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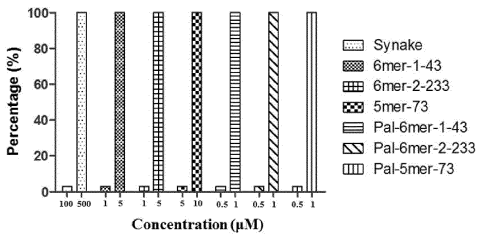
(54) OPTIMIZED SHORTENED PEPTIDE THAT BINDS TO ACETYLCHOLINE RECEPTOR, AND USE THEREOF

(57) The present disclosure relates to an optimized shortened peptide that binds to an acetylcholine receptor, and a use thereof. It is expected that it is possible to develop a cosmetic composition for alleviating wrinkles, pharmaceuticals for preventing or treating acetylcholine receptor-related diseases, and health functional foods for improvement of the acetylcholine receptor-related diseases, by using the optimized shortened peptide of the present disclosure, which is shorter than conventional acetylcholine receptor inhibitory peptides but has a high acetylcholine receptor binding force and an acetylcholine receptor inhibitory effect.



	Synake	6mer (1-43)	6mer (2-233)	5mer (73)	Pal-6mer (1-43)	Pal-6mer (2-233)	Pal-5mer (73)
IC50	250uM	2.5uM	2.5uM	7.5uM	0.75uM	0.75uM	0.75uM
Fold	1	100	100	33	330	330	330

FIG. 16

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Description

Technical Field

[0001] The present disclosure relates to an acetylcholine receptor-binding optimized shortened peptide and a use thereof. More specifically, the present disclosure relates to an acetylcholine receptor-binding, optimized shortened peptide expressed in a certain manner for the optimization of peptides, which inhibits the function of the acetylcholine receptor by binding thereto, and a use thereof.

Background Art

[0002] Acetylcholine is a chemical substance present in the nervous tissue of animals, secreted at the nerve endings, and plays a role in transmitting nerve stimulation to muscles. The transmitter substances secreted from nerve endings include acetylcholine in motor and parasympathetic nerves and epinephrine (adrenaline) in sympathetic nerves. When acetylcholine is secreted, it exhibits physiological actions such as lowering blood pressure, inhibiting heartbeats, contracting intestines, and contracting skeletal muscles. For muscles to contract, nerves have to command muscles to contract at the junction where nerves and muscles meet (neuromuscular junction), where nerves secrete acetylcholine, and this substance binds to the acetylcholine receptors on the muscles, enabling muscle contraction (Vincent, A., 1985; Lindstrom, J.M., et al., 1976). Blocking the peripheral acetylcholine receptors that dominate the femoral skeletal muscles causes paralysis of muscle movement, and blocking the acetylcholine receptors of smooth muscles and cardiac muscles responsible for breathing or heart movements leads to paralysis of breathing or heart movements.

[0003] Acetylcholine receptors are classified into muscarinic acetylcholine receptors (mAchR) and nicotinic acetylcholine receptors (nAchR). Muscarinic acetylcholine receptors are G protein-coupled receptors that can be activated by muscarine and activate different signaling mechanisms depending on the subtype. They are distributed all over the body, including the central nervous system and peripheral organs, mainly mediating the physiological actions of acetylcholine secreted from postganglionic fibers of the parasympathetic nervous system.

[0004] Nicotinic acetylcholine receptors are receptors that mimic the pharmacological actions caused by nicotine and are ion channels manipulated by neurotransmitters. They non-selectively allow the passage of ions such as sodium, potassium, and calcium through the opening and closing of ion channels, regulating electronic signaling between nerve and muscle cells. Nicotinic acetylcholine receptors can be divided into muscle type and neuronal type based on the expression site. Muscle-type nicotinic acetylcholine receptors are expressed at the neuromuscular junction where motor neurons meet skeletal muscles and contribute to inducing end plate potential (EPP) in skeletal muscle cell membranes when acetylcholine is secreted from motor neurons. Meanwhile, neuronal-type nicotinic acetylcholine receptors are expressed in peripheral ganglia of the autonomic nervous system (ANS) and contribute to exciting postganglionic fibers by acetylcholine secreted from preganglionic fibers.

[0005] Drugs that interfere or inhibit the activity of acetylcholine or mimic its actions are being used very effectively. Acetylcholine receptor agonists are used to treat severe myasthenia gravis and Alzheimer's disease. In the case of severe myasthenia gravis, it is an autoimmune disease caused by the body producing antibodies against nicotinic acetylcholine receptors, inhibiting normal acetylcholine signal transmission. Using acetylcholine esterase (AChE) inhibitors can increase the time each receptor can interact with acetylcholine in the synaptic gap between nerve and muscle before inactivation of the acetylcholine, thus treating severe myasthenia gravis.

[0006] Moreover, interference with the secretion of acetylcholine can inhibit muscle contraction, causing paralysis of muscles and smoothing wrinkles; this is utilized in Botox. Botox blocks the process of acetylcholine secretion, which is essential for muscle contraction at the motor nerve terminals. As a result, muscles become immobile, and wrinkles caused by muscles disappear. The muscle-relaxing effect of Botox gradually fades after 3-6 weeks, necessitating repeated administrations.

[0007] Furthermore, cosmetic peptides have been developed using the mechanism of smoothing wrinkles by inhibiting the binding of acetylcholine to its receptors. An example is Synake by DSM, a snake venom-derived peptide, known among wrinkle-improving peptides for having the best clinical effect (approximately 52%) and is widely used as an ingredient in peptide cosmetics.

[0008] The inventors, while researching acetylcholine receptor-binding peptides, screened and secured peptides with high binding affinity to the acetylcholine receptors. They confirmed that these peptides inhibit acetylcholine binding by binding to the acetylcholine receptors, thus inhibiting acetylcholine receptor action. However, as acetylcholine receptor-binding peptides were provided as peptide fragments, there were issues such as increased manufacturing costs with longer peptides and reduced skin permeability when manufactured as cosmetics. Consequently, there was a need for research on more shortened peptides while maintaining high binding affinity to the acetylcholine receptors.

[0009] As prior art, Korean Patent No. 10-2020-0080179 A issued to the present inventors discloses acetylcholine receptor inhibitory peptides and uses thereof. Still, only 8mer, 11mer, 14mer, and 18mer peptides are listed for acetyl-

choline receptor inhibitory peptides, and the optimized shortened peptides of the present disclosure and their effects are not mentioned. Also, Korean Patent No. 1216008 discloses acetylcholine receptor-binding peptides selected using biopanning, but does not include the peptide and library containing the amino acid sequence of the present disclosure.

[0010] Moreover, Korean Patent No. 2018-0028748 A describes a peptide regulating the release of neurotransmitters including acetylcholine, and the effect thereof on reducing wrinkles, but does not disclose the binding affinity of peptides containing the amino acid sequence of the present disclosure to acetylcholine receptors and the resulting inhibition of acetylcholine receptor action. Korean Patent No. 2014-0139010 A mentions a peptide for enhancing transdermal penetration but differs in composition and effect from the action-inhibiting peptide through acetylcholine receptor binding of the present disclosure.

Disclosure of Invention

Technical Problem

[0011] The present disclosure aims primarily to provide an optimized shortened peptide that binds to an acetylcholine receptor. Additionally, the present disclosure is to provide an optimized shortened peptide that binds to acetylcholine receptors.

[0012] In addition, the present disclosure aims to provide a cosmetic composition for wrinkle reduction, containing an optimized shortened peptide that binds to an acetylcholine receptor. Furthermore, the present disclosure is to provide a composition for preventing or treating diseases related to excessive activity of acetylcholine receptors, containing an optimized shortened peptide that binds to an acetylcholine receptor.

[0013] The present disclosure aims to provide a health functional food composition and a medical device composition for alleviating diseases related to excessive activity of acetylcholine receptors, each containing an optimized shortened peptide that bind to an acetylcholine receptor.

Solution to Problem

[0014] To accomplish the tasks, the present disclosure provides an optimized shortened peptide that binds to an acetylcholine receptor.

[0015] As used herein, the term "amino acid" or "any amino acid" encompasses both natural amino acids and other amino acids, such as non-natural amino acids, amino acids not encoded by genetic sequences, including both L- and D- isomers, used in the synthesis of peptides in the field of peptides.

[0016] The natural amino acids may be alanine (Ala, A), cysteine (Cys, C), aspartic acid (Asp, D), glutamic acid (Glu, E), phenylalanine (Phe, F), glycine (Gly, G), histidine (His, H), isoleucine (Ile, I), lysine (Lys, K), leucine (Leu, L), methionine (Met, M), asparagine (Asn, N), proline (Pro, P), glutamine (Gln, Q), arginine (Arg, R), serine (Ser, S), threonine (Thr, T), valine (Val, V), tryptophan (Trp, W), and tyrosine (Tyr, Y).

[0017] The other amino acids include a wide variety of modified or unusual amino acids, examples of which include 2-aminoadipic acid (2-aminohexanedioic acid), α-asparagine, 2-aminobutanoic acid, 2-aminocapric acid (2-aminodecanoic acid), α-glutamine, α-aminoisobutyric acid (α-methylalanine), 2-aminopimelic acid (2-aminohepanedioic acid), γ-amino-β-hydroxybenzenepentanoic acid, 2-aminosuberic acid (2-aminooctanedioic acid), 2-carboxyazetidine, β-alanine, β-aspartic acid, 3, 6-diaminohexanoic acid (β-lysine), butanoic acid, 4-amino-3-hydroxybutanoic acid, γ-amino-β-hydroxycyclohexanepentanoic acid, 3-cyclohexylalanine, N5-aminocarbonylornithine, 3-sulfoalanine, 2,3-diaminopropioic acid, 2,7-diaminosuberic acid (2,7-diaminooctanedioic acid), S-ethylthiocysteine, γ-glutamic acid, γ-carboxylglutamic acid, hydroxyacetic acid (glycolic acid), pyroglutamic acid, homogrginine, homocysteine, homohistidine, 2-hydroxyisovaleric acid, homoserine, 2-hydroxypentanoic acid, 5-hydroxylysine, 4-hydroxyproline, isovaline, 2-hydroxypropanoic acid (lactic acid), mercaptoacetic acid, mercaptobutanoic acid, 3-hydroxy-4-methylproline, mercaptopropanoic acid, 3-naphthylalanine, norleucine, nortyrosine, norvaline, 2-carboxyoctahydroindole, ornithine, penicillamine (3-mercaptovaline), 2-phenylglycine, 2-carboxypiperidine, sarcosine (N-methylglycine), 1-amino-1-carboxycyclopentane, statin (4-amino-3-hydroxy-6-methylheptanoic acid), 3-thienylalanine, 3-carboxyisoquinoline, 3-methylvaline, ε-N-trimethyllysine, 3-thiazolylalanine, α-amino-2,4-dioxopyrimidinepropanoic acid, etc.

[0018] As used herein, the "peptide" refers to a polymer made up of two or more amino acids linked by amide or peptide bonds.

[0019] In the present disclosure, "acetylcholine receptor" (AchR) refers to a receptor that binds to acetylcholine secreted from nerve endings, acting as a pathway for transmitting stimulation by acetylcholine. For example, when a muscle needs to contract, the nerve tells the muscle to contract, and the nerve secretes acetylcholine at the neuromuscular junction. When the secreted acetylcholine binds to the acetylcholine receptor in the muscle, the muscle contracts.

[0020] The acetylcholine receptors in the present disclosure are classified into muscarinic acetylcholine receptors and nicotinic acetylcholine receptors, with nicotinic acetylcholine receptors being preferred in the present disclosure.

[0021] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 1.

[Chemical Formula 1] (R/K)XXX(R/K)

(wherein R/K is arginine or lysine, X is any amino acid)

[0022] The peptide consists of a sequence of five amino acids, where the first and fifth amino acids are each arginine or lysine, and the second, third, and fourth amino acids are any amino acids.

[0023] The acetylcholine receptor-binding peptide consists of a sequence of five amino acids as expressed in [Chemical Formula 1], where the 1st and 5th amino acids, K or R, may be critical for binding to acetylcholine receptors. In the amino acid sequence represented by Chemical Formula 1, each of the 2nd, 3rd, and 4th amino acids may be any amino acid. This indicates that provided that the 1_{st} and 5th amino acids are K or R, the peptide can still show a certain level of acetylcholine receptor binding capacity even though the 2nd, 3rd, and 4th amino acids change.

[0024] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 1-1.

[Chemical Formula 1-1] (R/K) XYZ (R/K)

(wherein R/K represents either arginine or lysine, and XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T)

[0025] The amino acid sequence represented by Chemical Formula 1-1 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS: 1 to 600.

[0026] The present disclosure also provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 1-2.

[Chemical Formula 1-2] XRRQRR

(wherein R represents arginine, Q represents glutamine, and X represents any one amino acid).

[0027] The amino acid sequence represented by Chemical Formula 1-2 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS:3601 to 3620.

[0028] The present disclosure further provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 1-3.

[Chemical Formula 1-3] RRQRRX

(Wherein R represents arginine, Q represents glutamine, and X represents any one amino acid)

[0029] The amino acid sequence represented by Chemical Formula 1-3 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3621 to 3640.

[0030] The present disclosure also provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 2.

[Chemical Formula 2] (R/K) (R/K) XXX (R/K)

(Wherein R/K represents either arginine or lysine, and X represents any one amino acid)

[0031] The acetylcholine receptor-binding peptide includes a sequence of 6 amino acids as expressed in Chemical Formula 2, where the 1st, 2nd, and 6th amino acids, each being K or R, may be critical for binding to acetylcholine receptors. In the amino acid sequence represented by Chemical Formula 2, each of the 3rd, 4th, and 5th amino acids may be any amino acid. This indicates that provided that the 1st, 2nd, and 6th amino acids are K or R, the peptide can still show a certain level of acetylcholine receptor binding capacity even though the 3rd, 4th, and 5th amino acids change.

[0032] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 2-1.

[Chemical Formula 2-1] (R/K) (R/K)XYZ (R/K)

(wherein R/K represents either arginine or lysine, XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T)

[0033] The amino acid sequence represented by Chemical Formula 2-1 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS: 1201 to 1800.

[0034] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 2-2.

[Chemical Formula 2-2] XRRGVRR

(wherein R represents arginine, G represents glycine, V represents valine, and X represents any one amino acid)

[0035] The amino acid sequence represented by Chemical Formula 2-2 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3641 to 3660.

[0036] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 2-3.

[Chemical Formula 2-3] RRGVRRX

(wherein R represents arginine, G represents glycine, V represents valine, and X represents any one amino acid)

[0037] The amino acid sequence represented by Chemical Formula 2-3 may be selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3661 to 3680.

[0038] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 3.

[Chemical Formula 3] (R/K) XXX (R/K) (R/K)

(wherein R/K represents either arginine or lysine, and X represents any one amino acid)

[0039] The acetylcholine receptor-binding peptide consists of a sequence of 6 amino acids as expressed in Chemical Formula 3, where 1^{st}, 5^{th}, and 6^{th} amino acids, each being K or R, may be critical for binding to acetylcholine receptors. In the amino acid sequence represented by Chemical Formula 3, each of the 2^{nd}, 3^{rd}, and 4^{th} amino acids may be any amino acid. This indicates that provided that the 1^{st}, 5^{th}, and 6^{th} amino acids are K or R, the peptide can still show a certain level of acetylcholine receptor binding capacity even though the 2^{nd}, 3^{rd}, and 4^{th} amino acids change.

[0040] The present disclosure provides an acetylcholine receptor-binding peptide consisting of the amino acid sequence represented by the following Chemical Formula 3-1.

[Chemical Formula 3-1] (R/K)XYZ(R/K)(R/K)

(wherein R/K represents either arginine or lysine, XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T)

[0041] The amino acid sequence represented by Chemical Formula 3-1 may be selected from the group consisting of the amin acid sequences of SEQ ID NOS: 2401 to 3000.

[0042] The amino acid sequence of the acetylcholine receptor-binding peptide excludes the amino acid sequences described in Korean Patent No. 10-2020-0080179 A, which is the prior patent invention to the present disclosure, but includes the amino acid sequence RKSLLR disclosed in Korean Patent No. 10-2020-0080179 A.

[0043] The present disclosure pertains to an acetylcholine receptor-binding peptide with a modification to the N-terminus or C-terminus thereof.

[0044] In the acetylcholine receptor-binding peptide, the modification to the N-terminus or C-terminus may be palmitoylation, acetylation, formylation, PEGylation, or conjugation with 2-mercaptoacetic acid, 3-mercaptopropionic acid, 6-mercaptohexanoic acid, pyroglutamic acid, succinimide acid, amide, cystramine, methyl ester, ethyl ester, benzyl ester, or a fatty acid, such as at least one selected from the group consisting of myristic acid, stearic acid, palmitic acid, cholesterol, 6-amino hexanoic acid, and 8-amino octanoic acid.

[0045] The peptides of the present disclosure can be obtained through widely known methods in the field. Specifically, the peptides can be manufactured using genetic recombination and protein expression systems, or synthesized in vitro through chemical synthesis methods, including cell-free protein synthesis. More specifically, they can be synthesized using an automatic peptide synthesizer or produced using gene manipulation techniques, but are not limited to thereto. For example, a gene encoding a fusion protein comprising a fusion partner and the peptide of the present disclosure can be constructed by genetic manipulation, and the constructed gene can be transformed into a host microorganism. The fusion protein can then be expressed in the host microorganism, and the peptide of the present disclosure can be cleaved and separated from the fusion protein using proteolytic enzymes or compounds to produce the desired peptide.

[0046] The peptide of the present disclosure may exist in a salt form. Salt forms available in the present disclosure

can be formed during the final isolation and purification of the compound or by reacting the amino groups with an appropriate acid. For example, salts may include acetate, adipate, alginate, citrate, aspartate, benzoate, benzene sulfonate, bisulfate, butyrate, camphorate, camphorsulfonate, digluconate, glycerophosphate, hemisulfate, heptanoate, hexanoate, formate, fumarate, hydrochloride, hydrobromide, hydroiodide, 2-hydroxyethanesulfonate, lactate, maleate, methanesulfonate, naphthalenesulfonate, nicotinate, 2-naphthalenesulfonate, oxalate, pamoate, pectinate, persulfate, 3-phenylpropionate, picrate, pivalate, propionate, succinate, tartrate, trichloroacetate, trifluoroacetate, phosphate, glutamate, bicarbonate, para-toluenesulfonate, undecanoate, and more but are not limited thereto. Additionally, the acids used to form acid addition salts may include inorganic acids such as hydrochloric acid, hydrobromic acid, sulfuric acid, and phosphoric acid, and organic acids such as oxalic acid, malic acid, succinic acid, and citric acid, but are not limited to thereto.

[0047] With respect to the peptides, their N- or C-termini may be modified by adding a targeting sequence, a tag, a labeled residue, or an amino acid sequence designed for increasing the stability or half-life of the peptides; an antibody or an antibody fragment thereof, human serum albumin (HSA), and the like designed for increasing targeting efficacy or stability.

[0048] The term "antibody" refers to a specific protein molecule that is directed to an antigenic site. Preferably, the antibody refers to an antibody that specifically binds to a specific protein or an immunogenic fragment thereof, and may include all of monoclonal antibodies (mAb), polyclonal antibodies (pAb), and recombinant antibodies. The antibody may be easily produced using a known technique widely known in the art.

[0049] The antibody may include a complete form having two full-length light chains and two full-length heavy chains as well as a functional fragment of an antibody molecule. The functional fragment of the antibody molecule refers to a fragment retaining at least an antigen-binding function, and includes Fab, F(ab'), $F(ab')_2$, $F(ab)_2$, Fv, and the like.

[0050] The peptides may be encapsulated or immobilized in nanoparticles, microparticles, metal particles, ceramic particles, hydrogels, and the like, for delivery to specific tissues or to ensure stability, but are not limited thereto.

[0051] The nanoparticles, microparticles, metal particles, ceramic particles, hydrogels, and the like may be biocompatible and non-toxic.

[0052] The acetylcholine receptor-binding peptides bind to acetylcholine receptors, thereby preventing the binding of acetylcholine to the receptors, and thus can inhibit the actions of the acetylcholine receptors. Preferably, the peptides can relieve wrinkles and suppress abnormal muscle contraction by inhibiting muscle contraction; and, during surgery, can secure the convenience of surgery by promoting muscle relaxation.

[0053] Furthermore, the present disclosure provides a polynucleotide encoding the acetylcholine receptor-binding peptide. A polynucleotide containing a nucleotide sequence that is homologous to the nucleotide sequence constituting the polynucleotide may also be included in the scope of the polynucleotide provided in the present disclosure as long as the polynucleotide can encode a peptide capable of exhibiting binding activity to the acetylcholine receptor. Such a polynucleotide is preferably a polynucleotide containing an amino acid sequence showing at least 80% homology, more preferably a polynucleotide containing an amino acid sequence showing at least 90% homology, and most preferably a polynucleotide containing an amino acid sequence showing at least 95% homology.

[0054] Furthermore, the present disclosure provides a cosmetic composition, for wrinkle relief, including the acetylcholine receptor peptide.

[0055] The acetylcholine receptor-binding peptide can relieve wrinkles by inhibiting the action of the acetylcholine receptor to prevent muscle contraction.

[0056] The cosmetic composition may further contain the acetylcholine receptor-binding peptide, and an adjuvant commonly used in the field of cosmetics, for example, a hydrophilic or lipophilic gelling agent, a hydrophilic or lipophilic activator, a preservative, an antioxidant, a solvent, a flavoring agent, a filler, a blocker, a pigment, a deodorant, or a dye.

[0057] The amount of the adjuvant is an amount that is commonly used in the art and, in any case, the adjuvant and the proportion thereof may be for selected so as not to adversely affect desirable properties of the cosmetic composition according to the present disclosure.

