 8 fold, respectively. On the contrary, the peptide of SEQ ID N. 2 does not show any effect on the expression of cytokines.

In view of the above, it can be concluded that the peptide of SEQ ID N. 2 surprisingly shows significantly better tolerability and lack of toxicity compared to the peptide HAP of SEQ ID N.

1.

Claims

1. A peptide, able to inhibit IL-17A binding to ILRA, having the aminoacid sequence of either:

formula (I):

(I) $X_1-X_2-X_3-X_4-X_5-X_6-X_7-X_8-X_9-X_{10}-X_{11}-X_{12}-X_{13}-X_{14}-X_{15}$

wherein, independently from each other:

X_1 is I, V, D, K, W, A, G, L or P;

X_2 is H, M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, H, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q or it is absent;

X_{11} is D, E or N or it is absent;

X_{12} is W, F, V, H or Y or it is absent;

X_{13} is I, V, F, E, K, A, G, L, P or Y or its absent;

X_{14} is N, R, E, F, Q or D or it is absent;

X_{15} is K, R, E, F, V, W, H or D or it is absent;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1) or IHVTIPADLWDWIN, IHVTIPADLWDWI or IHVTIPADLWDW;

or formula (II):

(II) a_n -DLSAVCWAFPWDPECH- b_n

wherein, independently from each other:

a, b are selected from A, R, N, D, C, E, Q, G, H, I, L, K, M, F, P, S, T, W, Y or V;

n = integer from 0 to 3;

n' = integer from 0 to 3.

2. A peptide as claimed in claim 1, wherein in said formula (I):

X₁ is I, V, A, G, L, or P;

X₂ is H, M, K, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is W, Y, F or Q or it is absent;

X₁₁ is D, E or N or it is absent;

X₁₂ is W, F, H or Y or it is absent;

X₁₃ is I, V, F, E, K, A, G, L, P or Y or its absent;

X₁₄ is N, R, E, Q or D or it is absent;

X₁₅ is K, R, E, V, W, H or D or it is absent;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1),

IHVTIPADLWDWIN, IHVTIPADLWDWI or IHVTIPADLWDW.

3. A peptide as claimed in claim 1 or 2, having a 15 aminoacid sequence.

4. A peptide as claimed in claims 1 to 3, wherein in said formula (I):

X₁ is I, V or L;

X₂ is H, M, R, K or E;

X₃ is V, F or I;

X₄ is T, Q, S, Y or N;

X₅ is I, F or V;

X₆ is P;

X₇ is A, Q, or L;

X₈ is D, E, or Q;

X₉ is L, W, F, V or I;

X₁₀ is W, Y or F;

X₁₁ is D, E or N;

X₁₂ is W or F;

X₁₃ is I, V, F or L;

X₁₄ is N, R, Q or E;

X₁₅ is K, R, H or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

X₁ is I or V;

X₂ is H, M or R,

X₃ is V or F;

X₄ is T or Q;

X₅ is I, F or V;

X₆ is P or G;

X₇ is A or Q;

X₈ is D or E;

X₉ is L;

X₁₀ is W or Y;

X₁₁ is D or E;

X₁₂ is W;

X₁₃ is I or V;

X₁₄ is N, R or E;

X₁₅ is K, R or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

X₁ is I or V;

X₂ is H or M,

X₃ is V;

X₄ is T;

X₅ is I;

X₆ is P;

X₇ is A;

X₈ is D;

X₉ is L, W, F, V or I;

X₁₀ is W or Y;

X₁₁ is D or E;

X₁₂ is W;

X₁₃ is I or V;

X₁₄ is N, R or E;