[0058] The cosmetic composition for wrinkle relief may be prepared by further containing an additive.

[0059] The additive may be a moisturizer, a functional raw material, a thickener, a softener, an emulsifier, a surfactant, a pH adjuster, and the like.

[0060] The moisturizer may include glycerin, propylene glycol, butylene glycol, hyaluronic acid, a ceramide component, and the like, but is not limited thereto.

[0061] The thickener may include a polymer, xanthan gum, and guar gum, but is not limited thereto.

[0062] The softener may include mineral oil, shea butter, or paraffin, but is not limited thereto.

[0063] The emulsifier may include dimethicone, beeswax, and the like.

[0064] The cosmetic composition for wrinkle relief may be used by mixing with a raw material having a wrinkle relief effect.

[0065] The raw material having a wrinkle relief effect may include vitamin A, a vitamin A derivative (retinyl palmitate, retinyl acetate, etc.), adenosine, and polyethoxylated retinamide, but is not limited thereto.

[0066] The cosmetic composition may be in the formulation of at least one selected from the group consisting of a lotion, a skin softener, a skin toner, an astringent, a cream, a foundation, an essence, a pack, a mask pack, a soap, a body cleanser, a cleansing foam, a body oil, and a body lotion, but is not limited thereto.

[0067] The cosmetic composition may be used every day, and may also be used even for an undetermined period, and preferably, the amount of use, the number of times of use, and the period of the cosmetic composition may be adjusted according to user's age, skin condition, or skin type.

[0068] Furthermore, the present disclosure provides a pharmaceutical composition for prevention or treatment of an acetylcholine receptor hyperactivity-associated disease, the pharmaceutical composition containing the acetylcholine receptor-binding peptide.

[0069] The pharmaceutical composition can bind to an acetylcholine receptor to inhibit the activation of the acetylcholine receptor, thereby preventing or treating the acetylcholine receptor hyperactivity-associated disease.

[0070] The acetylcholine receptor hyperactivity-associated disease refers to a disease in which the muscle contracts abnormally excessively, and examples thereof may be cervical dystonia, limb dystonia, truncal dystonia, blepharospasm, spasticity, hemifacial spasm, strabismus, nystagmus, tics, chronic pain, chronic migraine, neurogenic bladder, detrusor-sphincter dyssynergia, achalasia cardia, hyperhidrosis, neuropathic pain, skin wrinkles, square jaw and sialorrhea, pediatric cerebral palsy, post-stroke muscle stiffness, back pain, enlarged prostate, urinary incontinence, vocal cord nodules and correction, hemorrhoids, dentition, and the like.

[0071] In addition, the pharmaceutical composition can be used to secure the convenience of surgery by promoting muscle relaxation during surgery, and can be used as a therapeutic agent or adjuvant for diseases caused by nicotine addiction, used for wrinkle removal, and used for square jaw or calf correction, but is not limited thereto.

[0072] The pharmaceutical composition may contain the acetylcholine receptor-binding peptide and a pharmaceutically acceptable excipient.

[0073] The pharmaceutical composition may be formulated in the forms of: an oral formulation, such as a powder, granules, a tablet, a capsule, a suspension, an emulsion, a syrup, or an aerosol; an externally applied preparation; a suppository; and a sterile injectable solution, according to usual methods, respectively. Examples of a carrier, an excipient, and a diluent that may be contained in the pharmaceutical composition may include lactose, dextrose, sucrose, sorbitol, mannitol, xylitol, erythritol, maltitol, starch, acacia rubber, alginate, gelatin, calcium phosphate, calcium silicate, cellulose, methyl cellulose, microcrystalline cellulose, polyvinyl pyrrolidone, water, methyl hydroxybenzoate, propyl hydroxybenzoate, talc, magnesium stearate, and mineral oil. The pharmaceutical composition may be prepared by using a diluent or an excipient that is usually used, such as a filler, an extender, a binder, a humectant, a disintegrant, or a surfactant. Solid preparations for oral administration include a tablet, a pill, a powder, granules, a capsule, and the like. These solid preparations may be prepared by mixing the acetylcholine receptor-binding peptide with at least one excipient, for example, starch, calcium carbonate, sucrose or lactose, gelatin, or the like. Also, a lubricant, such as magnesium stearate or talc, may be used in addition to simple excipients. Liquid preparations for oral administration correspond to a suspension, a liquid for internal use, an emulsion, a syrup, and the like, and may contain simple diluents that are frequently used, such as water and liquid paraffin, as well as several excipients, such as a humectant, a sweetener, a flavoring agent, and a preservative. Preparations for parenteral administration include a sterile aqueous solution, a non-aqueous solvent, a suspension, an emulsion, a freeze-drying agent, and a suppository. Examples of the non-aqueous solvent and suspension may include propylene glycol, polyethylene glycol, vegetable oils such as olive oil, injectable esters such as ethyl oleate, and the like. A base material for the suppository may include Witepsol, Macrogol, Tween 61, cocoa butter, laurin butter, glycerogelatin, and the like.

[0074] Although not particularly limited to the formulation, the pharmaceutical composition may be used as an externally-applied preparation for skin, having one formulation selected from an ointment agent, a lotion agent, a spray agent, a patch agent, a cream agent, a gel agent, and a gel. The pharmaceutical composition may contain an agent for increasing transdermal absorption, such as, but not limited to, dimethyl sulfoxide, dimethylacetamide, dimethylformamide, a surfactant, an alcohol, acetone, propylene glycol, or polyethylene glycol. The frequency of application may vary significantly depending on the age, sex, and weight of a subject to be treated, a specific disease or pathological condition to be treated, the severity of a disease or pathological condition, the route of administration, and the judgment of a prescriber. The frequency of application may range from once a month up to 10 times a day, preferably from once a week up to 4 times a day, more preferably from three times a week up to three times a day, still more preferably one or two times a day.

[0075] The pharmaceutical composition of the present disclosure may be administered to mammals, such as a rat, livestock, and a human, through various routes. All modes of administration may be expected, and for example, administration may be conducted orally, rectally, or by intravenous, intramuscular, subcutaneous, transdermal, endometrial, or intracerebrovascular injection. Preferably, administration may be conducted by transdermal injection.

[0076] Furthermore, the present disclosure is directed to a health functional food composition, containing the acetylcholine receptor-binding peptide, for alleviating an acetylcholine receptor hyperactivity-associated disease.

[0077] The health functional food composition may contain the acetylcholine receptor-binding peptide and a sitologically acceptable food supplement additive.

[0078] The health functional food composition of the present disclosure includes forms of a tablet, a capsule, a pill, a liquid preparation, and the like, and examples of foods to which peptide of the present disclosure can be added include various kinds of foods, beverages, gums, teas, vitamin complexes, and health functional foods.

[0079] In accordance with still another aspect of the present disclosure, there is provided a composition for a medicinal device, the composition containing the acetylcholine receptor-binding peptide.

[0080] The composition for a medicinal device may be a filler, but is not limited thereto.

[0081] As used herein, the term "filler" refers to a substance that can supplement skin tissues, and has the purpose of filling through injection for restoration of the resilient face, improvement of facial contour, and relief of wrinkles.

[0082] The composition for a medicinal device can relieve wrinkles by suppressing muscle contraction and can exhibit a contour improving effect, through the acetylcholine receptor-binding peptide, and microparticles, nanoparticles, and hydrogels, on which the acetylcholine receptor-binding peptide is immobilized, can be injected to fill tissue.

Advantageous Effects of Invention

[0083] The present disclosure relates to acetylcholine receptor-binding optimized shortened peptides and uses thereof and, more specifically, to pentamers and hexamers containing arginine or lysine at both ends and having a certain amino acid sequence XYZ in the center, and further including arginine or lysine at the N or C terminal for the hexamers. Compared to existing longer peptides or existing pentamers and hexamers, the optimized shortened peptides of the present disclosure have significantly improved binding affinity for acetylcholine receptors and enhanced skin permeability. Thus, it is expected that the peptides can be developed into cosmetic compositions for wrinkle reduction, pharmaceuticals for the prevention or treatment of acetylcholine receptor-associated diseases, and health functional foods for health improvement.

Brief Description of Drawings

[0084]

FIG. 1 shows comparison of affinity for acetylcholine receptors among the precursor peptides 11mer and 8mer, and their shortened peptides 6mer, and Synake.

FIG. 2 shows alanine scanning results to identify the critical sequence of the shortened peptides 6mer and 5mer of Espep2.

FIG. 3 shows the result of binding affinity for acetylcholine receptors of the shortened peptides 6mer and 5mer derived from Espep2.

FIG. 4 shows graphs of acetylcholine receptor binding specificity of phages screened through biopanning for the optimized shortened library 6mer-1, 6mer-2, and 5mer.

FIG. 5 is a graph comparing the RU value, which is the binding affinity, between the top XYZ repeating amino acid combination and the bottom XYZ repeating amino acid combination in the 5mer library.

FIG. 6 is a graph comparing the RU value, which is the binding affinity, between the top XYZ repeating amino acid combination and the bottom XYZ repeating amino acid combination in the 6mer-1 library.

FIG. 7 is a graph comparing the RU value, which is the binding affinity, between the top XYZ repeating amino acid combination and the bottom XYZ repeating amino acid combination in the 6mer-2 library.

FIG. 8 shows the result of comparing the binding affinity for acetylcholine receptors among simple 5mer (5mer-ND) and 6mer (Espep2-6mer) derived from Espep2, the control Synake, and the optimized peptides 5mer (5mer-73 and 5mer-311) and 6mer (6mer-1-43, 6mer-1-210, 6mer-2-233, and 6mer-2-136) according to the present disclosure.

FIG. 9 shows the affinity of the 6mer-1-43 peptide according to the present disclosure for acetylcholine receptors over concentration.

FIG. 10 is a graph showing the inhibitory capacity of Synake on acetylcholine receptors.

FIG. 11 shows the inhibitory capacity of the 6mer-1-43 and 6mer-1-210 peptides according to the present disclosure on acetylcholine receptors.

FIG. 12 shows the inhibitory capacity of the 6mer-2-136 and 6mer-2-233 peptides according to the present disclosure on acetylcholine receptors.

FIG. 13 shows the inhibitory capacity of the 5mer-73 and 5mer-311 peptides according to the present disclosure on acetylcholine receptors.

FIG. 14 shows the inhibitory capacity of the palmitoylated peptide (Pal-6mer-1-43) of the 6mer-1-43 peptide according to the present disclosure on acetylcholine receptors.

FIG. 15 is the result of the inhibitory capacity of the palmitoylated 5mer-73 peptide (Pal-5mer-73) according to the present disclosure on acetylcholine receptors.

FIG. 16 shows comparison of inhibitory capacity on acetylcholine receptors between each peptide according to the

present disclosure and Synake.

FIG. 17 shows results of assaying cytotoxicity of representative peptides according to the present disclosure for cytotoxicity.

FIG. 18 shows results of assaying skin permeability of the 11mer (Pal-Espep2) as the control group and the 5mer (Pal-5mer-73) according to the present disclosure.

FIG. 19 shows results of assaying clinical efficacy of the optimized short peptide (5mer-73, RRQRR) according to the present disclosure on eye skin wrinkles.

FIG. 20 shows results of assaying clinical efficacy of the optimized short peptide (5mer-73, RRQRR) according to the present disclosure on skin elasticity.

FIG. 21 shows results of assaying clinical efficacy of the optimized short peptide (5mer-73, RRQRR) according to the present disclosure on forehead wrinkle reduction.

Best Mode for Carrying out the Invention

[0085] The present inventors previously selected acetylcholine receptor (AchR)-specific peptides with high binding affinity and specificity for AchR in the prior patent (Korean Patent No. 10-2020-0080179 A). These peptides were based on the Espep-2 peptide sequence WTWKGRKSLLR and further developed to identify crucial sequence regions important for acetylcholine receptor binding, resulting in the discovery of optimized 8mer, 11mer, and 14mer peptides with increased affinity to AchR. While these peptides demonstrated selective binding affinity to AchR through repeated biopanning, their length of 8-14mers causes problems such as the expensive production costs and difficulty in penetrating the skin. Particularly, as the peptide length increases, it not only leads to higher production costs but also negatively impacts skin penetration.

[0086] To address these issues, the present inventors have developed the invention during the process of identifying shorter peptides that retain selective binding affinity for AchR. Particularly, it was discovered that even the simply shortened 6-mer and 5-mer peptides RKSLLR and KSLLR, derived from Espep2, demonstrated superior binding affinity compared to the Synake peptide. Based on the structure of Espep2, the inventors searched for the optimal peptide structures for 6-mer and 5-mer peptides. To determine the optimized shortened peptides, a random library of 6-mer and 5-mer peptides was generated, screened, and analyzed for the peptide sequences. The results confirmed that peptides with specific amino acid sequences at certain positions exhibited higher acetylcholine receptor binding affinity, compared to the existing Espep2 (11-mer), 6-mer, and 5-mer peptides.

[0087] Hereinafter, preferable exemplary embodiments of the present disclosure will be described in detail. However, the present disclosure is not limited to the exemplary embodiments described herein and can be embodied in many different forms. Rather, these exemplary embodiments are provided so that the present disclosure will be thorough and complete and will fully convey the scope of the disclosure to those skilled in the art.

<EXAMPLE 1: Affinity of Shortened Peptides for Construction of Optimized Shortened Library>

[0088] To construct an optimized shortened library from the previous Espep2 peptide, assessment was made of the affinity of peptides having sequences sequentially removed from the N- and C-terminals. Initially, surface plasmon resonance (SPR) experiments were conducted using a biosensor chip (Biacore3000, Biacore AB, Uppsala, Sweden). Selected acetylcholine receptor proteins were immobilized on a CM5 chip (Biacore) using EDC/NHS and observed for association and dissociation for up to 500 seconds. The observation conditions were set forth as follows: running buffer 20mM Tris (pH 7.4), rate 30ul/min, concentration 20 μM (peptide), and the results are depicted in FIG. 1.

[0089] As shown in FIG. 1, the affinity for acetylcholine receptor of the derivatives with reduced size by removing amino acids from the N and C terminals was 1.2 μM for 11mer (Espep2-11mer, WTWKGRKSLLR), 3.1 μM for 8mer (Espep2-8mer, KGRKSLLR), and 57 μM for 6mer (Espep2-6mer, RKSLLR), indicating higher affinity by 1916 times for the 11mer, 740 times for the 8mer, and 40 times for the 6mer, compared to Synake.

[0090] Synake, a snake venom-derived peptide, inhibits the binding of acetylcholine to its receptors, thus relieving wrinkles. The high affinity of the shortened Espep-2 peptides (11mer, 8mer, 6mer) for acetylcholine receptor protein, as seen in Figure 1, demonstrated superior performance compared to Synake, indicating their potential not only in cosmetic compositions for wrinkle relief, but also in preventing or treating diseases related to acetylcholine receptor hyperactivity by inhibiting the acetylcholine receptor.

[0091] Despite the excellent medical utility of botulinum toxin used in treating various diseases caused by muscle spasms and hyperactivity due to acetylcholine receptor hyperactivity, it possesses a highly toxic nature, capable of causing death to about a million people with just 1g, and is regulated under the Biological Weapons Convention. In consideration of this fact, short peptides were found to achieve high acetylcholine receptor inhibitory efficacy.

<EXAMPLE 2: Alanine Scanning and Affinity of Shortened Peptides to Confirm Core Sequence>

[0092] To identify the crucial sequences in the shortened peptides, alanine scanning was conducted. Wild-type (WT) Espep2-6mer (RKSLLR) and Espep2-5mer (KSLLR) peptides were synthesized with each amino acid sequentially substituted with alanine (Ala, A), and their affinity was measured using the same method as in Example 1. The measurements are depicted in FIG. 2 after normalization to WT.

[0093] As shown in FIG. 2, it was found that positively charged amino acids near the N and C terminals are important for binding.

[0094] Moreover, among the six amino acids in the RKSLLR sequence, R residues at the N and C terminals are crucial. Based on these results, 5mer-ND (KSLLR) and 5mer-CD (RKSLL) peptides were synthesized by removing one sequence from each end of the N and C terminals of the 6mer, and their respective affinities were measured and the measurements are presented in FIG. 3.

[0095] As shown in FIG. 3, Espep2 6mer had an RU value of 177, indicating higher affinity than that of Synake, and the shortened 5mer-ND showed higher binding affinity than Synake. In the case of 5mer-CD, it exhibited slightly lower binding affinity compared to Synake. Thus, it was found the structure of the 5mer shortened peptide, including lysine (K) or arginine (R) at both ends, is advantageous for acetylcholine receptor binding.

<EXAMPLE 3: Construction of Library of Shortened, 6mer-1, 6mer-2, 5mer-ND>

[0096] Based on the important sequences identified through alanine scanning in Example 2, optimized libraries were constructed for 6mer-1; (K/R)(K/R)XXX(K/R), 6mer-2; (K/R)XXX(K/R)(K/R), and 5mer-ND; (K/R)XXX(K/R) [(K/R) represents either K or R and X is a random amino acid].

Example 3-1: Construction of Optimized Shortened Library Vectors

[0097] To construct a 6mer optimized peptide library, DNA sequences for 6mer-1-F (SfiI_AR_AARANNKNNKNNKARA_NotI), 6mer-2-F (SfiI_ARANNKNNKNNKARAARA_NotI), 5mer-ND-F (SfiI_ARANNKNNKNNKARA_NotI), and Back (AACAGTTTCTGCGGCCGC) (where N is A, T, G or C; K is G or T; and M is C or A) were synthesized (Bioneer, Daejeon, Korea). With the synthesized DNA library of Table 1 serving as templates, 5mer and 6mer inserts were subjected to PCR (94°C for 5 min, 60 cycles of 40°C for 30 sec and 72°C for 30 sec, and 72°C for 7 min) to generate double-stranded products, followed by purification (PCR purification kit, GeneAll, Seoul, Korea) to obtain the library genes. The library genes were inserted into a phagemid vector (pIGT). In this regard, the phagemid vector and insert DNA were treated with restriction enzymes. About 10 μg of insert DNA was reacted with SfiI (New England Biolabs (NEB, Ipswich)) and NotI (NEB, Ipswich) for 8 hours, and then the purified DNA was obtained using the PCR purification kit. Similarly, about 10 μg of phagemid vector was treated with SfiI and NotI for 8 hours, followed by reaction with CIAP (Calf Intestinal Alkaline Phosphatase) (NEB, Ipswich) for 1 hour and then purification by the PCR purification kit. The insert DNA was ligated to the phagemid vector using T4 DNA ligase (Bioneer, Daejeon, Korea) for 15 hours at 18°C and then precipitated with ethanol, and the DNA was dissolved in 100 μL of TE buffer.

TABLE 1

Library	Amino acid sequence	Base sequence
6mer-1	(K or R)-(K or R)-XXX-(K or R), X=random amino acids	TTCTATGCGGCCCAGCTGGCCARAARANNKN NKNNKARAGCGGCCGCAGAAACTGTT
6mer-2	(K or R)-XXX-(K or R)-(K or R), X=random amino acids	TTCTATGCGGCCCAGCTGGCCARANNKNNKN NKARAARAGCGGCCGCAGAAACTGTT
5mer-ND	(K or R)-XXX-(K or R), X=random amino acids	TTCTATGCGGCCCAGCTGGCCARANNKNNKN NKARAGCGGCCGCAGAAACTGTT
N : A or C or G or T K : G or T R : A or G X : Random amino acids		

EXAMPLE 3-2. Electroporation

[0098] The phagemid vector (10 μg) and 6mer or 5mer random insert DNA (3 μg) were ligated in 100 μL which was then divided into 10 parts, followed by electroporation. Competent cells were thawed on ice, and 200μL of competent cells were mixed with 4μE of the ligated solution, cooled, and placed in a prepared 0.2 cm cuvette which was then left on ice for 1 minute. After an electroporator (BioRAD, Hercules, Ca) was programmed under conditions of 25 μF and 2.5 kV at 200 Q, the prepared cuvette was dried and placed in the electroporator and a pulse was applied thereto. The time constant was 4.5-5 msec. Immediately thereafter, the cells were transferred to 1mL of LB broth containing 20mM glucose prewarmed to 37°C, and the resulting 25mL of cells were transferred to a 100-mL tube and then cultured at 37°C at 200rpm for one hour. Of the cell culture, 10μL was taken, diluted, and spread on an ampicillin agar plate to count the library. The remaining cells were cultured overnight in 1 L of LB with 20mM glucose and 50pg/mL ampicillin at 30°C. After centrifugation for 20 minutes at 4,000g and 4°C, the supernatant was discarded and the cell pellet was resuspended in 40 mL of LB. Then, glycerol was added to a final concentration of more than 20%, and stored at - 80°C.

Example 3-3: Production of Recombinant Phage from Optimized Peptide Library

[0099] Recombinant phages were produced using the 6mer and 5mer optimized peptide library stored at -80°C. To 30 mL of SB broth was added 1 mL of the library stored at -80°C, followed by incubation at 37°C and 200 rpm for 20 minutes. Helper phage (1010 pfu) and ampicillin (final concentration 50 μg/mL) were added and cultured again under the same conditions for an hour. Then, the phages were transferred to 30mL of SB broth containing ampicillin (50pg/mL) and kanamycin (10μg/mL) and cultured under the same conditions for over 16 hours to produce recombinant phages. The culture was centrifuged at 5,000rpm for 10 minutes at 4°C, and the supernatant was mixed with PEG/NaCl in a 5:1 ratio, left on ice for 1 hour, then centrifuged at 13,000rpm for 20 minutes at 4°C. The supernatant was carefully discarded and the pellet was resuspended in 1 mL of PBS.

[0100] To ensure that all possible amino acid sequences were stochastically included in the library, the completed library number should be at least 3.2×104 for the 5mer optimized library, calculated as 2×2×20×20×20. Therefore, the 5mer library was constructed with a count of 1.95×106 in this study. For the 6mer optimized library, the number should be at least 6.4×104, calculated as 2×2×2×20×20×20. In this study, 1.23×106 and 1.53×106 libraries were obtained for 6mer-1 and 6mer-2, respectively, confirming successful library development. These results are summarized in Table 2 below. Additionally, partial sequencing of each library confirmed no errors in the designated sequence, and the results are given in Table 3.

TABLE 2

	Name	Sequence	Sequence and No. of optimized library
1	Espep 2_6mer-1	RKSLLR	(R/K) (R/K) XXX (R/K) 1.23×10 6
2	Espep 2_6mer-2	KSLLR (R/K)	(R/K) XXX (R/K) (R/K) 1.53×10 6
3	Espep 2_5mer (ND)	KSLLR	(R/K)XXX(R/K) 1.95×10 6

TABLE 3

No.	Name	Sequence
1	5mer-ND-1	AAQLAKGCCRAAAEQKLISEEDLSR@DDDD
2	5mer-ND-2	AAQLARWRRAAAEQKLISEEDLSR@DDDD
3	5mer-ND-3	AAQLAKWILKAAAEQKLISEEDLSR@DDDD
4	5mer-ND-4	AAQLAKSTCKAAAEQKLISEEDLSR@DDDD
5	5mer-ND-5	AAQLARSVQRAAAEQKLISEEDLSR@DDDD
6	5mer-ND-6	AAQLAKAQQRAAAEQKLISEEDLSR@DDDD
7	5mer-ND-7	AAQLARGLWKAAAEQKLISEEDLSR@DDDD
8	5mer-ND-8	AAQLARTDERAAAEQKLISEEDLSR@DDDD
9	5mer-ND-9	AAQLAKCYARAAAEQKLISEEDLSR@DDDD

(continued)

No.	Name	Sequence
10	5mer-ND-10	AAQLARKGTRAAAEQKLISEEDLSR@DDDD
11	6mer-1-1	AAQLARRGRGRAAAEQKLISEEDLSR@DDDD
12	6mer-1-2	AAQLARKALLRAAAEQKLISEEDLSR@DDDD
13	6mer-1-3	AAQLAKRQCSKAAAEQKLISEEDLSR@DDDD
14	6mer-1-4	AAQLARRCSRRAAAEQKLISEEDLSR@DDDD
15	6mer-1-5	AAQLARRRGYRAAAEQKLISEEDLSR@DDDD
16	6mer-1-6	AAQLAKRCVRRAAAEQKLISEEDLSR@DDDD
17	6mer-1-7	AAQLARKQLGKAAAEQKLISEEDLSR@DDDD
18	6mer-1-8	AAQLAKKSTTRAAAEQKLISEEDLSR@DDDD
19	6mer-1-9	AAQLARRQAQKAAAEQKLISEEDLSR@DDDD
20	6mer-1-10	AAQLAKRVSQRAAAEQKLISEEDLSR@DDDD
21	6mer-2-1	AAQLAKQLRKKAAAEQKLISEEDLSR@DDDD
22	6mer-2-2	AAQLAKRQLKRAAAEQKLISEEDLSR@DDDD
23	6mer-2-3	AAQLAKLSLRRAAAEQKLISEEDLSR@DDDD
24	6mer-2-4	AAQLARLVSRRAAAEQKLISEEDLSR@DDDD
25	6mer-2-5	AAQLAKVQLKKAAAEQKLISEEDLSR@DDDD
26	6mer-2-6	AAQLAKRFQKKAAAEQKLISEEDLSR@DDDD
27	6mer-2-7	AAQLAKSFRRKAAAEQKLISEEDLSR@DDDD
28	6mer-2-8	AAQLARVFSKKAAAEQKLISEEDLSR@DDDD
29	6mer-2-9	AAQLAKGLLKKAAAEQKLISEEDLSR@DDDD
30	6mer-2-10	AAQLAKSYYKRAAAEQKLISEEDLSR@DDDD

<EXAMPLE 4: Biopanning and Screening of Shortened Peptide Library>

Example 4-1: Biopanning

[0101] A procedure in which immobilized antigens were treated with a phage library surface-expressing antibodies to thereby antibody candidates binding to the antigens is called biopanning, and the biopanning is composed of three steps; binding/washing/elution. The phages having antibodies with weak binding affinity were removed during a washing step, and resultantly, only phages expressing antibodies with strong binding affinity remained. This procedure can be repeated to discover antibody candidates with excellent antigen binding affinity and specificity. Therefore, biopanning was used to screen acetylcholine receptor-binding peptides with excellent binding affinity and specificity to acetylcholine receptors.

[0102] In eight wells of a 96-well plate, 5 μg/ml AchR αl was placed at 50 μl per well, and then left overnight at 4°C. Next day, the wells were washed once with 200 ul of Tris (20 mM, pH 7), followed by the addition of 200 ul of 2% bovine serum albumin (BSA), and then blocked at room temperature for 2 hours. Then, the solution was all discarded, and the wells were washed three times with 200 ul of Tris (20 mM, pH 7). After 400 μl of the random peptide recombinant phages (input phages) suspended in PBS in Example 3-3 was mixed with 400 ul of 2% BSA, the mixture was placed at 100 μl per well and then left at 30°C for 1 hour. The solution in the wells was all removed, and the wells were washed three times with Tris (20 mM, pH 7). Thereafter, 0.2 M glycine (pH 2.2) was placed at 100 μl per well, and the phages were isolated for 20 minutes, and then, the phages were collected in one tube and added with 200 ul of 1 M Tris (pH 9.0) to obtain output phages.

[0103] To repeat biopanning, 500 ul of the isolated phages were mixed with 5 ml of E. coli, followed by incubation at 37°C and 200 rpm for 30 minutes. Then, 1×1010 pfu helper phages and ampicillin were added to a final concentration of 50 μg/ml before additional incubation for 30 minutes. The culture was transferred to SB broth containing 50 μg/ml ampicillin and 10 μg/ml kanamycin, and cultured overnight in the same conditions, thereby reproducing random peptide

recombinant phages. The reproduced random peptide recombinant phages were centrifuged at 4°C and 5,000 rpm for 10 minutes. The supernatant thus obtained and PEG/NaCl were mixed at 5:1 (v:v), left on ice for 1 hour, and centrifuged at 4°C and 13,000 rpm for 20 minutes. The supernatant was discarded while the precipitate was suspended in 1 ml of phosphate buffered saline (PBS), and used for a subsequent round of biopanning.

[0104] Random recombinant phages were reproduced in the same manner as in the foregoing, with the exception that the washing was 3, 3, 4, 4, 5, and 6 times repeated (0.05% PBST) as the round of biopanning increased.

[0105] To measure the number of input phages and output phages for each biopanning, the phages were mixed with E. coli having an absorbance at 600nm of 0.7 (OD600=0.7), and plated on agar plates containing ampicillin. The results are summarized in Tables 4-6 below.

TABLE 4

6mer-1 Biopanning				
Roun d	No. of wash	Input phage	Output phage	Input/out put
1st	3	9.6 × 1010	2.3 × 107	23.9 × 10-5
2nd	3	1.98 × 1012	1.98 × 108	10 × 10-5
3rd	4	1.63 × 1012	5.8 × 107	3.55 × 10-5
4th	4	3.77 × 1012	5.28 × 108	14 × 10-5
5th	5	4.07 × 1012	7.2 × 108	17.6 × 10-5
6th	6	3.13 × 1012	6.4 × 108	20.4 × 10-5

TABLE 5

6mer-2 Biopanning				
Round	No. of wash	Input phage	Output phage	Input/output
1st	3	4.57 × 1011	1.45 × 108	31.7 × 10-5
2nd	3	2.17 × 1012	5.23 × 108	24.1 × 10-5
3rd	4	0.61 × 1012	5.1 × 107	8.36 × 10-5
4th	4	5.21 × 1012	7.7 × 108	14.7 × 10-5
5th	5	4.01 × 1012	6.27 × 108	15.6 × 10-5
6th	6	3.87 × 1012	6.51 × 108	16.82 × 10-5

TABLE 6

5mer-ND Biopanning				
Round	No. of wash	Input phage	Output phage	Input/output
1st	3	8.88 × 1011	3 × 108	33.7 × 10-5
2nd	3	5.36 × 1011	1.09 × 108	20.33 × 10-5
3rd	4	1.58 × 1012	9 × 106	0.56 × 10-5
4th	4	3.55 × 1012	1.23 × 109	34.64 × 10-5
5th	5	3.12 × 1012	1.54 × 109	49.35 × 10-5
6th	6	2.83 × 1012	1.25 × 109	44.16 × 10-5

Example 4-2. Enzyme-Linked Immunosorbent Assay (ELISA) Using Random Peptide Library Input Recombinant Phages

[0106] ELISA was performed on bovine serum albumin (BSA) and AchR using the input phages for each round of biopanning in Example 4-1.

[0107] In a 96-well ELISA plate, 10 μg/ml AchR or BSA was added at 50 μl per well, and left overnight at 4°C. The next day, the wells were washed thrice with Tris (20 mM, pH7), followed by the addition of 2% BSA diluted with PBS, and then blocked at room temperature for 2 hours. After the solution was discarded, the wells were washed thrice with Tris (20 mM, pH7). After 800 μl of the input pages for each of 1st, 2nd, 3rd, 4th, 5th, and 6th rounds in Tables 4 to 6 in Example 4-1 were mixed with 200 μl of 10% BSA, the mixture was placed at 100 μl per well and then left at 30°C for 1 hour. The solution in the wells was all removed, and the wells were washed thrice with Tris (20 mM, pH 7). Then, horseradish peroxidase (HRP)-conjugated anti-M13 Ab (GE Healthcare) diluted 1:1,000 was added at 100 μl per well, followed by incubation at 30°C for 1 hour. After the wells were washed thrice with Tris (20 mM, pH 7), 100 μl of a tetramethylbenzidine (TMB) solution, which is a substrate of HRP, was added to each well to induce a color development reaction, and then the reaction was stopped by the addition of 100 μl of 1M HCl, and the absorbance (OD450) was measured at 450 nm. The results are depicted in FIG. 4. As shown in FIG. 4, with the increasing of the round of biopanning, the OD value of acetylcholine/BSA increases, indicating that phages with high specificity for the acetylcholine receptor were successfully screened.

<EXAMPLE 5. Analysis of Amino Acid X in Each Library Peptide>

[0108] Following biopanning, an analysis was conducted to determine if specific amino acids, associated with the random sequence XXX in the middle part of the peptide sequence from each library, could be identified as having high binding affinity for the acetylcholine receptor. The sequences of phages from the 6th round of biopanning, which exhibited high specificity from the libraries in Example 4, were analyzed. It was noted that both 5mer and 6mer peptides showed a high frequency of certain amino acids. Labeling the XXX portion sequentially as XYZ, the individual occurrences of amino acids at the positions of X, Y, and Z for peptides with high repetition are presented in Table 7.

TABLE 7

X position	No. of repetition	Y position	No. of repetition	Z position	No. of repetition
R	189	R	179	R	182
Q	151	Q	111	S	117
G	109	L	107	L	104
V	96	I	96	C	78
L	87	F	86	Y	65
S	75	V	75	Q	64
W	74	Y	75	T	61
F	23	P	24	W	24
T	12	G	13	G	13
M	12	W	13	V	13
Y	11	H	12	I	13
A	11	C	12	P	13
C	11	T	11	K	12
N	11	M	11	F	12
Y	11	S	11	H	12
K	11	D	11	A	11
		A	11	N	11
				D	11

[0109] Specifically, amino acids found to occur much more frequently than other amino acids were: seven amino acids R, Q, G, V, L, S, and W for the position X; seven amino acids R, Q, L, I, F, V, and Y for position Y; and seven amino acids R, S, L, C, Q, T, and Y for position Z.

<EXAMPLE 6: Binding Affinity Analysis of Peptides Composed of Top 7 Amino Acids in Repeated Sequence of XYZ>

[0110] Based on the frequencies of occurrence of the top 7 amino acids from Table 7 in Example 5, 600 peptides comprising these amino acids (top combinations) and those comprising the 13 less frequently occurring amino acids (bottom combinations) were synthesized for each series of 5mer, 6mer-1, and 6mer-2. The binding affinity of each sequence for the acetylcholine receptor was measured using Surface Plasmon Resonance (SPR) analysis method. The binding affinity was measured in terms of Resonance Units (Ru), and the results are summarized in Tables 8-13. The peptides were tested at a concentration of 10μM. Additionally, the average binding affinities of the top and bottom combinations in each series are depicted in FIGS. 5-7.

TABLE 8

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
1	5mer-1	RVQCK	54	301	5mer-301	KWIRK	64
2	5mer-2	KRISR	80	302	5mer-302	RRILK	70
3	5mer-3	KRVLK	66	303	5mer-303	KGRYR	87
4	5mer-4	KRFLR	58	304	5mer-304	RSVRK	76
5	5mer-5	KLFLR	54	305	5mer-305	KRICK	72
6	5mer-6	RWQQK	61	306	5mer-306	KSYYR	74
7	5mer-7	RQLTK	54	307	5mer-307	KQRCK	82
8	5mer-8	RQRSR	51	308	5mer-308	RLRCR	84
9	5mer-9	RGVQR	77	309	5mer-309	KVQYR	70
10	5mer-10	RVQRR	55	310	5mer-310	KSRQR	78
11	5mer-11	KQRLR	84	311	5mer-311	RSYSR	167
12	5mer-12	RVFLR	70	312	5mer-312	KRYCR	81
13	5mer-13	RLISK	52	313	5mer-313	RSQLK	75
14	5mer-14	RWLCK	63	314	5mer-314	RWYTR	80
15	5mer-15	KGVCK	75	315	5mer-315	KLFSR	77
16	5mer-16	KLYTK	66	316	5mer-316	KQYLR	73
17	5mer-17	KRIYK	70	317	5mer-317	RRVQR	86
18	5mer-18	RQLRR	69	318	5mer-318	KRVCK	64
19	5mer-19	KRFQR	72	319	5mer-319	RVQTR	74
20	5mer-20	RGRYK	78	320	5mer-320	RVVQR	75
21	5mer-21	KWFTR	63	321	5mer-321	RSLSR	68
22	5mer-22	RQQLK	66	322	5mer-322	RRQSR	84
23	5mer-23	KWLYK	86	323	5mer-323	KWYYR	77
24	5mer-24	KSQCR	67	324	5mer-324	KSQRR	58
25	5mer-25	KVVYK	60	325	5mer-325	KRIQR	50
26	5mer-26	RQQQR	65	326	5mer-326	RRFTK	68
27	5mer-27	KGYLR	67	327	5mer-327	RVLCR	86
28	5mer-28	RLLSR	74	328	5mer-328	RWVLK	61
29	5mer-29	KGFCR	63	329	5mer-329	RRFCR	79
30	5mer-30	KSQLR	70	330	5mer-330	RWQLR	86

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
31	5mer-31	RRLQR	65	331	5mer-331	RGIQR	79
32	5mer-32	RQLSR	75	332	5mer-332	RRYCR	85
33	5mer-33	RRISK	59	333	5mer-333	RVLQR	67
34	5mer-34	KRIRK	82	334	5mer-334	KRFYK	64
35	5mer-35	RWQYK	80	335	5mer-335	KSLTR	56
36	5mer-36	RRLQK	60	336	5mer-336	KSVSR	83
37	5mer-37	RRLSR	72	337	5mer-337	KGRSR	67
38	5mer-38	RGYCK	53	338	5mer-338	RWILR	61
39	5mer-39	KQVSR	67	339	5mer-339	KWVRK	87
40	5mer-40	KSVCR	67	340	5mer-340	KGYRR	51
41	5mer-41	KVISK	82	341	5mer-341	RWYRR	52
42	5mer-42	RQRLR	83	342	5mer-342	KVYQR	69
43	5mer-43	KSFYR	53	343	5mer-343	KSFSR	60
44	5mer-44	RSRTR	59	344	5mer-344	KQFQR	52
45	5mer-45	RVFQR	86	345	5mer-345	RQQRR	86
46	5mer-46	KRQCK	76	346	5mer-346	KGISK	57
47	5mer-47	KGVRR	70	347	5mer-347	KRICR	78
48	5mer-48	RVYLR	62	348	5mer-348	KRQTK	80
49	5mer-49	KWRTR	62	349	5mer-349	KQVYR	50
50	5mer-50	KLLCR	63	350	5mer-350	KSYYK	59
51	5mer-51	RSLQR	70	351	5mer-351	KSFSK	75
52	5mer-52	RQQYK	50	352	5mer-352	RLVRK	76
53	5mer-53	RLVTR	50	353	5mer-353	KSQLK	59
54	5mer-54	KWLQR	66	354	5mer-354	RSQTR	64
55	5mer-55	RRFSR	58	355	5mer-355	KLLYR	87
56	5mer-56	KRFCK	59	356	5mer-356	KQVLR	65
57	5mer-57	KQLYR	73	357	5mer-357	RGFRK	54
58	5mer-58	KWVSK	75	358	5mer-358	KVRSK	50
59	5mer-59	KLQYR	68	359	5mer-359	KRFQK	79
60	5mer-60	RLFTK	86	360	5mer-360	RQLCK	66
61	5mer-61	RLILK	66	361	5mer-361	RSYQR	58
62	5mer-62	KQLTK	70	362	5mer-362	KQRLK	62
63	5mer-63	RLLRK	86	363	5mer-363	KRVRK	59
64	5mer-64	KVVTR	76	364	5mer-364	RWITR	62
65	5mer-65	RQIRR	67	365	5mer-365	KRRYK	52
66	5mer-66	KRLLR	80	366	5mer-366	RQLQK	52
67	5mer-67	RQLYR	86	367	5mer-367	RSVQK	71

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
68	5mer-68	RGFYK	82	368	5mer-368	KRIRR	50
69	5mer-69	RSRSR	50	369	5mer-369	RGFTR	84
70	5mer-70	RLLQR	69	370	5mer-370	KWRRK	67
71	5mer-71	KLQSK	68	371	5mer-371	RGISK	86
72	5mer-72	KLYRR	50	372	5mer-372	RSVCR	54
73	5mer-73	RRQRR	179	373	5mer-373	KVFTK	87
74	5mer-74	RQITK	87	374	5mer-374	KLFTR	75
75	5mer-75	KVQTK	63	375	5mer-375	KQLCR	84
76	5mer-76	RGYRR	80	376	5mer-376	KGQLR	65
77	5mer-77	KWRQK	74	377	5mer-377	KGFYK	67
78	5mer-78	KVICK	79	378	5mer-378	RRLSK	65
79	5mer-79	RWFLR	82	379	5mer-379	KSRLR	79
80	5mer-80	KSRTR	83	380	5mer-380	KRYLK	82
81	5mer-81	RGIYR	79	381	5mer-381	KGQRR	87
82	5mer-82	RQRYK	84	382	5mer-382	RLRQR	62
83	5mer-83	KGFSR	64	383	5mer-383	RWQRK	56
84	5mer-84	RVVRR	67	384	5mer-384	KSLRK	75
85	5mer-85	KGVLK	74	385	5mer-385	RGVYR	51
86	5mer-86	RRLCK	55	386	5mer-386	RSFLK	78
87	5mer-87	RQITR	55	387	5mer-387	RRILR	52
88	5mer-88	RRVQK	73	388	5mer-388	KLFCK	78
89	5mer-89	KRITK	77	389	5mer-389	KWRRR	57
90	5mer-90	RWYTK	86	390	5mer-390	KRFCR	64
91	5mer-91	RQIQK	55	391	5mer-391	KVFRR	72
92	5mer-92	RVRLK	62	392	5mer-392	RSRLR	87
93	5mer-93	KWVYR	79	393	5mer-393	KSLQR	75
94	5mer-94	RWFQR	50	394	5mer-394	KRRRK	66
95	5mer-95	RGRRK	68	395	5mer-395	RWVCK	50
96	5mer-96	RVLYR	55	396	5mer-396	KVVCR	53
97	5mer-97	KRQLR	52	397	5mer-397	RRITK	52
98	5mer-98	KWYCK	68	398	5mer-398	KGQCR	71
99	5mer-99	RWICK	58	399	5mer-399	KWIQR	62
100	5mer-100	KVIRK	80	400	5mer-400	RWRCK	70
101	5mer-101	RQQYR	55	401	5mer-401	RGVLR	52
102	5mer-102	RGFSK	82	402	5mer-402	RLRYR	86
103	5mer-103	RWFLK	62	403	5mer-403	RRLYK	64
104	5mer-104	RVVLK	74	404	5mer-404	KGYLK	83