X₁₅ is K, R or E;

with the proviso that said sequence is not IHVTIPADLWDWINK (SEQ ID N. 1);

or

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;
 X_{10} is Y, F or Q;
 X_{11} is D, E or N;
 X_{12} is W, F, H or Y;
 X_{13} is I, V, F, E, K, A, G, L, P or Y;
 X_{14} is N, R, E, Q or D;
 X_{15} is K, R, E, V, W, H or D;
or
 X_1 is V, A, G, L, or P;
 X_2 is M, K, R, E, Q, W or Y;
 X_3 is V, F, A, G, L, P, I, Y or W;
 X_4 is T, Q, S, N or Y;
 X_5 is I, F, A, G, L, P, V or Y;
 X_6 is P, G, A, L, V, I or N;
 X_7 is A, Q, G, L, P, V, I, N or E;
 X_8 is D, E, N, Q or Y;
 X_9 is L, V, F, W, A, G, P, I or H;
 X_{10} is Y, F or Q;
 X_{11} is D, E or N;
 X_{12} is W, F, H or Y;
 X_{13} is I, V, F, E, K, A, G, L, P or Y;
 X_{14} is N, R, E, Q or D;
 X_{15} is K, R, E, V, W, H or D;
or
 X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L or P;

X_2 is M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L or P;

X_2 is H, M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is V, A, G, L or P;

X_2 is M, K, N, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is Y, F or Q;

X_{11} is E or N;

X_{12} is W, F, H or Y;

X_{13} is V, F, E, K, A, G, L, P or Y;

X_{14} is N, R, E, Q or D;

X_{15} is K, R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is R, E, Q or D;

X_{15} is R, E, V, W, H or D;

or

X_1 is V, A, G, L, or P;

X_2 is H, M, K, R, E, Q, W or Y;

X_3 is V, F, A, G, L, P, I, Y or W;

X_4 is T, Q, S, N or Y;

X_5 is I, F, A, G, L, P, V or Y;

X_6 is P, G, A, L, V, I or N;

X_7 is A, Q, G, L, P, V, I, N or E;

X_8 is D, E, N, Q or Y;

X_9 is L, V, F, W, A, G, P, I or H;

X_{10} is W, Y, F or Q;

X_{11} is D, E or N;

X_{12} is W, F, H or Y;

X_{13} is I, V, F, E, K, A, G, L, P or Y;

X_{14} is R, E, Q or D;

X_{15} is R, E, V, W, H or D;

or

X_1 is I, V, A, G, L, or P;

X_2 is M, K, R, E, Q, W or Y;

X₃ is V, F, A, G, L, P, I, Y or W;

X₄ is T, Q, S, N or Y;

X₅ is I, F, A, G, L, P, V or Y;

X₆ is P, G, A, L, V, I or N;

X₇ is A, Q, G, L, P, V, I, N or E;

X₈ is D, E, N, Q or Y;

X₉ is L, V, F, W, A, G, P, I or H;

X₁₀ is W, Y, F or Q;

X₁₁ is D, E or N;

X₁₂ is W, F, H or Y;

X₁₃ is I, V, F, E, K, A, G, L, P or Y;

X₁₄ is R, E, Q or D;

X₁₅ is R, E, V, W, H or D;

5. A peptide as claimed in claims 1 to 4, wherein in formula (I) X₁ is V.

6. A peptide of formula (I) as claimed in claim 1 or 2, having an aminoacid sequence selected from SEQ ID N. 2, SEQ ID N. 3, SEQ ID N. 4, SEQ ID N. 5, SEQ ID N. 6, SEQ ID N. 7, SEQ ID N. 8, SEQ ID N. 9, SEQ ID N. 10, SEQ ID N. 11, SEQ ID N. 12, SEQ ID N. 13, SEQ ID N. 14, SEQ ID N. 15, SEQ ID N. 16, SEQ ID N. 17, SEQ ID N. 18, SEQ ID N. 42, SEQ ID N. 111, SEQ ID N. 112, SEQ ID N. 113, SEQ ID N. 114, SEQ ID N. 115, SEQ ID N. 116, SEQ ID N. 117, SEQ ID N. 118, SEQ ID N. 119, SEQ ID N. 120, SEQ ID N. 121, SEQ ID N. 122, SEQ ID N. 123, SEQ ID N. 124, SEQ ID N. 125, SEQ ID N. 126, SEQ ID N. 127, SEQ ID N. 128, SEQ ID N. 129, SEQ ID N. 130, SEQ ID N. 131, SEQ ID N. 132, SEQ ID N. 133, SEQ ID N. 134, SEQ ID N. 135, SEQ ID N. 136, SEQ ID N. 137, SEQ ID N. 138, SEQ ID N. 139, SEQ ID N. 140, SEQ ID N. 141, SEQ ID N. 142, SEQ ID N. 143, SEQ ID N. 144, SEQ ID N. 145, SEQ ID N. 146, SEQ ID N. 147, SEQ ID N. 148, SEQ ID N. 149, SEQ ID N.