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
105	5mer-105	RGQQR	50	405	5mer-405	KSYTK	68
106	5mer-106	KLLQR	78	406	5mer-406	KVYLR	84
107	5mer-107	RWVSR	56	407	5mer-407	RQIYK	58
108	5mer-108	KWQLK	77	408	5mer-408	KVFRK	74
109	5mer-109	RLQCR	68	409	5mer-409	KQIYK	62
110	5mer-110	KRRLK	76	410	5mer-410	RRFLR	76
111	5mer-111	KSVLK	85	411	5mer-411	KGRLR	66
112	5mer-112	KRYYR	58	412	5mer-412	RGRSR	81
113	5mer-113	KRLRK	79	413	5mer-413	RWLTR	56
114	5mer-114	KRQRR	82	414	5mer-414	KVRCK	71
115	5mer-115	RWLLR	75	415	5mer-415	KVFLR	77
116	5mer-116	RWRSK	64	416	5mer-416	KLYLR	67
117	5mer-117	RSVYK	69	417	5mer-417	KWLQK	65
118	5mer-118	RVICK	87	418	5mer-418	RWRTR	53
119	5mer-119	KQIRK	60	419	5mer-419	RVYTR	67
120	5mer-120	RQILK	68	420	5mer-420	KLFCR	84
121	5mer-121	RQVTR	73	421	5mer-421	RVVYK	68
122	5mer-122	RSYQK	78	422	5mer-422	KWICK	87
123	5mer-123	KWIRR	53	423	5mer-423	RRQLK	60
124	5mer-124	KGFSK	58	424	5mer-424	RVYLK	87
125	5mer-125	RVRQK	67	425	5mer-425	RGFYR	80
126	5mer-126	RGVTK	61	426	5mer-426	RRVSR	57
127	5mer-127	RWVTK	86	427	5mer-427	RGLYR	87
128	5mer-128	RGVCR	56	428	5mer-428	RQFLK	86
129	5mer-129	KSLLK	63	429	5mer-429	KSQYK	63
130	5mer-130	RRFRK	80	430	5mer-430	KWRTK	80
131	5mer-131	KLRRR	72	431	5mer-431	KVQLK	81
132	5mer-132	RVRCK	83	432	5mer-432	RQVRR	52
133	5mer-133	KGQRK	84	433	5mer-433	KWRCR	73
134	5mer-134	RQFSK	61	434	5mer-434	RVLQK	74
135	5mer-135	RRLLR	64	435	5mer-435	KLRQR	69
136	5mer-136	RRIYK	75	436	5mer-436	RVFYK	60
137	5mer-137	KGVSK	77	437	5mer-437	RVRLR	50
138	5mer-138	RQRCR	71	438	5mer-438	RVRSR	76
139	5mer-139	RLQYK	73	439	5mer-439	KRVTR	65
140	5mer-140	KWRLR	69	440	5mer-440	RQVTK	57
141	5mer-141	RWQQR	50	441	5mer-441	KLIRK	53

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
142	5mer-142	RQYSR	52	442	5mer-442	KVRLR	61
143	5mer-143	KGQQR	64	443	5mer-443	RGFTK	80
144	5mer-144	KRFSK	58	444	5mer-444	KQQYR	65
145	5mer-145	RSFSK	62	445	5mer-445	RLFTR	77
146	5mer-146	RWFTK	52	446	5mer-446	RGLQK	53
147	5mer-147	RRYQK	66	447	5mer-447	KGYYK	76
148	5mer-148	RSQTK	50	448	5mer-448	RQIRK	74
149	5mer-149	KQFLR	80	449	5mer-449	KGLYR	65
150	5mer-150	RVRTR	64	450	5mer-450	RVIQK	78
151	5mer-151	RVFTK	66	451	5mer-451	RQVLK	53
152	5mer-152	RRRRR	56	452	5mer-452	RGVSK	82
153	5mer-153	RSIQK	72	453	5mer-453	KGVCR	68
154	5mer-154	RSITR	54	454	5mer-454	RQVLR	77
155	5mer-155	KRYLR	57	455	5mer-455	RWLYK	61
156	5mer-156	KGLRK	85	456	5mer-456	RLVCK	52
157	5mer-157	KGRCR	78	457	5mer-457	RGQYK	59
158	5mer-158	RWQTK	65	458	5mer-458	RRFLK	65
159	5mer-159	RGQRR	73	459	5mer-459	RSQLR	76
160	5mer-160	RSIRR	53	460	5mer-460	RLQQR	74
161	5mer-161	KWVTK	52	461	5mer-461	KQLLK	74
162	5mer-162	RGYQR	51	462	5mer-462	RWQSK	69
163	5mer-163	KSLCK	61	463	5mer-463	KWYTK	52
164	5mer-164	KSICK	54	464	5mer-464	RGVTR	57
165	5mer-165	KWRSK	56	465	5mer-465	RWFRK	57
166	5mer-166	KSFQR	55	466	5mer-466	RRVRK	53
167	5mer-167	KQFRK	64	467	5mer-467	RRIYR	83
168	5mer-168	KLFSK	84	468	5mer-468	RWQCK	54
169	5mer-169	RWYRK	61	469	5mer-469	KSRRR	69
170	5mer-170	RLICK	62	470	5mer-470	KQRSK	57
171	5mer-171	KSIQR	55	471	5mer-471	RGYLR	69
172	5mer-172	RSRRR	82	472	5mer-472	RRYRK	55
173	5mer-173	RSVSR	59	473	5mer-473	RLVQR	75
174	5mer-174	KGRQR	59	474	5mer-474	RQFLR	80
175	5mer-175	RWQLK	63	475	5mer-475	RRFCK	56
176	5mer-176	RVLYK	52	476	5mer-476	RSICK	70
177	5mer-177	RWVRK	77	477	5mer-477	KGYSR	58
178	5mer-178	RRVLK	87	478	5mer-478	RVQTK	75

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
179	5mer-179	RLYTK	55	479	5mer-479	RQYYK	70
180	5mer-180	KQRYR	74	480	5mer-480	RWYLR	75
181	5mer-181	RSLLK	72	481	5mer-481	KSYCK	78
182	5mer-182	RVLSK	70	482	5mer-482	KQFCK	75
183	5mer-183	KRVYR	64	483	5mer-483	RSISR	51
184	5mer-184	KLQCR	68	484	5mer-484	RSFQK	51
185	5mer-185	RRYRR	86	485	5mer-485	KRQRK	58
186	5mer-186	KRLQR	64	486	5mer-486	RWLQR	53
187	5mer-187	RWVCR	74	487	5mer-487	RLVTK	62
188	5mer-188	KWFSK	82	488	5mer-488	KVRSR	58
189	5mer-189	RLLQK	65	489	5mer-489	KSYSR	63
190	5mer-190	RWRSR	84	490	5mer-490	RWLLK	60
191	5mer-191	RVRCR	75	491	5mer-491	KQIRR	81
192	5mer-192	KSFRK	75	492	5mer-492	RVVLR	80
193	5mer-193	RVIRK	80	493	5mer-493	KSIRR	57
194	5mer-194	KWQSK	84	494	5mer-494	RGFCK	54
195	5mer-195	KVVSR	82	495	5mer-495	KVVTK	52
196	5mer-196	RSYYR	69	496	5mer-496	KGIQK	81
197	5mer-197	RSRQK	68	497	5mer-497	KRRCR	76
198	5mer-198	KLISR	74	498	5mer-498	KLISK	53
199	5mer-199	KRYQR	84	499	5mer-499	RVLTK	76
200	5mer-200	KRVRR	55	500	5mer-500	KSLQK	63
201	5mer-201	RWIYR	62	501	5mer-501	KLQRK	78
202	5mer-202	KWYRR	65	502	5mer-502	RRISR	84
203	5mer-203	RQLTR	78	503	5mer-503	KRVSK	61
204	5mer-204	RQFQR	84	504	5mer-504	KQIQR	72
205	5mer-205	RWYYR	75	505	5mer-505	RQIYR	71
206	5mer-206	KLQLR	57	506	5mer-506	RGRLR	51
207	5mer-207	KQVRR	72	507	5mer-507	KWVQK	84
208	5mer-208	KLICR	80	508	5mer-508	KGLQK	67
209	5mer-209	RGVRR	78	509	5mer-509	RVQRK	61
210	5mer-210	KVYYR	67	510	5mer-510	RQLSK	71
211	5mer-211	RLYYR	73	511	5mer-511	KSLSR	56
212	5mer-212	KQQYK	64	512	5mer-512	RLYLK	70
213	5mer-213	RQYTK	83	513	5mer-513	RWYYK	83
214	5mer-214	KQQCK	79	514	5mer-514	KLLLK	52
215	5mer-215	RQYRR	79	515	5mer-515	RGQRK	56

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
216	5mer-216	KWVRR	56	516	5mer-516	KWQTR	83
217	5mer-217	KLQRR	72	517	5mer-517	KGYTR	70
218	5mer-218	KVQYK	80	518	5mer-518	RVYYR	87
219	5mer-219	KQYTR	55	519	5mer-519	RLYSK	72
220	5mer-220	KRILR	81	520	5mer-520	RVLLK	86
221	5mer-221	RGRTR	58	521	5mer-521	KRFRK	78
222	5mer-222	KWLLR	86	522	5mer-522	RLVYR	78
223	5mer-223	KQVRK	61	523	5mer-523	KQFQK	84
224	5mer-224	RLQRR	67	524	5mer-524	RRICR	83
225	5mer-225	KRQQK	51	525	5mer-525	KQRYK	51
226	5mer-226	RRYTR	60	526	5mer-526	KQFSR	54
227	5mer-227	RRQQR	84	527	5mer-527	KSVQR	70
228	5mer-228	KRFLK	53	528	5mer-528	RVLLR	50
229	5mer-229	KGLTR	84	529	5mer-529	RVQSR	84
230	5mer-230	KVLCR	67	530	5mer-530	RWRRR	80
231	5mer-231	KGLLK	60	531	5mer-531	KRQSR	65
232	5mer-232	KWYTR	71	532	5mer-532	KQICK	75
233	5mer-233	RVYYK	84	533	5mer-533	RLVYK	84
234	5mer-234	RQYCR	62	534	5mer-534	RRQLR	50
235	5mer-235	KGYSK	70	535	5mer-535	KSLLR	70
236	5mer-236	KRRCK	81	536	5mer-536	RLITK	78
237	5mer-237	RGLRK	77	537	5mer-537	RLRLR	59
238	5mer-238	KQVLK	58	538	5mer-538	KQQQR	72
239	5mer-239	KRLYR	61	539	5mer-539	RVVTR	70
240	5mer-240	KWRYR	51	540	5mer-540	RQFYR	74
241	5mer-241	KVRCR	51	541	5mer-541	KVFLK	80
242	5mer-242	RGYTK	64	542	5mer-542	KRYTR	85
243	5mer-243	KLLSK	51	543	5mer-543	RLRLK	65
244	5mer-244	KSVSK	78	544	5mer-544	RLQLR	63
245	5mer-245	RQRSK	62	545	5mer-545	KGQYR	80
246	5mer-246	KSFTR	60	546	5mer-546	KWLK	65
247	5mer-247	RWYCR	80	547	5mer-547	KQVTK	77
248	5mer-248	RWYLK	63	548	5mer-548	KWLCK	60
249	5mer-249	RSYCR	52	549	5mer-549	KWITK	78
250	5mer-250	RQFSR	76	550	5mer-550	RQQSR	83
251	5mer-251	KRISK	70	551	5mer-551	RWQYR	59
252	5mer-252	KQYRK	53	552	5mer-552	RLYSR	63

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
253	5mer-253	RSLYR	75	553	5mer-553	KLLSR	72
254	5mer-254	KLLRK	87	554	5mer-554	RLLSK	65
255	5mer-255	KQRTR	82	555	5mer-555	KVQCK	71
256	5mer-256	RGVCK	60	556	5mer-556	RVIYK	52
257	5mer-257	RQFTR	85	557	5mer-557	KQRRK	87
258	5mer-258	KRQYK	84	558	5mer-558	RWRYK	84
259	5mer-259	RLIRK	71	559	5mer-559	KQQLK	81
260	5mer-260	KVYRR	57	560	5mer-560	KWYQR	59
261	5mer-261	RRVLR	59	561	5mer-561	KWRCK	72
262	5mer-262	KSRCR	59	562	5mer-562	RVRQR	70
263	5mer-263	KQVTR	80	563	5mer-563	RLVLK	60
264	5mer-264	KWYRK	50	564	5mer-564	RSRYR	74
265	5mer-265	RWQCR	77	565	5mer-565	RLVSK	77
266	5mer-266	KSYQK	66	566	5mer-566	KQLYK	78
267	5mer-267	KRLLK	66	567	5mer-567	RRYCK	63
268	5mer-268	KRYCK	54	568	5mer-568	KQITR	64
269	5mer-269	RLFLR	85	569	5mer-569	RQQRK	79
270	5mer-270	RSQQR	52	570	5mer-570	KLVRR	56
271	5mer-271	RGRYR	68	571	5mer-571	RRLTK	51
272	5mer-272	KGYQR	83	572	5mer-572	KLRTK	58
273	5mer-273	RVQSK	82	573	5mer-573	RSIYR	84
274	5mer-274	RQVRK	62	574	5mer-574	KGFTR	59
275	5mer-275	KVYTR	64	575	5mer-575	KGFYR	69
276	5mer-276	RSLRR	70	576	5mer-576	RLFRK	62
277	5mer-277	RVFTR	82	577	5mer-577	KLVTK	77
278	5mer-278	RWQRR	66	578	5mer-578	KSVLR	65
279	5mer-279	RVVTK	56	579	5mer-579	RSLYK	53
280	5mer-280	KWILK	53	580	5mer-580	RGYTR	70
281	5mer-281	RGFLK	58	581	5mer-581	KGVLR	65
282	5mer-282	RVLTR	77	582	5mer-582	RGICK	82
283	5mer-283	KWVYK	51	583	5mer-583	KVVYR	75
284	5mer-284	KQVQR	52	584	5mer-584	KQIQK	76
285	5mer-285	KGQLK	75	585	5mer-585	RSVSK	74
286	5mer-286	RWFQK	71	586	5mer-586	KGRRR	78
287	5mer-287	KRYRR	68	587	5mer-587	RVITR	66
288	5mer-288	KLILK	73	588	5mer-588	RSFTR	60
289	5mer-289	RRQYR	87	589	5mer-589	KGLCR	58

(continued)

5mer Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
290	5mer-290	RGYYR	57	590	5mer-590	KQYTK	81
291	5mer-291	RWFTR	72	591	5mer-591	RVYTK	61
292	5mer-292	KLVCK	59	592	5mer-592	RWLCR	56
293	5mer-293	RQYYR	83	593	5mer-593	KQYLK	77
294	5mer-294	KQYYK	50	594	5mer-594	KQYSR	50
295	5mer-295	RGRCR	52	595	5mer-595	KWQQR	58
296	5mer-296	KWISK	55	596	5mer-596	KLQQR	56
297	5mer-297	RSLRK	81	597	5mer-597	KLVSR	68
298	5mer-298	KSIYR	75	598	5mer-598	RVRSK	84
299	5mer-299	KGRRK	62	599	5mer-599	KWVSR	61
300	5mer-300	RQYRK	81	600	5mer-600	KLYSK	64
Average Binding affinity							68.5

TABLE 9]

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
601	5mer-601	RFCFK	13	901	5mer-901	KCTNR	30
602	5mer-602	KMSVR	12	902	5mer-902	REDPK	23
603	5mer-603	RKEPK	27	903	5mer-903	RHHKR	21
604	5mer-604	RKEGK	13	904	5mer-904	KPDPK	23
605	5mer-605	RECFK	22	905	5mer-905	RPSPR	30
606	5mer-606	RIHWK	25	906	5mer-906	RKHAK	31
607	5mer-607	RIEER	25	907	5mer-907	KDSVR	18
608	5mer-608	RDSER	20	908	5mer-908	RCHFK	25
609	5mer-609	RKTMK	32	909	5mer-909	RINVK	33
610	5mer-610	KCDDK	16	910	5mer-910	RPCFR	17
611	5mer-611	KDHIR	33	911	5mer-911	REHGK	14
612	5mer-612	KCTDK	23	912	5mer-912	KKMGR	16
613	5mer-613	RAE FR	20	913	5mer-913	KHTFK	13
614	5mer-614	RNTWK	29	914	5mer-914	RPTMR	26
615	5mer-615	KCCNR	20	915	5mer-915	KMTHR	28
616	5mer-616	KFCPR	15	916	5mer-916	RCHER	12
617	5mer-617	RYCAK	28	917	5mer-917	KCAPR	11
618	5mer-618	RMSWK	19	918	5mer-918	RNNVR	12
619	5mer-619	KCSFK	19	919	5mer-919	KNNIK	32
620	5mer-620	RCMHK	23	920	5mer-920	KPKIK	15

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
621	5mer-621	KKSMK	13	921	5mer-921	KKKFK	21
622	5mer-622	RKPKR	22	922	5mer-922	RMWKR	14
623	5mer-623	KNTGR	19	923	5mer-923	KCWMK	19
624	5mer-624	KEHER	22	924	5mer-924	RNEKK	27
625	5mer-625	KMCDR	33	925	5mer-925	KDCFK	25
626	5mer-626	KICMR	12	926	5mer-926	RNCWK	22
627	5mer-627	KMSPK	30	927	5mer-927	RDEDR	19
628	5mer-628	RYMDR	19	928	5mer-928	KHMVR	27
629	5mer-629	RPTNK	32	929	5mer-929	KYTFR	28
630	5mer-630	RITFR	30	930	5mer-930	RAWVR	20
631	5mer-631	RPANR	17	931	5mer-931	RITER	11
632	5mer-632	RFSHR	33	932	5mer-932	RTAWK	27
633	5mer-633	RAAKR	20	933	5mer-933	RYMKK	27
634	5mer-634	RMMMR	26	934	5mer-934	KMMMR	17
635	5mer-635	RMNGR	21	935	5mer-935	RETFK	32
636	5mer-636	KDKGR	11	936	5mer-936	RNHKR	29
637	5mer-637	KCDHK	28	937	5mer-937	KASNR	21
638	5mer-638	KHCIR	33	938	5mer-938	RIEFK	18
639	5mer-639	KETWK	13	939	5mer-939	KMHAR	24
640	5mer-640	KNPHK	15	940	5mer-940	KCMGK	18
641	5mer-641	RITWK	22	941	5mer-941	KNHHR	21
642	5mer-642	RAWDR	22	942	5mer-942	RPSDR	11
643	5mer-643	KHDGR	28	943	5mer-943	KDKGK	12
644	5mer-644	RMKWK	24	944	5mer-944	RYEFK	25
645	5mer-645	RHKDK	20	945	5mer-945	RYEKR	23
646	5mer-646	KDTKR	16	946	5mer-946	KYPWR	32
647	5mer-647	KHTVK	29	947	5mer-947	KDWIR	27
648	5mer-648	KNKKR	15	948	5mer-948	KDSFK	18
649	5mer-649	RYSFK	20	949	5mer-949	KMKMK	26
650	5mer-650	RPEDK	22	950	5mer-950	KDADR	22
651	5mer-651	RFTVR	11	951	5mer-951	RYMGR	18
652	5mer-652	RCAAR	23	952	5mer-952	KTMHK	12
653	5mer-653	KTTWK	16	953	5mer-953	RKMAR	23
654	5mer-654	KEWNR	27	954	5mer-954	KTEVK	23
655	5mer-655	RKCIR	15	955	5mer-955	KNADK	14
656	5mer-656	KATGR	13	956	5mer-956	KPTWK	19
657	5mer-657	KDNDR	22	957	5mer-957	RDCER	30

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
658	5mer-658	KKWGR	31	958	5mer-958	RKWKR	11
659	5mer-659	KIHEK	22	959	5mer-959	KPNMK	29
660	5mer-660	KFDVK	11	960	5mer-960	RNPGK	14
661	5mer-661	RCNMK	30	961	5mer-961	KIANR	32
662	5mer-662	KIEEK	28	962	5mer-962	RIWKR	23
663	5mer-663	RATPR	31	963	5mer-963	RAPNK	24
664	5mer-664	KPTWR	17	964	5mer-964	KYTDR	22
665	5mer-665	KTWEK	26	965	5mer-965	KMEIR	30
666	5mer-666	RHDWR	18	966	5mer-966	RPSAK	32
667	5mer-667	RDCHR	16	967	5mer-967	KKTHK	26
668	5mer-668	RPHAK	27	968	5mer-968	RIPHR	11
669	5mer-669	RNPER	24	969	5mer-969	RNTVR	27
670	5mer-670	KPCVK	23	970	5mer-970	KYMNR	33
671	5mer-671	KMNAK	21	971	5mer-971	KMTGK	12
672	5mer-672	KHAPK	12	972	5mer-972	KYAKR	14
673	5mer-673	RISPR	14	973	5mer-973	RYWAR	12
674	5mer-674	KETHR	22	974	5mer-974	RHMMR	26
675	5mer-675	RKPGR	31	975	5mer-975	RFAHK	18
676	5mer-676	RTMFR	18	976	5mer-976	RETNR	16
677	5mer-677	RCEMR	15	977	5mer-977	KNMIR	16
678	5mer-678	KYMGR	23	978	5mer-978	RYDHK	30
679	5mer-679	KKTVK	21	979	5mer-979	RHHMK	23
680	5mer-680	RFTER	21	980	5mer-980	RKPHR	33
681	5mer-681	KDTMR	18	981	5mer-981	KNDKK	33
682	5mer-682	KPNVK	31	982	5mer-982	KFMHK	12
683	5mer-683	KYPDK	32	983	5mer-983	RTTGR	23
684	5mer-684	KCAER	27	984	5mer-984	KNAHK	11
685	5mer-685	RNDIK	21	985	5mer-985	RDPKR	17
686	5mer-686	RFNIR	18	986	5mer-986	RPMDK	12
687	5mer-687	RMEIR	22	987	5mer-987	RAHWR	22
688	5mer-688	RPHFK	31	988	5mer-988	RCKWR	17
689	5mer-689	RFSDK	20	989	5mer-989	RCTAR	31
690	5mer-690	RAEIK	12	990	5mer-990	KEEPK	12
691	5mer-691	KEWEK	16	991	5mer-991	RPEFR	24
692	5mer-692	RDHWK	15	992	5mer-992	RNDKK	15
693	5mer-693	RPSKK	17	993	5mer-993	KEKFR	27
694	5mer-694	KNNAR	24	994	5mer-994	KAWVR	26

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
695	5mer-695	KKPDR	26	995	5mer-995	KFTDK	18
696	5mer-696	RCEHR	11	996	5mer-996	RMTKK	32
697	5mer-697	KASKK	25	997	5mer-997	RYPHR	30
698	5mer-698	KFDWK	12	998	5mer-998	RCTAK	18
699	5mer-699	KKNER	12	999	5mer-999	KTKFK	19
700	5mer-700	RAWER	17	1000	5mer-1000	KHCWR	20
701	5mer-701	RNHNK	22	1001	5mer-1001	KPCGK	33
702	5mer-702	KISHK	30	1002	5mer-1002	KEDNK	12
703	5mer-703	KPNWR	22	1003	5mer-1003	RMTVR	11
704	5mer-704	RFMGK	28	1004	5mer-1004	RDADR	30
705	5mer-705	RHAKK	15	1005	5mer-1005	RTHGR	30
706	5mer-706	RKMAK	27	1006	5mer-1006	KEPER	17
707	5mer-707	KIEAK	32	1007	5mer-1007	RDMMR	30
708	5mer-708	KPKAR	20	1008	5mer-1008	KDSNR	11
709	5mer-709	RHTIR	27	1009	5mer-1009	KMCAK	29
710	5mer-710	KEKAR	21	1010	5mer-1010	KCDNK	16
711	5mer-711	KECIK	32	1011	5mer-1011	KTDMK	25
712	5mer-712	RADFK	18	1012	5mer-1012	RHKVR	22
713	5mer-713	KYPKK	16	1013	5mer-1013	KCCVK	19
714	5mer-714	RPCAK	32	1014	5mer-1014	RKNKR	23
715	5mer-715	KCNGR	22	1015	5mer-1015	RCWMK	30
716	5mer-716	KINVR	25	1016	5mer-1016	KYTMR	28
717	5mer-717	KCKFR	20	1017	5mer-1017	RCTWK	24

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
718	5mer-718	RNKKK	19	1018	5mer-1018	KFWAK	20
719	5mer-719	KISER	21	1019	5mer-1019	RFKFK	28
720	5mer-720	KDPKR	32	1020	5mer-1020	KCKVK	12
721	5mer-721	RYSKK	22	1021	5mer-1021	KITHK	26
722	5mer-722	KNHKK	33	1022	5mer-1022	KIADK	29
723	5mer-723	RASPR	22	1023	5mer-1023	RYCKK	13
724	5mer-724	KTTAK	14	1024	5mer-1024	KIDNK	26
725	5mer-725	RNADR	19	1025	5mer-1025	RHKWK	25
726	5mer-726	KATMK	33	1026	5mer-1026	RNAVR	20
727	5mer-727	KMDAR	31	1027	5mer-1027	KNTNR	28
728	5mer-728	KPHIK	19	1028	5mer-1028	RMAMR	28
729	5mer-729	KEPDK	23	1029	5mer-1029	KADIK	25
730	5mer-730	KFCNK	27	1030	5mer-1030	RISDK	18
731	5mer-731	KADHK	18	1031	5mer-1031	RKEER	13
732	5mer-732	KIMWR	22	1032	5mer-1032	RHHMR	23
733	5mer-733	KTCDR	23	1033	5mer-1033	REWDK	28
734	5mer-734	KATER	16	1034	5mer-1034	RFAKK	14
735	5mer-735	RHCER	11	1035	5mer-1035	KEHVR	19
736	5mer-736	KKHHR	24	1036	5mer-1036	KTHMK	23
737	5mer-737	RINVR	13	1037	5mer-1037	KKS FR	28
738	5mer-738	KTPMK	29	1038	5mer-1038	KCCKR	17

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
739	5mer-739	KDCPR	16	1039	5mer-1039	KKDVK	32
740	5mer-740	RMMGK	21	1040	5mer-1040	KTPWR	17
741	5mer-741	KPTPR	14	1041	5mer-1041	RDWFK	27
742	5mer-742	RNSDK	11	1042	5mer-1042	RCCAK	28
743	5mer-743	KYAFR	15	1043	5mer-1043	KFEMK	15
744	5mer-744	KTEAK	32	1044	5mer-1044	RDCFK	22
745	5mer-745	RMEIK	14	1045	5mer-1045	KMDEK	22
746	5mer-746	RMTVK	26	1046	5mer-1046	KHTMR	19
747	5mer-747	RKTDK	31	1047	5mer-1047	KAHMR	23
748	5mer-748	REPMK	12	1048	5mer-1048	KYDNK	12
749	5mer-749	KHTWR	24	1049	5mer-1049	KPPGR	29
750	5mer-750	KEADK	13	1050	5mer-1050	KPEDR	31
751	5mer-751	RYMMR	20	1051	5mer-1051	RYAHR	28
752	5mer-752	KAWVK	26	1052	5mer-1052	RNDWR	17
753	5mer-753	RKTPK	30	1053	5mer-1053	KHEHK	27
754	5mer-754	RKNER	29	1054	5mer-1054	RNKVR	21
755	5mer-755	KNWDR	15	1055	5mer-1055	KHHEK	15
756	5mer-756	RCDWR	18	1056	5mer-1056	RCTPK	11
757	5mer-757	KYCMR	17	1057	5mer-1057	RFDPK	13
758	5mer-758	KCDFK	30	1058	5mer-1058	KIPWR	25
759	5mer-759	KHKMR	17	1059	5mer-1059	RMAGR	29

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
760	5mer-760	RIWAR	19	1060	5mer-1060	KTHIK	29
761	5mer-761	RMPWR	31	1061	5mer-1061	KDS FR	24
762	5mer-762	KMPER	21	1062	5mer-1062	RAPWR	24
763	5mer-763	RCHVR	30	1063	5mer-1063	RPHVK	20
764	5mer-764	KTWPK	19	1064	5mer-1064	KCMKR	20
765	5mer-765	RNE FR	12	1065	5mer-1065	KNPIR	18
766	5mer-766	RNMEK	30	1066	5mer-1066	RFWVK	25
767	5mer-767	RFHFK	12	1067	5mer-1067	KHENK	23
768	5mer-768	RDSWR	11	1068	5mer-1068	RMHKK	11
769	5mer-769	KTEWK	32	1069	5mer-1069	RPSFK	31
770	5mer-770	KKPFR	11	1070	5mer-1070	RETGK	26
771	5mer-771	RKWVK	24	1071	5mer-1071	RYEGR	16
772	5mer-772	KYWFK	11	1072	5mer-1072	KDWPK	32
773	5mer-773	RPNMR	25	1073	5mer-1073	RDEAK	29
774	5mer-774	RTCDR	25	1074	5mer-1074	RPCPR	17
775	5mer-775	RHTVK	23	1075	5mer-1075	RKHIK	26
776	5mer-776	RCDFR	17	1076	5mer-1076	KFEKK	21
777	5mer-777	RYNWK	28	1077	5mer-1077	KADMK	12
778	5mer-778	KKDHK	24	1078	5mer-1078	KEAWK	19
779	5mer-779	KYPPR	21	1079	5mer-1079	KYTGR	31
780	5mer-780	RDSHK	27	1080	5mer-1080	RYTHK	25

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
781	5mer-781	RIDPR	28	1081	5mer-1081	RPNVR	13
782	5mer-782	KANAR	32	1082	5mer-1082	RACER	11
783	5mer-783	KCKVR	29	1083	5mer-1083	KFSVR	31
784	5mer-784	RACEK	21	1084	5mer-1084	RTHDR	21
785	5mer-785	KPTIR	31	1085	5mer-1085	RTTER	14
786	5mer-786	RFNKK	29	1086	5mer-1086	RIWDR	19
787	5mer-787	KDNIR	17	1087	5mer-1087	KKKKR	11
788	5mer-788	KYHGK	16	1088	5mer-1088	KAKKK	16
789	5mer-789	KFWIR	12	1089	5mer-1089	KTHHR	29
790	5mer-790	REAGK	33	1090	5mer-1090	KISGK	31
791	5mer-791	KTKMR	26	1091	5mer-1091	KTEHR	29
792	5mer-792	RMEKK	31	1092	5mer-1092	KPMVK	12
793	5mer-793	KKPHR	19	1093	5mer-1093	REEDK	32
794	5mer-794	KEAPK	20	1094	5mer-1094	RYSMK	15
795	5mer-795	RTKKR	20	1095	5mer-1095	KAEKR	27
796	5mer-796	KNWVR	17	1096	5mer-1096	RPTDK	15
797	5mer-797	KETHK	15	1097	5mer-1097	KPDIR	28
798	5mer-798	RETMK	13	1098	5mer-1098	RFHGR	31
799	5mer-799	KDKPR	24	1099	5mer-1099	RATAR	14
800	5mer-800	KEAPR	29	1100	5mer-1100	RPWKR	24
801	5mer-801	KFHGR	20	1101	5mer-1101	KYKNR	11

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
802	5mer-802	RITVR	27	1102	5mer-1102	KTHKK	20
803	5mer-803	RFSDR	11	1103	5mer-1103	KKSHR	18
804	5mer-804	RNTIR	20	1104	5mer-1104	RETHK	12
805	5mer-805	RPTNR	27	1105	5mer-1105	RPTKR	33
806	5mer-806	RKMFR	17	1106	5mer-1106	RYTER	18
807	5mer-807	RKNKK	20	1107	5mer-1107	RPWHK	21
808	5mer-808	KFCIR	13	1108	5mer-1108	RNPIR	19
809	5mer-809	RKSGK	15	1109	5mer-1109	KCHPK	14
810	5mer-810	KFHKK	11	1110	5mer-1110	RMHMK	13
811	5mer-811	KMTMR	32	1111	5mer-1111	KAEHK	12
812	5mer-812	KTEGR	27	1112	5mer-1112	RTTFK	29
813	5mer-813	RAHVR	21	1113	5mer-1113	RHMER	19
814	5mer-814	RITMR	11	1114	5mer-1114	RKTFR	28
815	5mer-815	RKDHR	27	1115	5mer-1115	KEPEK	27
816	5mer-816	RKPIK	26	1116	5mer-1116	KECFR	24
817	5mer-817	RHKDR	23	1117	5mer-1117	RHKIR	11
818	5mer-818	KHWHR	12	1118	5mer-1118	RMDAR	28
819	5mer-819	RNTIK	19	1119	5mer-1119	KMNIK	19
820	5mer-820	RIMHK	28	1120	5mer-1120	RPPDR	33
821	5mer-821	RESDR	12	1121	5mer-1121	RFKVK	29
822	5mer-822	RAKGK	16	1122	5mer-1122	RNTDR	14

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
823	5mer-823	KECFK	26	1123	5mer-1123	KYEKR	24
824	5mer-824	KIDMK	13	1124	5mer-1124	KKPVK	30
825	5mer-825	RDEKK	14	1125	5mer-1125	RYPFK	29
826	5mer-826	KCKMK	11	1126	5mer-1126	KPTHK	26
827	5mer-827	KKAGR	18	1127	5mer-1127	RIADR	16
828	5mer-828	RFCWR	27	1128	5mer-1128	REWVR	26
829	5mer-829	KCWHR	26	1129	5mer-1129	KFDAR	14
830	5mer-830	RIDGK	25	1130	5mer-1130	RFMVR	17
831	5mer-831	RAAGK	24	1131	5mer-1131	KCDGK	14
832	5mer-832	RMHER	18	1132	5mer-1132	KFSMK	19
833	5mer-833	KATAK	33	1133	5mer-1133	KCSMK	23
834	5mer-834	RMNIK	15	1134	5mer-1134	RTCKR	26
835	5mer-835	RFMMR	14	1135	5mer-1135	RHTAR	17
836	5mer-836	REWNR	15	1136	5mer-1136	KNSAR	25
837	5mer-837	RPMDR	28	1137	5mer-1137	KEEEK	22
838	5mer-838	RHSMK	13	1138	5mer-1138	RENHK	24
839	5mer-839	RHHDK	26	1139	5mer-1139	KHCWK	28
840	5mer-840	KDTAR	11	1140	5mer-1140	RNEFK	28
841	5mer-841	KNEMR	22	1141	5mer-1141	REEVR	26
842	5mer-842	RHNVK	20	1142	5mer-1142	KTENK	24
843	5mer-843	KTTPK	17	1143	5mer-1143	RATGK	19

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
844	5mer-844	KTDPR	32	1144	5mer-1144	KAKNR	33
845	5mer-845	RYEDR	15	1145	5mer-1145	RMPAK	25
846	5mer-846	RPDWR	32	1146	5mer-1146	KPHGR	23
847	5mer-847	KAPEK	28	1147	5mer-1147	RDTGK	16
848	5mer-848	RYMVK	12	1148	5mer-1148	RDWFR	24
849	5mer-849	KTWMK	15	1149	5mer-1149	KETDR	25
850	5mer-850	KYDIR	13	1150	5mer-1150	KFTNR	12
851	5mer-851	KMCWK	19	1151	5mer-1151	KTNAR	26
852	5mer-852	KDSMK	22	1152	5mer-1152	KENFK	18
853	5mer-853	RYHIK	13	1153	5mer-1153	RDAPR	27
854	5mer-854	RNTER	21	1154	5mer-1154	KCWVR	12
855	5mer-855	RFMKK	18	1155	5mer-1155	RYDMK	25
856	5mer-856	KPPDR	23	1156	5mer-1156	KKMNK	13
857	5mer-857	KMENR	23	1157	5mer-1157	KTSHR	21
858	5mer-858	RIMGR	33	1158	5mer-1158	KYNPR	23
859	5mer-859	KHNAR	26	1159	5mer-1159	KKWKK	17
860	5mer-860	RCHAK	31	1160	5mer-1160	KETWR	14
861	5mer-861	KTKIR	20	1161	5mer-1161	KCHDR	21
862	5mer-862	KKNAK	19	1162	5mer-1162	KIKKK	15
863	5mer-863	REANR	16	1163	5mer-1163	KKSKR	12
864	5mer-864	KYHPR	25	1164	5mer-1164	RFPWR	33

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
865	5mer-865	RMMER	21	1165	5mer-1165	RNMNR	21
866	5mer-866	RINWR	11	1166	5mer-1166	KTHEK	32
867	5mer-867	KDSWK	14	1167	5mer-1167	KESWK	12
868	5mer-868	KMHFK	18	1168	5mer-1168	RHHWR	31
869	5mer-869	KKHPK	31	1169	5mer-1169	KDTPK	29
870	5mer-870	RCKVK	25	1170	5mer-1170	KHSEK	28
871	5mer-871	RHSHR	21	1171	5mer-1171	RCSWK	21
872	5mer-872	RKKWK	29	1172	5mer-1172	KIWWR	25
873	5mer-873	RYNFR	32	1173	5mer-1173	KECKR	30
874	5mer-874	RIHMR	27	1174	5mer-1174	KYSGK	25
875	5mer-875	KHCNK	33	1175	5mer-1175	RDMIR	30
876	5mer-876	KETAR	16	1176	5mer-1176	KIHFK	25
877	5mer-877	RFSMR	17	1177	5mer-1177	KIPVR	20
878	5mer-878	KHTER	24	1178	5mer-1178	RFDNR	22
879	5mer-879	KDCMK	13	1179	5mer-1179	RMNVR	18
880	5mer-880	RCDKK	17	1180	5mer-1180	KETAK	27
881	5mer-881	RNDAK	31	1181	5mer-1181	KKAKR	22
882	5mer-882	REEGR	18	1182	5mer-1182	REKWK	15
883	5mer-883	KMSAK	16	1183	5mer-1183	RHAPK	13
884	5mer-884	KIWEK	28	1184	5mer-1184	RDSMK	14
885	5mer-885	RHCNR	19	1185	5mer-1185	KPTGR	30

(continued)

5mer Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
886	5mer-886	RMMFR	21	1186	5mer-1186	KMWVK	12
887	5mer-887	KTPVR	30	1187	5mer-1187	KHHIR	27
888	5mer-888	KKCIR	31	1188	5mer-1188	KPSGK	30
889	5mer-889	KTPGR	25	1189	5mer-1189	RKMDK	11
890	5mer-890	KKHFK	33	1190	5mer-1190	RFSEK	32
891	5mer-891	RKKMK	24	1191	5mer-1191	RMDWK	30
892	5mer-892	RKPMR	29	1192	5mer-1192	RYAKK	28
893	5mer-893	RIKIK	18	1193	5mer-1193	KHWFK	22
894	5mer-894	KMSPR	18	1194	5mer-1194	RDNGK	18
895	5mer-895	RFTKK	18	1195	5mer-1195	RHWEK	19
896	5mer-896	RYHWR	27	1196	5mer-1196	RICIR	24
897	5mer-897	KFCER	30	1197	5mer-1197	KDDAR	24
898	5mer-898	RYCMR	20	1198	5mer-1198	RAADK	25
899	5mer-899	RYTFR	31	1199	5mer-1199	KNNNR	29
900	5mer-900	RHSVK	29	1200	5mer-1200	RKNEK	16
Average Binding affinity							21.8

TABLE 10]

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1201	6mer-1-1	KKVISK	122	1501	6mer-1-301	RRSILR	154
1202	6mer-1-2	RKQILR	142	1502	6mer-1-302	RRGQSR	151
1203	6mer-1-3	RKRRSR	154	1503	6mer-1-303	RKQYCK	123

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1204	6mer-1-4	RKSFYK	139	1504	6mer-1-304	RKLYSR	121
1205	6mer-1-5	KRQIRK	135	1505	6mer-1-305	RKWISR	153
1206	6mer-1-6	RKSRCK	153	1506	6mer-1-306	KKLFYR	135
1207	6mer-1-7	KRQYSK	126	1507	6mer-1-307	KRWYRR	153
1208	6mer-1-8	RKRRRK	125	1508	6mer-1-308	KRRITR	135
1209	6mer-1-9	RKSFCK	154	1509	6mer-1-309	KKGICK	153
1210	6mer-1-10	KRWRLK	139	1510	6mer-1-310	RKRQLK	127
1211	6mer-1-11	KRQFTK	139	1511	6mer-1-311	RRGYQK	127
1212	6mer-1-12	KKQICK	128	1512	6mer-1-312	KKSRQK	151
1213	6mer-1-13	KRQIQR	147	1513	6mer-1-313	RRWFCK	148
1214	6mer-1-14	RKRFLK	145	1514	6mer-1-314	RRRILR	141
1215	6mer-1-15	KRQICK	123	1515	6mer-1-315	RKQQTK	128
1216	6mer-1-16	KKQYCR	136	1516	6mer-1-316	RKQIRK	145
1217	6mer-1-17	KRVQCR	135	1517	6mer-1-317	KRSFRR	148
1218	6mer-1-18	KKQFTR	145	1518	6mer-1-318	KKSRRK	145
1219	6mer-1-19	KRSFYR	135	1519	6mer-1-319	KRWVQK	123
1220	6mer-1-20	KKSRYK	147	1520	6mer-1-320	KRVQYR	121
1221	6mer-1-21	RKWYLK	137	1521	6mer-1-321	RKQVRR	154
1222	6mer-1-22	RKRLCK	126	1522	6mer-1-322	KRGVQR	146
1223	6mer-1-23	KRSVSR	153	1523	6mer-1-323	RRWLYR	149
1224	6mer-1-24	RKVIRK	142	1524	6mer-1-324	RRLQRR	128

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1225	6mer-1-25	KKLIRR	135	1525	6mer-1-325	RRQIQR	142
1226	6mer-1-26	KKRVLR	123	1526	6mer-1-326	RKWIYK	136
1227	6mer-1-27	KRSFTK	142	1527	6mer-1-327	KRGITR	139
1228	6mer-1-28	RRWISK	125	1528	6mer-1-328	KRWLQK	151
1229	6mer-1-29	KRLISR	124	1529	6mer-1-329	RKWRQK	123
1230	6mer-1-30	RRQVRR	154	1530	6mer-1-330	RKVQRK	148
1231	6mer-1-31	KRLYCR	121	1531	6mer-1-331	RKRITR	128
1232	6mer-1-32	RKGQCR	121	1532	6mer-1-332	KKRVQK	122
1233	6mer-1-33	KKSYCR	154	1533	6mer-1-333	RKRQSR	135
1234	6mer-1-34	RKWLYK	135	1534	6mer-1-334	RRRRLR	154
1235	6mer-1-35	RRGRQR	136	1535	6mer-1-335	RRSQRR	148
1236	6mer-1-36	RKWQQK	124	1536	6mer-1-336	KRVVTK	154
1237	6mer-1-37	KKWVLR	121	1537	6mer-1-337	RKSRRR	144
1238	6mer-1-38	RRQQTK	126	1538	6mer-1-338	KKQVLK	127
1239	6mer-1-39	RKVYQK	139	1539	6mer-1-339	KKSIQK	147
1240	6mer-1-40	KRSQYK	121	1540	6mer-1-340	KRLLCK	142
1241	6mer-1-41	RKGITK	122	1541	6mer-1-341	RKQQQR	128
1242	6mer-1-42	KKRIQR	139	1542	6mer-1-342	RKRFCR	131
1243	6mer-1-43	RKRIRR	548	1543	6mer-1-343	KKLYTK	135
1244	6mer-1-44	KRQYCK	148	1544	6mer-1-344	KKSQCR	125
1245	6mer-1-45	RKGLTK	145	1545	6mer-1-345	KKLLCR	147