150, SEQ ID N. 151, SEQ ID N. 152, SEQ ID N. 153, SEQ ID N. 154, SEQ ID N. 155, SEQ ID N. 158, SEQ ID N. 159, SEQ ID N. 160, SEQ ID N. 161, SEQ ID N. 162, SEQ ID N. 163, SEQ ID N. 164, SEQ ID N. 165, SEQ ID N. 166, SEQ ID N. 167, SEQ ID N. 168,, SEQ ID N. 169, SEQ ID N. 170, SEQ ID N. 171, SEQ ID N. 172, SEQ ID N. 173, SEQ ID N. 174, SEQ ID N. 175, SEQ ID N. 176, SEQ ID N. 177, SEQ ID N. 178, SEQ ID N. 179, SEQ ID N. 180, SEQ ID N. 181, SEQ ID N. 182, SEQ ID N. 183, SEQ ID N. 184, SEQ ID N. 185, SEQ ID N. 186, SEQ ID N. 187, SEQ ID N. 188, SEQ ID N. 189, SEQ ID N. 190, SEQ ID N. 191, SEQ ID N. 192, SEQ ID N. 193, SEQ ID N. 194, SEQ ID N. 195, SEQ ID N. 196, SEQ ID N. 197, SEQ ID N. 198, SEQ ID N. 200, SEQ ID N. 201, SEQ ID N. 202, SEQ ID N. 203, SEQ ID N. 204, SEQ ID N. 205, SEQ ID N. 206, SEQ ID N. 207, SEQ ID N. 208, SEQ ID N. 209, SEQ ID N. 210, SEQ ID N. 211, SEQ ID N. 212, SEQ ID N. 213, SEQ ID N. 214, SEQ ID N. 215, SEQ ID N. 216, SEQ ID N. 217, SEQ ID N. 218, SEQ ID N. 219, SEQ ID N. 220, SEQ ID N. 221, SEQ ID N. 222, SEQ ID N. 223, SEQ ID N. 224, SEQ ID N. 225, SEQ ID N. 226, SEQ ID N. 227, SEQ ID N. 228, SEQ ID N. 229, SEQ ID N. 230, SEQ ID N. 231, SEQ ID N. 232, SEQ ID N. 233, SEQ ID N. 234, SEQ ID N. 235, SEQ ID N. 236, SEQ ID N. 237, SEQ ID N. 238, SEQ ID N. 239, SEQ ID N. 240, SEQ ID N. 241, SEQ ID N. 242, SEQ ID N. 243, SEQ ID N. 244, SEQ ID N. 245, SEQ ID N. 246, SEQ ID N. 247, SEQ ID N. 248, SEQ ID N. 249, SEQ ID N. 250, SEQ ID N. 251, SEQ ID N. 252, SEQ ID N. 253, SEQ ID N. 254, SEQ ID N. 255, SEQ ID N. 256, SEQ ID N. 257.