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1246	6mer-1-46	KRLYQR	142	1546	6mer-1-346	KKRIYR	123
1247	6mer-1-47	KRRLLK	149	1547	6mer-1-347	KKQQSK	126
1248	6mer-1-48	RRWVRR	124	1548	6mer-1-348	RKQRLK	142
1249	6mer-1-49	RRWQTR	149	1549	6mer-1-349	KRLYSK	123
1250	6mer-1-50	KKVRTR	139	1550	6mer-1-350	KKLQTK	153
1251	6mer-1-51	RRVLYK	127	1551	6mer-1-351	RRGLRK	141
1252	6mer-1-52	RRRFLR	131	1552	6mer-1-352	RKVFRK	142
1253	6mer-1-53	KRVIQR	123	1553	6mer-1-353	KRLYLK	126
1254	6mer-1-54	RRRVCK	144	1554	6mer-1-354	KKVFLK	153
1255	6mer-1-55	KRSIYR	133	1555	6mer-1-355	RKVFYR	148
1256	6mer-1-56	RRGIQR	137	1556	6mer-1-356	KRGYSK	153
1257	6mer-1-57	RKQYYK	139	1557	6mer-1-357	KRRQTR	148
1258	6mer-1-58	RKSVTR	126	1558	6mer-1-358	KRRYTR	124
1259	6mer-1-59	KRLQCK	145	1559	6mer-1-359	KRQFLR	131
1260	6mer-1-60	RKSIQK	139	1560	6mer-1-360	KRVFLK	148
1261	6mer-1-61	KRSYCK	121	1561	6mer-1-361	RKSVQR	127
1262	6mer-1-62	RRWFTK	133	1562	6mer-1-362	KRWYK	133
1263	6mer-1-63	KKWVSR	148	1563	6mer-1-363	KRQIRR	121
1264	6mer-1-64	RKQFTK	154	1564	6mer-1-364	RKRQSK	124
1265	6mer-1-65	KKSRRR	121	1565	6mer-1-365	KKRICK	142
1266	6mer-1-66	KKSISR	147	1566	6mer-1-366	KRWFCR	133

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1267	6mer-1-67	RRSYTR	135	1567	6mer-1-367	RKGFSK	154
1268	6mer-1-68	RKLQLK	153	1568	6mer-1-368	RRRFSK	145
1269	6mer-1-69	RKVRRR	142	1569	6mer-1-369	KKWYRK	144
1270	6mer-1-70	KKLLYR	139	1570	6mer-1-370	RKQLYK	142
1271	6mer-1-71	KRWFYK	121	1571	6mer-1-371	KRSLTR	153
1272	6mer-1-72	RKVQLK	139	1572	6mer-1-372	RKLRSK	145
1273	6mer-1-73	KKQQQR	142	1573	6mer-1-373	KRGVLK	149
1274	6mer-1-74	KKVRLR	142	1574	6mer-1-374	KKQFQK	148
1275	6mer-1-75	RRQYQK	139	1575	6mer-1-375	RRVFYR	154
1276	6mer-1-76	RRLQLK	126	1576	6mer-1-376	RRQLRK	121
1277	6mer-1-77	KKQLRR	149	1577	6mer-1-377	KRWITR	148
1278	6mer-1-78	KKRVSK	145	1578	6mer-1-378	KRSLQK	153
1279	6mer-1-79	KRLFCK	137	1579	6mer-1-379	KRRISK	153
1280	6mer-1-80	KRVQQR	133	1580	6mer-1-380	KRLQLR	121
1281	6mer-1-81	RRWQLR	148	1581	6mer-1-381	RKGFYR	124
1282	6mer-1-82	KKVLYR	123	1582	6mer-1-382	KRQYTR	139
1283	6mer-1-83	RRSFLR	146	1583	6mer-1-383	RKRRTK	148
1284	6mer-1-84	RRGQTK	142	1584	6mer-1-384	RKVICK	148
1285	6mer-1-85	RKRQCK	121	1585	6mer-1-385	KRQVLR	127
1286	6mer-1-86	KKWRQK	142	1586	6mer-1-386	RRSYQK	127
1287	6mer-1-87	KKQVYK	139	1587	6mer-1-387	KKGRLR	148

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1288	6mer-1-88	KRWICK	121	1588	6mer-1-388	RRLLQR	142
1289	6mer-1-89	RKQRCK	142	1589	6mer-1-389	RKLFCK	125
1290	6mer-1-90	KKGISK	125	1590	6mer-1-390	RKLQQR	121
1291	6mer-1-91	RKQQCK	131	1591	6mer-1-391	RRQRCK	131
1292	6mer-1-92	RRWRLK	153	1592	6mer-1-392	RRVQTR	135
1293	6mer-1-93	KRWIRR	136	1593	6mer-1-393	KRLYYK	148
1294	6mer-1-94	RKVQQK	142	1594	6mer-1-394	KKVRRR	149
1295	6mer-1-95	KKWQTK	142	1595	6mer-1-395	KKRQTK	125
1296	6mer-1-96	KRGVRK	125	1596	6mer-1-396	KRQIQK	148
1297	6mer-1-97	KKVYLR	139	1597	6mer-1-397	KRLILR	125
1298	6mer-1-98	KRLQCR	154	1598	6mer-1-398	KKQYYR	137
1299	6mer-1-99	RKVVYR	136	1599	6mer-1-399	KRWILR	125
1300	6mer-1-100	RKWISK	146	1600	6mer-1-400	KRWQTK	123
1301	6mer-1-101	KRWLYR	142	1601	6mer-1-401	RRLYCR	127
1302	6mer-1-102	RRRYRR	127	1602	6mer-1-402	RRRVLR	153
1303	6mer-1-103	RKRICK	122	1603	6mer-1-403	KRSQTK	153
1304	6mer-1-104	KRGFSK	121	1604	6mer-1-404	KKQRQK	137
1305	6mer-1-105	KKSISK	141	1605	6mer-1-405	KKVQTR	148
1306	6mer-1-106	KRGQLK	149	1606	6mer-1-406	RKVLLR	153
1307	6mer-1-107	KKQRSR	131	1607	6mer-1-407	KRLRTR	153
1308	6mer-1-108	RRLLLR	139	1608	6mer-1-408	KRGRSR	147

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1309	6mer-1-109	KKRYLR	148	1609	6mer-1-409	RRWISR	144
1310	6mer-1-110	KRQLLK	121	1610	6mer-1-410	KRVLRK	148
1311	6mer-1-111	RKVICR	144	1611	6mer-1-411	RRQRSR	121
1312	6mer-1-112	KKWVCR	148	1612	6mer-1-412	RKSILK	139
1313	6mer-1-113	KRGVQK	148	1613	6mer-1-413	RKQFCR	148
1314	6mer-1-114	RRQITK	153	1614	6mer-1-414	KRSFLR	153
1315	6mer-1-115	RRSLSR	133	1615	6mer-1-415	RRGVCR	135
1316	6mer-1-116	RKVRCK	139	1616	6mer-1-416	RKLIYR	153
1317	6mer-1-117	KRLFTR	142	1617	6mer-1-417	RKSVCK	139
1318	6mer-1-118	RKLQLR	127	1618	6mer-1-418	RRQVRK	123
1319	6mer-1-119	KRLQTR	133	1619	6mer-1-419	KRGFYR	148
1320	6mer-1-120	RRRYSR	124	1620	6mer-1-420	KKGQYK	148
1321	6mer-1-121	KRRYTK	148	1621	6mer-1-421	RKVLYR	135
1322	6mer-1-122	KKLIRK	139	1622	6mer-1-422	KRVRQR	154
1323	6mer-1-123	RRGVQK	148	1623	6mer-1-423	RRGYCK	147
1324	6mer-1-124	KRVQQK	137	1624	6mer-1-424	RRRIYR	135
1325	6mer-1-125	KRRLCR	135	1625	6mer-1-425	RKGVQK	131
1326	6mer-1-126	KKWIQR	148	1626	6mer-1-426	KKGQYR	131
1327	6mer-1-127	KRVIYR	147	1627	6mer-1-427	KRWVLR	147
1328	6mer-1-128	RKQFYR	126	1628	6mer-1-428	KRWLR	139
1329	6mer-1-129	RRRQSK	121	1629	6mer-1-429	RRQRRK	135

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1330	6mer-1-130	RKQVLR	142	1630	6mer-1-430	KKQLQK	144
1331	6mer-1-131	KRGIQR	142	1631	6mer-1-431	RRRFRR	144
1332	6mer-1-132	RRQVYR	153	1632	6mer-1-432	RKGIQK	139
1333	6mer-1-133	RKRFLR	154	1633	6mer-1-433	RKQQYR	154
1334	6mer-1-134	KKSIYR	128	1634	6mer-1-434	KRWVCR	137
1335	6mer-1-135	KRQVSR	123	1635	6mer-1-435	RKWRCK	135
1336	6mer-1-136	RRWLYK	148	1636	6mer-1-436	KKLFYK	148
1337	6mer-1-137	RRLFRR	121	1637	6mer-1-437	RKWFLK	131
1338	6mer-1-138	RKWTR	124	1638	6mer-1-438	RRGFQK	142
1339	6mer-1-139	KRRFLR	122	1639	6mer-1-439	KRRQTK	121
1340	6mer-1-140	KRQVQR	148	1640	6mer-1-440	KRVYSK	153
1341	6mer-1-141	RKLYQK	141	1641	6mer-1-441	RRVYYR	146
1342	6mer-1-142	KKVYYK	123	1642	6mer-1-442	RKLQYK	131
1343	6mer-1-143	KRGVLR	145	1643	6mer-1-443	RKVLLK	145
1344	6mer-1-144	RKRYTR	148	1644	6mer-1-444	KKWILK	144
1345	6mer-1-145	RKVFQR	141	1645	6mer-1-445	KRVRLR	145
1346	6mer-1-146	KRGRRR	139	1646	6mer-1-446	RRVIRR	124
1347	6mer-1-147	KKQIQR	125	1647	6mer-1-447	RRRQQK	146
1348	6mer-1-148	RKLRCR	146	1648	6mer-1-448	RKRFSR	141
1349	6mer-1-149	RRWVCK	131	1649	6mer-1-449	KRGRCK	135
1350	6mer-1-150	RKRQCR	142	1650	6mer-1-450	RKWYK	151

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1351	6mer-1-151	KRGVRR	145	1651	6mer-1-451	RKVRLR	153
1352	6mer-1-152	KRVIRR	154	1652	6mer-1-452	KRLYTR	141
1353	6mer-1-153	KKWQQR	146	1653	6mer-1-453	KKWQQK	154
1354	6mer-1-154	KKLYSR	153	1654	6mer-1-454	RKVLRR	124
1355	6mer-1-155	RRVRSR	127	1655	6mer-1-455	RRVFYK	126
1356	6mer-1-156	RRSVTK	154	1656	6mer-1-456	RRGQYR	153
1357	6mer-1-157	KKSLLR	123	1657	6mer-1-457	RKLLCR	121
1358	6mer-1-158	RRLIYR	131	1658	6mer-1-458	RKGQLK	139
1359	6mer-1-159	KRLRRK	139	1659	6mer-1-459	RRWVYK	131
1360	6mer-1-160	RRVIQR	149	1660	6mer-1-460	RRGFYR	148
1361	6mer-1-161	KRRYCK	139	1661	6mer-1-461	RRGYTR	142
1362	6mer-1-162	KKSLSK	142	1662	6mer-1-462	RKQILK	126
1363	6mer-1-163	KRLQTK	147	1663	6mer-1-463	KRSFRK	153
1364	6mer-1-164	KRGQYK	145	1664	6mer-1-464	RRQRLK	131
1365	6mer-1-165	KKWFTK	148	1665	6mer-1-465	RKQVYK	154
1366	6mer-1-166	RRWYSK	148	1666	6mer-1-466	KRSICR	148
1367	6mer-1-167	RRRYQR	122	1667	6mer-1-467	KRGYQK	121
1368	6mer-1-168	KRWFCK	131	1668	6mer-1-468	RRLYRR	153
1369	6mer-1-169	RRQQSK	153	1669	6mer-1-469	KKLIYR	139
1370	6mer-1-170	RKSFYR	148	1670	6mer-1-470	KKWVYR	148
1371	6mer-1-171	RKQFQK	123	1671	6mer-1-471	KKWRCK	123

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1372	6mer-1-172	RRLIRK	153	1672	6mer-1-472	KRQRCK	142
1373	6mer-1-173	RKQYYR	123	1673	6mer-1-473	KKVLSK	154
1374	6mer-1-174	KKGVCR	154	1674	6mer-1-474	KRLFSK	121
1375	6mer-1-175	RRRIQK	137	1675	6mer-1-475	RKLQTK	148
1376	6mer-1-176	KKVYCK	121	1676	6mer-1-476	KRRRQK	154
1377	6mer-1-177	KRGYRR	121	1677	6mer-1-477	KRQQTK	145
1378	6mer-1-178	RKRYQK	139	1678	6mer-1-478	RKVRYK	139
1379	6mer-1-179	KRSQYR	148	1679	6mer-1-479	RRSLTR	135
1380	6mer-1-180	RKLVRK	146	1680	6mer-1-480	KKQFYK	121
1381	6mer-1-181	KKGVLR	148	1681	6mer-1-481	KRWRCK	133
1382	6mer-1-182	KRGICK	147	1682	6mer-1-482	RKQVRK	133
1383	6mer-1-183	KKGQTR	121	1683	6mer-1-483	KRQVTK	151
1384	6mer-1-184	KRQICR	139	1684	6mer-1-484	KKLYLR	154
1385	6mer-1-185	KRQLRK	153	1685	6mer-1-485	RRWYRR	126
1386	6mer-1-186	RRRVYK	147	1686	6mer-1-486	KRQVRK	151
1387	6mer-1-187	RKLFYK	139	1687	6mer-1-487	RKGRRK	121
1388	6mer-1-188	RKSLQK	122	1688	6mer-1-488	KKWYSK	135
1389	6mer-1-189	KKSYSK	137	1689	6mer-1-489	KKVITK	148
1390	6mer-1-190	RKLYYR	153	1690	6mer-1-490	KKLFRR	133
1391	6mer-1-191	KKQILK	139	1691	6mer-1-491	RKLRLR	137
1392	6mer-1-192	KRQYQR	127	1692	6mer-1-492	RRWRQK	139

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1393	6mer-1-193	KRVQLK	149	1693	6mer-1-493	KRGYLR	131
1394	6mer-1-194	RKWQRR	144	1694	6mer-1-494	KKLFSR	128
1395	6mer-1-195	KRGISR	122	1695	6mer-1-495	RKGFQR	126
1396	6mer-1-196	RKWRRK	142	1696	6mer-1-496	RRVYQR	148
1397	6mer-1-197	RRSIRR	139	1697	6mer-1-497	KRRQLR	133
1398	6mer-1-198	KRLFCR	148	1698	6mer-1-498	RKRQQK	139
1399	6mer-1-199	KKQVQK	151	1699	6mer-1-499	RKLFYR	149
1400	6mer-1-200	RKLYQR	142	1700	6mer-1-500	RKLQSK	151
1401	6mer-1-201	RRRIQR	151	1701	6mer-1-501	KRVLYK	154
1402	6mer-1-202	RRQLTK	154	1702	6mer-1-502	RKLFSR	146
1403	6mer-1-203	RRQITR	142	1703	6mer-1-503	KRRLCK	151
1404	6mer-1-204	KKRQRR	154	1704	6mer-1-504	RRSITR	122
1405	6mer-1-205	KRWRLR	133	1705	6mer-1-505	RRRFTR	148
1406	6mer-1-206	RRLQTR	121	1706	6mer-1-506	RRRLSK	151
1407	6mer-1-207	KKSQQR	151	1707	6mer-1-507	RRSQSK	139
1408	6mer-1-208	KRSIQR	122	1708	6mer-1-508	RRQFSK	135
1409	6mer-1-209	RKGYTR	121	1709	6mer-1-509	RKWLRK	128
1410	6mer-1-210	RRGVRR	184	1710	6mer-1-510	KRRQSR	122
1411	6mer-1-211	KKQLLR	123	1711	6mer-1-511	RKVYRR	136
1412	6mer-1-212	RRRICR	148	1712	6mer-1-512	RKWICK	154
1413	6mer-1-213	KRRVRK	127	1713	6mer-1-513	RKQIRR	154

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1414	6mer-1-214	RRSYCK	139	1714	6mer-1-514	KKGRSK	128
1415	6mer-1-215	RKRYSR	136	1715	6mer-1-515	RRGLSR	139
1416	6mer-1-216	RKSIQR	148	1716	6mer-1-516	KKRFSR	139
1417	6mer-1-217	KRVLQR	135	1717	6mer-1-517	KKGLCK	139
1418	6mer-1-218	KKQVTR	126	1718	6mer-1-518	KRWVLK	153
1419	6mer-1-219	RRLFCR	121	1719	6mer-1-519	KRRQCK	147
1420	6mer-1-220	KRQRQK	148	1720	6mer-1-520	KRQIYK	127
1421	6mer-1-221	KKWFQR	148	1721	6mer-1-521	RKVISR	128
1422	6mer-1-222	RRRVRR	145	1722	6mer-1-522	RKRRLR	126
1423	6mer-1-223	KKRRRK	133	1723	6mer-1-523	KRRRSK	139
1424	6mer-1-224	KRGFLR	142	1724	6mer-1-524	KKGRQK	148
1425	6mer-1-225	RKLICK	142	1725	6mer-1-525	RRQLRR	139
1426	6mer-1-226	RRWITR	128	1726	6mer-1-526	KRGYTR	148
1427	6mer-1-227	KRLVQK	139	1727	6mer-1-527	KKGIYR	142
1428	6mer-1-228	KRVIYK	139	1728	6mer-1-528	KRSYTR	139
1429	6mer-1-229	RRRLLR	153	1729	6mer-1-529	RRSLCK	139
1430	6mer-1-230	RKGYCK	128	1730	6mer-1-530	KRLVSK	137
1431	6mer-1-231	KRQRTK	136	1731	6mer-1-531	RKGQTK	135
1432	6mer-1-232	RRRICK	146	1732	6mer-1-532	KKSQLR	121
1433	6mer-1-233	KKWQSR	128	1733	6mer-1-533	RKWFSR	145
1434	6mer-1-234	RRGISR	142	1734	6mer-1-534	KKRLCR	126

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1435	6mer-1-235	KKRYCR	148	1735	6mer-1-535	RRVILK	139
1436	6mer-1-236	RKLISR	151	1736	6mer-1-536	RRWFRK	151
1437	6mer-1-237	RKSRYK	137	1737	6mer-1-537	RRGLCK	154
1438	6mer-1-238	KKGQQK	154	1738	6mer-1-538	RRSQCK	142
1439	6mer-1-239	RKVLCR	136	1739	6mer-1-539	KRGIRK	148
1440	6mer-1-240	RRSRRR	148	1740	6mer-1-540	KRVQTR	128
1441	6mer-1-241	RRLYYK	148	1741	6mer-1-541	RKWFTR	136
1442	6mer-1-242	KRQYLK	148	1742	6mer-1-542	KRWFRR	128
1443	6mer-1-243	KKWYLR	136	1743	6mer-1-543	RRSVCK	145
1444	6mer-1-244	RRRVQK	144	1744	6mer-1-544	KRVICR	149
1445	6mer-1-245	RRGFRR	142	1745	6mer-1-545	RRSYRK	127
1446	6mer-1-246	RRLVSR	122	1746	6mer-1-546	RKLVQR	123
1447	6mer-1-247	KKVRQK	122	1747	6mer-1-547	RKVQQR	148
1448	6mer-1-248	RRLIYK	151	1748	6mer-1-548	RRVYSR	123
1449	6mer-1-249	RKGVSR	142	1749	6mer-1-549	KKSYQR	142
1450	6mer-1-250	RRVICR	142	1750	6mer-1-550	RRLICR	148
1451	6mer-1-251	RKVQSK	133	1751	6mer-1-551	KRGRLR	142
1452	6mer-1-252	RRWIRR	131	1752	6mer-1-552	RKRYRK	144
1453	6mer-1-253	RRVQLK	145	1753	6mer-1-553	RRGVRK	128
1454	6mer-1-254	RKSLSK	137	1754	6mer-1-554	KRSVTR	131
1455	6mer-1-255	KKGFQK	139	1755	6mer-1-555	KKWYLK	128

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1456	6mer-1-256	KRVRTK	125	1756	6mer-1-556	KKGFTK	145
1457	6mer-1-257	RKWVTR	124	1757	6mer-1-557	KRQVQK	128
1458	6mer-1-258	KKLQYK	137	1758	6mer-1-558	RRLIQR	139
1459	6mer-1-259	KRRYRK	141	1759	6mer-1-559	RRRLTK	139
1460	6mer-1-260	RKQRTK	141	1760	6mer-1-560	RRSFSK	127
1461	6mer-1-261	KRWVTR	121	1761	6mer-1-561	RKVYLK	131
1462	6mer-1-262	RKQLQR	139	1762	6mer-1-562	KRSYQR	148
1463	6mer-1-263	RKSYTK	146	1763	6mer-1-563	RRSFTR	139
1464	6mer-1-264	RRQYQR	128	1764	6mer-1-564	KRSITK	139
1465	6mer-1-265	RKSVCR	145	1765	6mer-1-565	KRSIRR	151
1466	6mer-1-266	KKGRLK	144	1766	6mer-1-566	KKSFCR	148
1467	6mer-1-267	KRRLLR	139	1767	6mer-1-567	KKRVSR	136
1468	6mer-1-268	KRRQSK	144	1768	6mer-1-568	KRWQQK	147
1469	6mer-1-269	RKRRQR	142	1769	6mer-1-569	RRVITK	148
1470	6mer-1-270	KRGLRR	149	1770	6mer-1-570	RKRLRK	122
1471	6mer-1-271	RRQVSK	122	1771	6mer-1-571	RKLLCK	154
1472	6mer-1-272	KKQVSR	139	1772	6mer-1-572	KRVLLK	126
1473	6mer-1-273	KKQVSK	137	1773	6mer-1-573	KRVLLR	126
1474	6mer-1-274	KRLLYK	135	1774	6mer-1-574	RKSYLR	148
1475	6mer-1-275	RKRVLK	123	1775	6mer-1-575	KRWVRR	148
1476	6mer-1-276	RRVICK	128	1776	6mer-1-576	RKRQRR	153

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1477	6mer-1-277	KKGLCR	141	1777	6mer-1-577	KKQYQR	128
1478	6mer-1-278	KRQQTR	142	1778	6mer-1-578	RKGQYK	139
1479	6mer-1-279	RRLRYR	145	1779	6mer-1-579	KRSVRK	148
1480	6mer-1-280	RKLQCK	149	1780	6mer-1-580	KKSLQK	121
1481	6mer-1-281	KRLLCR	154	1781	6mer-1-581	KRGLYK	139
1482	6mer-1-282	RRRRYR	121	1782	6mer-1-582	KRWFLK	137
1483	6mer-1-283	KKWVQK	133	1783	6mer-1-583	KKVLYK	139
1484	6mer-1-284	KRSRQK	145	1784	6mer-1-584	RKQVSK	127
1485	6mer-1-285	KRWVQR	122	1785	6mer-1-585	RKSRQK	144
1486	6mer-1-286	RKLISK	139	1786	6mer-1-586	KRVICK	136
1487	6mer-1-287	RKWLTR	136	1787	6mer-1-587	KKQLLK	148
1488	6mer-1-288	KKVQQR	148	1788	6mer-1-588	RRLVRK	153
1489	6mer-1-289	RKRYYR	153	1789	6mer-1-589	KKLQQK	139
1490	6mer-1-290	RKQLTK	146	1790	6mer-1-590	RKGVTK	142
1491	6mer-1-291	KKQIRK	142	1791	6mer-1-591	KKRLYR	147
1492	6mer-1-292	RKWQTK	122	1792	6mer-1-592	RRWLSK	135
1493	6mer-1-293	RKRVCK	154	1793	6mer-1-593	RKVYRK	148
1494	6mer-1-294	KKLYRR	123	1794	6mer-1-594	KRQLQR	121
1495	6mer-1-295	KRQRCR	148	1795	6mer-1-595	KKSLCK	121
1496	6mer-1-296	RKSIRR	121	1796	6mer-1-596	RKGVLR	148
1497	6mer-1-297	RRGFSK	139	1797	6mer-1-597	KRGFYK	148

(continued)

6mer-1 Top sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1498	6mer-1-298	KKLYCK	147	1798	6mer-1-598	RKWLSK	142
1499	6mer-1-299	KRWLSK	139	1799	6mer-1-599	KKLYQR	124
1500	6mer-1-300	RRWQQK	148	1800	6mer-1-600	KRGYCR	139
Average Binding affinity							138.66

TABLE 11

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1801	6mer-1-601	KKEWNK	27	2101	6mer-1-901	RKPNGR	35
1802	6mer-1-602	RKAEKR	18	2102	6mer-1-902	RRDKMK	39
1803	6mer-1-603	KRPHFK	13	2103	6mer-1-903	KKHKPR	37
1804	6mer-1-604	KKFTKK	24	2104	6mer-1-904	KKDTKR	31
1805	6mer-1-605	RKNADR	20	2105	6mer-1-905	RRICER	36
1806	6mer-1-606	RREWFR	15	2106	6mer-1-906	KKINGK	30
1807	6mer-1-607	KKDHFR	22	2107	6mer-1-907	RKPAWR	42
1808	6mer-1-608	KKACMR	18	2108	6mer-1-908	KKFMVR	37
1809	6mer-1-609	RKNPVR	24	2109	6mer-1-909	RKFCMR	33
1810	6mer-1-610	KKHHER	27	2110	6mer-1-910	KRPTIR	42
1811	6mer-1-611	KKNCHK	23	2111	6mer-1-911	KRCAAR	28
1812	6mer-1-612	KRIMER	17	2112	6mer-1-912	KKETFR	33
1813	6mer-1-613	KRIMKK	14	2113	6mer-1-913	KRFWWK	27
1814	6mer-1-614	KKEEER	12	2114	6mer-1-914	RRKCVR	39
1815	6mer-1-615	KKTSER	18	2115	6mer-1-915	RKDTWK	27

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1816	6mer-1-616	KKNTIK	31	2116	6mer-1-916	RRNAAK	33
1817	6mer-1-617	KRHNVR	31	2117	6mer-1-917	KRADDK	27
1818	6mer-1-618	RKCHVK	19	2118	6mer-1-918	RRESMR	33
1819	6mer-1-619	KKIDKR	23	2119	6mer-1-919	RKDHIK	26
1820	6mer-1-620	RRKTAK	11	2120	6mer-1-920	RRPAMR	40
1821	6mer-1-621	RRMAGK	30	2121	6mer-1-921	RKFWHR	36
1822	6mer-1-622	KKCPNR	18	2122	6mer-1-922	RRDWGR	34
1823	6mer-1-623	RRTDWR	21	2123	6mer-1-923	RRASDR	43
1824	6mer-1-624	KKPPAK	30	2124	6mer-1-924	RKFNWR	29
1825	6mer-1-625	KREDKK	33	2125	6mer-1-925	KKAMHR	42
1826	6mer-1-626	KRPDNR	27	2126	6mer-1-926	KRESDR	40
1827	6mer-1-627	RRTWWR	29	2127	6mer-1-927	KRESHR	37
1828	6mer-1-628	RRENEK	23	2128	6mer-1-928	KRYCPK	30
1829	6mer-1-629	RKMDAK	11	2129	6mer-1-929	RRCDHK	25
1830	6mer-1-630	KRMEPR	14	2130	6mer-1-930	KKESNK	43
1831	6mer-1-631	RRYSDR	13	2131	6mer-1-931	KKNWPR	35
1832	6mer-1-632	RKDTAR	17	2132	6mer-1-932	KRFEFK	38
1833	6mer-1-633	RKIDAK	16	2133	6mer-1-933	RRPWNR	28
1834	6mer-1-634	KKNTMR	12	2134	6mer-1-934	KRPPGK	39
1835	6mer-1-635	KKTTWK	33	2135	6mer-1-935	RKKDIK	40
1836	6mer-1-636	RKYKDR	27	2136	6mer-1-936	RKETDR	36

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1837	6mer-1-637	RRFEFK	33	2137	6mer-1-937	RKPTNR	34
1838	6mer-1-638	KKESHR	20	2138	6mer-1-938	KKIAWK	28
1839	6mer-1-639	KRPNVR	24	2139	6mer-1-939	KRNDFK	41
1840	6mer-1-640	RRNCWR	25	2140	6mer-1-940	RKPEDR	29
1841	6mer-1-641	RREMFK	21	2141	6mer-1-941	RKTPKK	29
1842	6mer-1-642	KKYNGK	24	2142	6mer-1-942	RRMMVR	37
1843	6mer-1-643	KRYSMR	31	2143	6mer-1-943	KKEHDK	43
1844	6mer-1-644	RKTWFR	31	2144	6mer-1-944	RKPAGK	25
1845	6mer-1-645	RRTTIR	33	2145	6mer-1-945	RKTSIK	31
1846	6mer-1-646	RRCTGK	33	2146	6mer-1-946	RRCEPR	31
1847	6mer-1-647	RKYNVR	14	2147	6mer-1-947	KRTKGR	31
1848	6mer-1-648	KKFWEK	17	2148	6mer-1-948	RKFTVR	24
1849	6mer-1-649	RRIAGK	32	2149	6mer-1-949	RKEMPR	37
1850	6mer-1-650	RRCNNR	18	2150	6mer-1-950	RKEDKR	29
1851	6mer-1-651	KRICWK	27	2151	6mer-1-951	RKAMDK	29
1852	6mer-1-652	RRPEVK	26	2152	6mer-1-952	KRHDKK	28
1853	6mer-1-653	KRMTHR	15	2153	6mer-1-953	KRTNGK	26
1854	6mer-1-654	KRMNDR	23	2154	6mer-1-954	KKAKGR	41
1855	6mer-1-655	RKNMFR	12	2155	6mer-1-955	RKECFK	23
1856	6mer-1-656	RRPTHK	28	2156	6mer-1-956	KRKSNK	34
1857	6mer-1-657	RRCTVR	17	2157	6mer-1-957	KKPPDK	43

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1858	6mer-1-658	RKKEMK	20	2158	6mer-1-958	KRYAGR	43
1859	6mer-1-659	KKPSKR	29	2159	6mer-1-959	KKIWFR	36
1860	6mer-1-660	KKYHVK	31	2160	6mer-1-960	KKCPFR	34
1861	6mer-1-661	RKPKWR	14	2161	6mer-1-961	RRTWAR	22
1862	6mer-1-662	KKMTER	20	2162	6mer-1-962	KKNCDK	42
1863	6mer-1-663	KKFKDR	26	2163	6mer-1-963	RREEDK	29
1864	6mer-1-664	KRDHIK	26	2164	6mer-1-964	RKFKNK	42
1865	6mer-1-665	KKCDGK	21	2165	6mer-1-965	KRIWDK	36
1866	6mer-1-666	KKAANK	18	2166	6mer-1-966	RRNSWK	22
1867	6mer-1-667	KRDSPK	32	2167	6mer-1-967	RRTEDR	24
1868	6mer-1-668	RKATVK	17	2168	6mer-1-968	RREDFR	39
1869	6mer-1-669	KRNMAK	23	2169	6mer-1-969	RKDHWR	33
1870	6mer-1-670	KKDWNR	11	2170	6mer-1-970	RRCCAR	38
1871	6mer-1-671	KKNMVR	11	2171	6mer-1-971	RKIEMK	32
1872	6mer-1-672	RKMEIR	17	2172	6mer-1-972	RRHTHK	43
1873	6mer-1-673	RRAMPK	16	2173	6mer-1-973	RRDHVK	25
1874	6mer-1-674	RKHPKK	32	2174	6mer-1-974	RKPAHK	27
1875	6mer-1-675	KKIWKR	21	2175	6mer-1-975	RKASIK	22
1876	6mer-1-676	KRCPWR	16	2176	6mer-1-976	RKEMIK	40
1877	6mer-1-677	KKCCFR	22	2177	6mer-1-977	RRPCFR	43
1878	6mer-1-678	KRMAAK	25	2178	6mer-1-978	RRKSHK	43

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1879	6mer-1-679	KKAEER	30	2179	6mer-1-979	RRYWEK	42
1880	6mer-1-680	KKDPPR	27	2180	6mer-1-980	RKICAK	33
1881	6mer-1-681	KKEWKK	32	2181	6mer-1-981	RKDDKK	27
1882	6mer-1-682	KKKDIR	30	2182	6mer-1-982	KRCPDR	35
1883	6mer-1-683	KRDSMR	16	2183	6mer-1-983	KRPHKK	38
1884	6mer-1-684	KRNNDR	20	2184	6mer-1-984	KKESDK	33
1885	6mer-1-685	RRESWK	14	2185	6mer-1-985	KRKSER	22
1886	6mer-1-686	KKYEVR	25	2186	6mer-1-986	KKAEEK	22
1887	6mer-1-687	RREWIK	23	2187	6mer-1-987	RRTEFK	34
1888	6mer-1-688	RKDEVR	33	2188	6mer-1-988	KRYPDR	24
1889	6mer-1-689	KRCPVR	11	2189	6mer-1-989	KRATVR	27
1890	6mer-1-690	KREAER	21	2190	6mer-1-990	RRFTER	40
1891	6mer-1-691	RKPKAR	31	2191	6mer-1-991	RKAHDK	25
1892	6mer-1-692	RKNTHK	22	2192	6mer-1-992	RRCTAK	28
1893	6mer-1-693	RKIDMK	22	2193	6mer-1-993	KRAHDK	26
1894	6mer-1-694	RKYTKR	27	2194	6mer-1-994	KKHEFR	37
1895	6mer-1-695	KRADVK	13	2195	6mer-1-995	KRCHHR	33
1896	6mer-1-696	KKHCNR	18	2196	6mer-1-996	RRPPWK	39
1897	6mer-1-697	RRPTNR	13	2197	6mer-1-997	KKPTFR	35
1898	6mer-1-698	KRFNHK	27	2198	6mer-1-998	KRNPVK	41
1899	6mer-1-699	RRTTVR	28	2199	6mer-1-999	RKATNR	24

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1900	6mer-1-700	RKKMWK	19	2200	6mer-1-1000	RKMSHR	28
1901	6mer-1-701	RRKTWR	13	2201	6mer-1-1001	RRMPER	23
1902	6mer-1-702	KRDWVK	31	2202	6mer-1-1002	KRIHMK	29
1903	6mer-1-703	KKFHPR	18	2203	6mer-1-1003	RKYCHR	24
1904	6mer-1-704	RRMCER	16	2204	6mer-1-1004	RKHSHR	41
1905	6mer-1-705	KRTEWR	12	2205	6mer-1-1005	RKPPDR	26
1906	6mer-1-706	KRMKDR	29	2206	6mer-1-1006	KKDKIK	25
1907	6mer-1-707	KRFWPK	26	2207	6mer-1-1007	RKPTDR	39
1908	6mer-1-708	KKKHEK	14	2208	6mer-1-1008	RKPWAR	21
1909	6mer-1-709	KKFKPK	29	2209	6mer-1-1009	RKMSKK	29
1910	6mer-1-710	KKMHHR	21	2210	6mer-1-1010	KKPKHK	33
1911	6mer-1-711	RRATHR	19	2211	6mer-1-1011	RKKPEK	35
1912	6mer-1-712	KKPSNK	24	2212	6mer-1-1012	RRAWVR	35
1913	6mer-1-713	KKATNK	20	2213	6mer-1-1013	KKTTNK	29
1914	6mer-1-714	KRTSFK	25	2214	6mer-1-1014	KKNAWR	25
1915	6mer-1-715	KRMMVK	18	2215	6mer-1-1015	KREEWR	26
1916	6mer-1-716	RRMPFK	11	2216	6mer-1-1016	KRHTHR	21
1917	6mer-1-717	KRHEDR	22	2217	6mer-1-1017	KRANMK	37
1918	6mer-1-718	RKFKAR	23	2218	6mer-1-1018	KKTAFK	28
1919	6mer-1-719	KKDAEK	27	2219	6mer-1-1019	KRDAWR	37
1920	6mer-1-720	RRKHKR	11	2220	6mer-1-1020	KKMEAK	38

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1921	6mer-1-721	RKAMEK	22	2221	6mer-1-1021	KKHDIK	41
1922	6mer-1-722	RRNKVR	12	2222	6mer-1-1022	RKDTVR	22
1923	6mer-1-723	RKMPAK	33	2223	6mer-1-1023	KRIMHK	39
1924	6mer-1-724	KRPKNK	19	2224	6mer-1-1024	RKTEIR	36
1925	6mer-1-725	KKDKPK	32	2225	6mer-1-1025	KRFAKR	33
1926	6mer-1-726	KKHSMK	33	2226	6mer-1-1026	RKKCER	30
1927	6mer-1-727	RKANGK	29	2227	6mer-1-1027	KKPWHK	22
1928	6mer-1-728	RRDNAR	23	2228	6mer-1-1028	RRHCWR	36
1929	6mer-1-729	KKKSGK	23	2229	6mer-1-1029	RRCMAK	40
1930	6mer-1-730	KRATFR	13	2230	6mer-1-1030	KKFCFR	30
1931	6mer-1-731	RRIKAR	18	2231	6mer-1-1031	RKDTHK	38
1932	6mer-1-732	RRAAVR	26	2232	6mer-1-1032	KKTSMR	27
1933	6mer-1-733	KKKMFK	21	2233	6mer-1-1033	KRHMVK	30
1934	6mer-1-734	RRTHER	21	2234	6mer-1-1034	KKASDR	24
1935	6mer-1-735	RKDKER	19	2235	6mer-1-1035	RRCHHR	34
1936	6mer-1-736	KKATDK	15	2236	6mer-1-1036	KKITFR	21
1937	6mer-1-737	RRKNAR	27	2237	6mer-1-1037	RRKNNR	36
1938	6mer-1-738	RKYHHR	25	2238	6mer-1-1038	RRKKIR	21
1939	6mer-1-739	RKCCEK	32	2239	6mer-1-1039	KRADIK	40
1940	6mer-1-740	RKDNKR	26	2240	6mer-1-1040	KRIEFR	28
1941	6mer-1-741	RKEAGR	24	2241	6mer-1-1041	RKEHGK	23

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1942	6mer-1-742	RRFHWR	14	2242	6mer-1-1042	KKITAR	40
1943	6mer-1-743	KKTMVR	14	2243	6mer-1-1043	KRAAHR	30
1944	6mer-1-744	RKHEIK	31	2244	6mer-1-1044	KKHHIR	24
1945	6mer-1-745	KKTMEK	11	2245	6mer-1-1045	KKTPGR	27
1946	6mer-1-746	RKMSVK	24	2246	6mer-1-1046	RKDPHR	38
1947	6mer-1-747	KKTMDR	24	2247	6mer-1-1047	RKATDK	30
1948	6mer-1-748	RKHNGR	24	2248	6mer-1-1048	RRCMMK	36
1949	6mer-1-749	RKPHWR	33	2249	6mer-1-1049	KKDHKK	31
1950	6mer-1-750	KRENIK	33	2250	6mer-1-1050	KKMEDR	38
1951	6mer-1-751	RRTNFK	27	2251	6mer-1-1051	KKKSFK	43
1952	6mer-1-752	KRPTEK	16	2252	6mer-1-1052	KRHWIR	33
1953	6mer-1-753	KKDTHK	12	2253	6mer-1-1053	RKYTPK	27
1954	6mer-1-754	RKKKMK	24	2254	6mer-1-1054	RRMKVK	37
1955	6mer-1-755	RRANMR	25	2255	6mer-1-1055	KRCNDK	40
1956	6mer-1-756	RKAKMK	33	2256	6mer-1-1056	RRNTAK	27
1957	6mer-1-757	RKDNEK	26	2257	6mer-1-1057	KRKPVR	43
1958	6mer-1-758	KKYHHR	33	2258	6mer-1-1058	KRFPWR	21
1959	6mer-1-759	RKMTWR	23	2259	6mer-1-1059	RRETVK	39
1960	6mer-1-760	KRMMVR	21	2260	6mer-1-1060	KRYNVR	21
1961	6mer-1-761	RKETFR	33	2261	6mer-1-1061	RRISIR	41
1962	6mer-1-762	KKTKAR	13	2262	6mer-1-1062	RRICMR	27

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1963	6mer-1-763	RRDCAK	12	2263	6mer-1-1063	KKIDHK	25
1964	6mer-1-764	RRNPFK	24	2264	6mer-1-1064	RKPTAK	41
1965	6mer-1-765	KRASPK	25	2265	6mer-1-1065	KRDKAK	23
1966	6mer-1-766	RKCTIR	15	2266	6mer-1-1066	RKEDVK	23
1967	6mer-1-767	KRTPDK	18	2267	6mer-1-1067	RRKHWK	38
1968	6mer-1-768	RKFEWK	32	2268	6mer-1-1068	KRYHIR	31
1969	6mer-1-769	RKMPVK	14	2269	6mer-1-1069	KKIWAR	23
1970	6mer-1-770	RKTNAR	29	2270	6mer-1-1070	KKTCDK	24
1971	6mer-1-771	KKMDIK	17	2271	6mer-1-1071	RKTKAK	38
1972	6mer-1-772	KRNCAK	12	2272	6mer-1-1072	KKCTPR	36
1973	6mer-1-773	KRTEIR	29	2273	6mer-1-1073	RKYMWK	27
1974	6mer-1-774	KKEMER	21	2274	6mer-1-1074	KRTCGR	24
1975	6mer-1-775	KKYPWR	12	2275	6mer-1-1075	KKPSVK	38
1976	6mer-1-776	KKTSIK	13	2276	6mer-1-1076	RKKEPK	43
1977	6mer-1-777	RRHNHR	16	2277	6mer-1-1077	RRKWGR	24
1978	6mer-1-778	RRDDFR	28	2278	6mer-1-1078	RRPDIK	25
1979	6mer-1-779	RRPDAR	30	2279	6mer-1-1079	RKHPVK	25
1980	6mer-1-780	KRKCWR	24	2280	6mer-1-1080	KKHNMR	38
1981	6mer-1-781	RRHWDK	16	2281	6mer-1-1081	KRPSNK	23
1982	6mer-1-782	KKNAWK	30	2282	6mer-1-1082	KKTCDR	37
1983	6mer-1-783	KKNEFK	29	2283	6mer-1-1083	KKNAVR	36

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
1984	6mer-1-784	KKFTPK	33	2284	6mer-1-1084	KKCCPK	25
1985	6mer-1-785	KKTCER	19	2285	6mer-1-1085	KREAMK	33
1986	6mer-1-786	KRIKEK	26	2286	6mer-1-1086	RKEANK	22
1987	6mer-1-787	KKESIK	16	2287	6mer-1-1087	KKPWKR	27
1988	6mer-1-788	RKIPKK	22	2288	6mer-1-1088	RRETHK	38
1989	6mer-1-789	KRMMPK	19	2289	6mer-1-1089	RKFTKK	31
1990	6mer-1-790	KKPNPK	12	2290	6mer-1-1090	KKTMWR	27
1991	6mer-1-791	RKPDDK	13	2291	6mer-1-1091	KKDDGK	32
1992	6mer-1-792	KRKDKK	30	2292	6mer-1-1092	RKYHDK	43
1993	6mer-1-793	KKTPNR	31	2293	6mer-1-1093	RRKSDR	37
1994	6mer-1-794	RKYEPK	11	2294	6mer-1-1094	RRMAIK	42
1995	6mer-1-795	KKCHMR	12	2295	6mer-1-1095	RRCHVK	27
1996	6mer-1-796	RRHAFK	28	2296	6mer-1-1096	RKPEPR	23
1997	6mer-1-797	RRAWNK	22	2297	6mer-1-1097	RKNCNK	39
1998	6mer-1-798	RRDCFR	18	2298	6mer-1-1098	RKKDMR	42
1999	6mer-1-799	RRKKKR	30	2299	6mer-1-1099	RRKTDR	24
2000	6mer-1-800	RREHIR	15	2300	6mer-1-1100	KRMSHK	43
2001	6mer-1-801	KKCAVK	18	2301	6mer-1-1101	RRECDK	37
2002	6mer-1-802	RKYHGR	32	2302	6mer-1-1102	KRFTKK	35
2003	6mer-1-803	RKMKHK	31	2303	6mer-1-1103	KREDNK	27
2004	6mer-1-804	KRDPFR	31	2304	6mer-1-1104	KRNSAR	28