7. A peptide having an aminoacid sequence consisting of the sequence of a peptide as claimed in claims 1 to 6 and at the C- and/or N- terminal of said sequence a sequence Sequence A having the aminoacid sequence of formula (III)

(III) $Y_1-Y_2-Y_3-Y_4-Y_5-Y_6-Y_7-Y_8-Y_9-Y_{10}-Y_{11}-Y_{12}-Y_{13}-Y_{14}-Y_{15}-Y_{16}$

wherein:

Y_1 is A, T, V, K, R, I, L, X or G;

Y₂ is R, W, P, E, Q or A;

Y₃ is K, W, G, T, I, R or P;

Y₄ is K, T, E, W, A, R, D, G, X or F;

Y₅ is A, E, T, G, W, I, R, P or V;

Y₆ is A, W, E, R, G, P or absent;

Y₇ is K, S, W, T, F, R, V, G or absent;

Y₈ is A, Q, W, R, G or absent;

Y₉ is N, G or absent;

Y₁₀ is R or absent;

Y₁₁ is R or absent;

Y₁₂ is M or absent;

Y₁₃ is K or absent.

Y₁₄ is W or absent;

Y₁₅ is K or absent;

Y₁₆ is K or absent.

8. A peptide as claimed in claim 7, having sequence of SEQ ID N. 21, SEQ ID N. 22, SEQ ID N. 23, SEQ ID N. 24, SEQ ID N. 25, SEQ ID N. 26, SEQ ID N. 27, SEQ ID N. 28, SEQ ID N. 31, SEQ ID N. 32, SEQ ID N. 33 SEQ ID N. 34, SEQ ID N. 35, SEQ ID N. 36, SEQ ID N 37, SEQ ID N 38, SEQ ID N 39, SEQ ID N 40.

9. A peptide having an aminoacid sequence consisting of the sequence of a peptide as claimed in claims 1 to 6 and at the C- and/or N- terminal of said sequence a sequence (A)_m, wherein A is an aminoacid selected from R, K, G, E, Q or A, preferably R, K, G, E or A, and m is an integer between 1 and 10.

10. A peptide as claimed in claim 9, having sequence of SEQ ID N. 19, SEQ ID N. 20, SEQ ID N. 29, SEQ ID N. 30, SEQ ID N. 43.

11. A peptide as claimed in claims 1 to 10, bound at the C- and/or N- terminal to a protective cap group, preferably the protective cap group bound to a C-terminal being selected from amides, aldehydes, esters, p-Nitroanilide, 7-Amino-4-methylcoumarin and the protective group cap bound to a N-terminal being selected from acetyl, formyl, pyroglutamyl, fatty acids, urea, carbamate sulfonamide, alkylamine.
12. Dimer formed by two peptides as claimed in claims 1 to 11.
13. Dimer as claimed in claim 12, wherein said peptides are linked by a polyethylene spacer.
14. Bioconjugate comprising a peptide as claimed in claims 1 to 10 and a biomolecule, preferably said molecule being bound to the N- and/or C- terminal of said peptide.
15. Bioconjugate as claimed in claim 14 wherein said biomolecule is preferably selected from capric acid, capronic acid, ascorbic acid, NAG-NAM, NAG, NAM, hyaluronic acid, alginic acid, chitin, (GalNAc)₂, Gal- α 1,3-GalNAc and trigalacturonic acid.
16. Pharmaceutical composition comprising a peptide as claimed in claims 1 to 11, a dimer as claimed in claims 12 or 13, a bioconjugate as claimed in claims 14 or 15 and at least one pharmaceutically acceptable excipient.
17. A peptide as claimed in claims 1 to 11, a dimer as claimed in claims 12 or 13 or a bioconjugate as claimed in claims 14 or 15, for use in the treatment and/or prevention of a disease selected from rheumatoid arthritis, multiple sclerosis, Crohn's disease, systemic lupus erythematosus, asthma, Behçet's disease, hyper IgE syndrome, ankylosing spondylitis, psoriasis, psoriatic arthritis, rheumatoid arthritis, keratoconjunctivitis sicca, vernal keratoconjunctivitis, stromal herpetic keratitis, corneal allograft rejection, corneal infections, herpes virus or Pseudomonas aeruginosa keratitis and dry eye disease, preferably psoriasis or dry eye disease.