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
2005	6mer-1-805	KRDTMK	24	2305	6mer-1-1105	RRCTAR	40
2006	6mer-1-806	RKKTIR	12	2306	6mer-1-1106	KRFMNK	39
2007	6mer-1-807	RRDKNR	13	2307	6mer-1-1107	KRCPPR	36
2008	6mer-1-808	RRFEKK	24	2308	6mer-1-1108	RRAHNK	43
2009	6mer-1-809	KKKSNR	12	2309	6mer-1-1109	KRCCVR	41
2010	6mer-1-810	RKCNAR	12	2310	6mer-1-1110	RKFTER	24
2011	6mer-1-811	KRHCHK	16	2311	6mer-1-1111	RRASPR	38
2012	6mer-1-812	RKDHMK	26	2312	6mer-1-1112	KKDPWK	27
2013	6mer-1-813	RREDFK	15	2313	6mer-1-1113	RRCTMK	28
2014	6mer-1-814	KKCNAK	15	2314	6mer-1-1114	KKFNFK	38
2015	6mer-1-815	RRFEMR	23	2315	6mer-1-1115	RKCAFR	43
2016	6mer-1-816	RKIDFK	14	2316	6mer-1-1116	KRHPFR	35
2017	6mer-1-817	RRIMKR	16	2317	6mer-1-1117	KKEWFR	40
2018	6mer-1-818	RKIKAR	14	2318	6mer-1-1118	KKDTIK	33
2019	6mer-1-819	KRMHAK	17	2319	6mer-1-1119	KRIWVR	31
2020	6mer-1-820	KRNDGK	12	2320	6mer-1-1120	RRKEAK	22
2021	6mer-1-821	RRTTNR	22	2321	6mer-1-1121	KKTWWR	28
2022	6mer-1-822	KREPIK	17	2322	6mer-1-1122	RRTMGR	33
2023	6mer-1-823	KRHTGK	12	2323	6mer-1-1123	RRDNVK	41
2024	6mer-1-824	KKMNIK	12	2324	6mer-1-1124	KKDEIR	21
2025	6mer-1-825	RKEKWK	30	2325	6mer-1-1125	KKPTDR	26

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
2026	6mer-1-826	KKAHMR	31	2326	6mer-1-1126	RRHCDK	41
2027	6mer-1-827	RKKKFR	30	2327	6mer-1-1127	RKMMMK	34
2028	6mer-1-828	RRPNMK	26	2328	6mer-1-1128	KKKKPK	39
2029	6mer-1-829	RRIHKK	25	2329	6mer-1-1129	RKDHAR	39
2030	6mer-1-830	KKTTMK	33	2330	6mer-1-1130	RKATFR	31
2031	6mer-1-831	KKNPWK	15	2331	6mer-1-1131	RKDNIK	42
2032	6mer-1-832	RKYWGK	12	2332	6mer-1-1132	RRKAER	31
2033	6mer-1-833	RRYKNR	19	2333	6mer-1-1133	KKPNIK	24
2034	6mer-1-834	KRNTIR	17	2334	6mer-1-1134	KRMSWK	22
2035	6mer-1-835	KRTADK	26	2335	6mer-1-1135	KKHTER	26
2036	6mer-1-836	RRCMIK	22	2336	6mer-1-1136	KKIEIK	34
2037	6mer-1-837	KRDHAK	19	2337	6mer-1-1137	KRFTDK	33
2038	6mer-1-838	KRNTWK	17	2338	6mer-1-1138	KRDCFR	21
2039	6mer-1-839	KRNWAK	29	2339	6mer-1-1139	KKMENR	36
2040	6mer-1-840	RKICNK	12	2340	6mer-1-1140	KRATMK	43
2041	6mer-1-841	KKDAPR	30	2341	6mer-1-1141	KRNMHK	40
2042	6mer-1-842	RRFANK	11	2342	6mer-1-1142	KKETPR	24
2043	6mer-1-843	KKKTIK	28	2343	6mer-1-1143	KRHEFK	32
2044	6mer-1-844	KKPMNR	28	2344	6mer-1-1144	KKCMGR	25
2045	6mer-1-845	KKIDKK	23	2345	6mer-1-1145	RRDCKK	40
2046	6mer-1-846	RKDAEK	28	2346	6mer-1-1146	KKMMPK	34

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
2047	6mer-1-847	KKYNHK	20	2347	6mer-1-1147	RKAPHR	35
2048	6mer-1-848	RKTMFK	19	2348	6mer-1-1148	RRCSHR	31
2049	6mer-1-849	KKFNWK	21	2349	6mer-1-1149	RKMTPK	30
2050	6mer-1-850	RRNPEK	29	2350	6mer-1-1150	KRKWWR	34
2051	6mer-1-851	RRYMEK	30	2351	6mer-1-1151	KKKEAK	34
2052	6mer-1-852	KRASVK	19	2352	6mer-1-1152	RKYKEK	23
2053	6mer-1-853	KRCNGR	30	2353	6mer-1-1153	RKHNKK	23
2054	6mer-1-854	KKEAVR	16	2354	6mer-1-1154	RKCEKR	41
2055	6mer-1-855	RKCDVR	15	2355	6mer-1-1155	RKKEKR	28
2056	6mer-1-856	KRMWFK	30	2356	6mer-1-1156	KRYTVR	37
2057	6mer-1-857	KRPAFK	14	2357	6mer-1-1157	RKESVR	36
2058	6mer-1-858	KKKHKR	27	2358	6mer-1-1158	RKPMMK	33
2059	6mer-1-859	RKCMVK	27	2359	6mer-1-1159	RRAWPR	39
2060	6mer-1-860	RKHWWR	22	2360	6mer-1-1160	RRDWAK	29
2061	6mer-1-861	KRINIR	21	2361	6mer-1-1161	KRHWVK	40
2062	6mer-1-862	KKHSEK	32	2362	6mer-1-1162	KKCDHR	41
2063	6mer-1-863	RRCTER	27	2363	6mer-1-1163	RKCAFK	21
2064	6mer-1-864	RRTWGR	32	2364	6mer-1-1164	KKHHAK	41
2065	6mer-1-865	KKMTAR	21	2365	6mer-1-1165	RRATWR	29
2066	6mer-1-866	KRCHFR	26	2366	6mer-1-1166	KKEEKR	22
2067	6mer-1-867	KRIPMR	25	2367	6mer-1-1167	KRHMMK	42

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
2068	6mer-1-868	KKHHAR	14	2368	6mer-1-1168	KKEKFR	40
2069	6mer-1-869	KRKDER	22	2369	6mer-1-1169	RKMDIR	32
2070	6mer-1-870	KRMSHR	25	2370	6mer-1-1170	KKYNPK	25
2071	6mer-1-871	KREWDR	30	2371	6mer-1-1171	RKIAFK	40
2072	6mer-1-872	KRPCHR	23	2372	6mer-1-1172	RRFNFR	23
2073	6mer-1-873	KRIWAR	23	2373	6mer-1-1173	KKIPMK	26
2074	6mer-1-874	KRANHK	18	2374	6mer-1-1174	RKDAIR	30
2075	6mer-1-875	KKTNGR	33	2375	6mer-1-1175	RKTWEK	23
2076	6mer-1-876	RKYWAR	19	2376	6mer-1-1176	KKADHK	21
2077	6mer-1-877	KKPEWR	19	2377	6mer-1-1177	RRHTMR	21
2078	6mer-1-878	RRKDNR	27	2378	6mer-1-1178	RKKMAK	29
2079	6mer-1-879	RRYNNR	27	2379	6mer-1-1179	KRMTPR	40
2080	6mer-1-880	KRPMDK	21	2380	6mer-1-1180	KRPPPK	34
2081	6mer-1-881	KKHMER	20	2381	6mer-1-1181	RRMDAK	21
2082	6mer-1-882	KKPAMR	25	2382	6mer-1-1182	KKTCHR	35
2083	6mer-1-883	KKIDDK	21	2383	6mer-1-1183	RKIHNK	35
2084	6mer-1-884	KRYTKR	26	2384	6mer-1-1184	RRDTVK	30
2085	6mer-1-885	RRKTPR	17	2385	6mer-1-1185	KKEMMK	29
2086	6mer-1-886	RKFSNK	17	2386	6mer-1-1186	KKNNAK	37
2087	6mer-1-887	KRINHR	30	2387	6mer-1-1187	RRHAHK	26
2088	6mer-1-888	KKTANK	33	2388	6mer-1-1188	RRMNER	41

(continued)

6mer-1 Bottom sequence							
SEQ ID NO:	Unique No .	Sequence	Binding affinity	SEQ ID NO:	Unique No .	Sequence	Binding affinity
2089	6mer-1-889	KRIMEK	25	2389	6mer-1-1189	KKCHWR	40
2090	6mer-1-890	RRTSNK	18	2390	6mer-1-1190	KKCMKR	29
2091	6mer-1-891	RKMAFR	13	2391	6mer-1-1191	RKYTKK	39
2092	6mer-1-892	RKTEKR	20	2392	6mer-1-1192	RKDDDR	36
2093	6mer-1-893	RRIPHR	22	2393	6mer-1-1193	KKPTNK	33
2094	6mer-1-894	RKCWWR	18	2394	6mer-1-1194	KKTHAK	22
2095	6mer-1-895	KKDSKK	28	2395	6mer-1-1195	KRDEDK	25
2096	6mer-1-896	KRDWIK	11	2396	6mer-1-1196	KKTTGR	25
2097	6mer-1-897	RRPSIK	24	2397	6mer-1-1197	KRPMAK	21
2098	6mer-1-898	RKATKR	31	2398	6mer-1-1198	RRATER	28
2099	6mer-1-899	KRMKWK	31	2399	6mer-1-1199	KKTNKR	39
2100	6mer-1-900	RRDTGR	24	2400	6mer-1-1200	RKACEK	21
Average Binding affinity							27.17

TABLE 12

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2401	6mer-2-1	RRRLKK	131	2701	6mer-2-301	RQVRKR	122
2402	6mer-2-2	RWYLKR	139	2702	6mer-2-302	KQICKK	148
2403	6mer-2-3	KVYSRK	148	2703	6mer-2-303	KVFTKR	126
2404	6mer-2-4	RSYYRR	125	2704	6mer-2-304	KWFYRK	144
2405	6mer-2-5	RWVSKR	124	2705	6mer-2-305	KQFYKK	154
2406	6mer-2-6	KSICRR	122	2706	6mer-2-306	RQFQKR	141

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2407	6mer-2-7	KSRCRK	126	2707	6mer-2-307	RLRSKK	141
2408	6mer-2-8	KSLQKK	135	2708	6mer-2-308	KGISKR	148
2409	6mer-2-9	KLICRK	139	2709	6mer-2-309	KRRRRR	151
2410	6mer-2-10	KVFSKK	124	2710	6mer-2-310	KLFQRK	149
2411	6mer-2-11	RQYQRR	121	2711	6mer-2-311	KWTRK	147
2412	6mer-2-12	RQFQRK	147	2712	6mer-2-312	KWRTKR	121
2413	6mer-2-13	RQYTRK	123	2713	6mer-2-313	RWRTKR	154
2414	6mer-2-14	RGRQKK	153	2714	6mer-2-314	KQYCKK	127
2415	6mer-2-15	KQVRKR	133	2715	6mer-2-315	RRQRRR	139
2416	6mer-2-16	KGVCRR	121	2716	6mer-2-316	KGIRRR	139
2417	6mer-2-17	RWVTRR	142	2717	6mer-2-317	RGLYKR	135
2418	6mer-2-18	RSILRR	124	2718	6mer-2-318	RGIQKK	145
2419	6mer-2-19	RSFSKK	135	2719	6mer-2-319	RSRQRK	137
2420	6mer-2-20	RVQTRR	137	2720	6mer-2-320	RQYRRK	148
2421	6mer-2-21	RLFTRK	141	2721	6mer-2-321	KLVSRK	139
2422	6mer-2-22	RQIRKK	124	2722	6mer-2-322	RRYSRR	148
2423	6mer-2-23	RWVRKK	148	2723	6mer-2-323	KVLLRK	145
2424	6mer-2-24	KGIQRK	141	2724	6mer-2-324	KLQSRK	139
2425	6mer-2-25	KQVQKR	148	2725	6mer-2-325	RVFSRK	142
2426	6mer-2-26	RWRRKK	121	2726	6mer-2-326	RGFYKK	142
2427	6mer-2-27	KVIRRK	128	2727	6mer-2-327	KGLRKR	153

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2428	6mer-2-28	KVLSRK	142	2728	6mer-2-328	KRYQRK	131
2429	6mer-2-29	RSQRKR	142	2729	6mer-2-329	RVYTKR	142
2430	6mer-2-30	RQFYKK	139	2730	6mer-2-330	KQLRKK	139
2431	6mer-2-31	KSYQRK	121	2731	6mer-2-331	RWVSKK	148
2432	6mer-2-32	RRLCRK	139	2732	6mer-2-332	RRQYKK	145
2433	6mer-2-33	RQFRKK	142	2733	6mer-2-333	KRFRRK	139
2434	6mer-2-34	KVFRRK	124	2734	6mer-2-334	KVILRR	146
2435	6mer-2-35	RWISRK	148	2735	6mer-2-335	KWRSRR	153
2436	6mer-2-36	RRLQKK	131	2736	6mer-2-336	KLITKR	135
2437	6mer-2-37	KLLYRK	148	2737	6mer-2-337	KQFQKK	142
2438	6mer-2-38	RSYYKR	136	2738	6mer-2-338	RSVQKR	145
2439	6mer-2-39	RWRYRK	137	2739	6mer-2-339	KQVYKK	151
2440	6mer-2-40	RRYRKK	153	2740	6mer-2-340	RRLTRR	122
2441	6mer-2-41	KQLCKR	142	2741	6mer-2-341	KWTKR	144
2442	6mer-2-42	KLLSKR	126	2742	6mer-2-342	KRYRKK	145
2443	6mer-2-43	RVITKR	146	2743	6mer-2-343	KQISKK	146
2444	6mer-2-44	KSVRRK	145	2744	6mer-2-344	KGIRRK	148
2445	6mer-2-45	RSLTKK	121	2745	6mer-2-345	KSRQKK	148
2446	6mer-2-46	KLYLKR	153	2746	6mer-2-346	KRFSKK	153
2447	6mer-2-47	KLQSRR	148	2747	6mer-2-347	RRYSKK	148
2448	6mer-2-48	RRFRKK	153	2748	6mer-2-348	KSQLRR	153

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2449	6mer-2-49	RLRCRK	154	2749	6mer-2-349	RRLSRR	137
2450	6mer-2-50	RSQSKR	125	2750	6mer-2-350	RGQTRK	148
2451	6mer-2-51	KQFLKK	139	2751	6mer-2-351	KLYTKR	135
2452	6mer-2-52	KRQRKK	136	2752	6mer-2-352	RWFYRR	137
2453	6mer-2-53	KSLSRR	125	2753	6mer-2-353	RLQTKK	137
2454	6mer-2-54	KGRRRR	124	2754	6mer-2-354	RWISKK	135
2455	6mer-2-55	RLFYKK	125	2755	6mer-2-355	RGIRKK	124
2456	6mer-2-56	RSQLRR	149	2756	6mer-2-356	RLLQRR	145
2457	6mer-2-57	KQRCRR	139	2757	6mer-2-357	RGQRKK	151
2458	6mer-2-58	KRLQRK	122	2758	6mer-2-358	RQIYKK	154
2459	6mer-2-59	RVLSRK	123	2759	6mer-2-359	RLFCKK	136
2460	6mer-2-60	RRLSKK	148	2760	6mer-2-360	KGVRRR	141
2461	6mer-2-61	RGFQRK	148	2761	6mer-2-361	RSFQRR	153
2462	6mer-2-62	RLVTKR	147	2762	6mer-2-362	RGRQKR	154
2463	6mer-2-63	KSFRKR	121	2763	6mer-2-363	KSIYRK	147
2464	6mer-2-64	KSVSKK	136	2764	6mer-2-364	KVFTKK	154
2465	6mer-2-65	KGVCKR	148	2765	6mer-2-365	RWRYRR	121
2466	6mer-2-66	RVIRRR	123	2766	6mer-2-366	KQYYRR	142
2467	6mer-2-67	KLFCKK	124	2767	6mer-2-367	RWRSRR	142
2468	6mer-2-68	KGRRRK	142	2768	6mer-2-368	RLRTRR	142
2469	6mer-2-69	KWFLRK	139	2769	6mer-2-369	KVVRRR	145

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2470	6mer-2-70	KRLLRK	126	2770	6mer-2-370	KSLLRR	142
2471	6mer-2-71	KQVYKR	141	2771	6mer-2-371	KRLSRR	148
2472	6mer-2-72	KRIQKK	144	2772	6mer-2-372	KLVQRR	141
2473	6mer-2-73	RLYTKR	139	2773	6mer-2-373	KLIYRK	139
2474	6mer-2-74	RWIYKR	136	2774	6mer-2-374	KRQLKK	125
2475	6mer-2-75	KLYTRK	133	2775	6mer-2-375	RWQKK	131
2476	6mer-2-76	RRQSRK	142	2776	6mer-2-376	KQQCKR	141
2477	6mer-2-77	KQQTRR	123	2777	6mer-2-377	RRYCRR	142
2478	6mer-2-78	KRYLKR	135	2778	6mer-2-378	KRFQRK	131
2479	6mer-2-79	RQLSKR	135	2779	6mer-2-379	RGVQKR	127
2480	6mer-2-80	RRQYKR	148	2780	6mer-2-380	RLVYRK	141
2481	6mer-2-81	RRVSRR	121	2781	6mer-2-381	KVYRRR	139
2482	6mer-2-82	RGVQKK	124	2782	6mer-2-382	KSVSRR	148
2483	6mer-2-83	KQYQRR	135	2783	6mer-2-383	KLVRRK	128
2484	6mer-2-84	KQRYKK	139	2784	6mer-2-384	RSFQKK	142
2485	6mer-2-85	KSQYKR	137	2785	6mer-2-385	RGVCKR	154
2486	6mer-2-86	KQFRRK	126	2786	6mer-2-386	KWQSKR	136
2487	6mer-2-87	RRLTKR	142	2787	6mer-2-387	KWLCKK	146
2488	6mer-2-88	KSFQRR	141	2788	6mer-2-388	KRFQKK	139
2489	6mer-2-89	KSRSKK	141	2789	6mer-2-389	KSLYKK	153
2490	6mer-2-90	KGRTKR	133	2790	6mer-2-390	KWLRRR	145

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2491	6mer-2-91	KWIYKR	121	2791	6mer-2-391	KQYQKR	141
2492	6mer-2-92	KWCKR	131	2792	6mer-2-392	RQILKR	149
2493	6mer-2-93	RWQTRR	133	2793	6mer-2-393	RGLQRK	145
2494	6mer-2-94	RLYQRK	126	2794	6mer-2-394	KLVLKR	141
2495	6mer-2-95	RRIYRK	142	2795	6mer-2-395	KWRYRR	148
2496	6mer-2-96	KWRQRK	154	2796	6mer-2-396	KWLQRR	122
2497	6mer-2-97	RQFYRK	154	2797	6mer-2-397	RSIYRK	154
2498	6mer-2-98	RRQQRR	148	2798	6mer-2-398	RQQRRR	141
2499	6mer-2-99	RQRSRR	151	2799	6mer-2-399	RWLTRR	148
2500	6mer-2-100	RRRCRR	142	2800	6mer-2-400	RQIRRR	154
2501	6mer-2-101	RLICRK	154	2801	6mer-2-401	RSILRK	153
2502	6mer-2-102	KVYQKK	139	2802	6mer-2-402	KRYSRR	145
2503	6mer-2-103	RWTKK	136	2803	6mer-2-403	KGVLRK	123
2504	6mer-2-104	RGVCRK	145	2804	6mer-2-404	RVLSKR	121
2505	6mer-2-105	RGFTRR	151	2805	6mer-2-405	KGYRKK	137
2506	6mer-2-106	RWVQRK	123	2806	6mer-2-406	KGIYRR	139
2507	6mer-2-107	RGVYRK	144	2807	6mer-2-407	KQVSKR	122
2508	6mer-2-108	RWYKK	153	2808	6mer-2-408	KQIYRR	139
2509	6mer-2-109	RRVYRK	144	2809	6mer-2-409	KRRRKR	139
2510	6mer-2-110	KSQLKK	153	2810	6mer-2-410	KRFRKK	153
2511	6mer-2-111	KLIRRK	123	2811	6mer-2-411	RSRQKK	121

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2512	6mer-2-112	RLQQKR	142	2812	6mer-2-412	KRFLKK	139
2513	6mer-2-113	KRYSRK	145	2813	6mer-2-413	RLILKR	136
2514	6mer-2-114	KLQYRK	121	2814	6mer-2-414	KWRQKK	135
2515	6mer-2-115	KWQYRK	144	2815	6mer-2-415	KGRCKK	149
2516	6mer-2-116	KLQRKK	126	2816	6mer-2-416	RWRLRR	131
2517	6mer-2-117	KRYTRK	148	2817	6mer-2-417	RWVYKK	151
2518	6mer-2-118	KWFSRR	135	2818	6mer-2-418	RVQYKK	121
2519	6mer-2-119	RSISKK	139	2819	6mer-2-419	RSRYKK	154
2520	6mer-2-120	RRQCRK	146	2820	6mer-2-420	RRQYRK	128
2521	6mer-2-121	KRVYRK	137	2821	6mer-2-421	KVICRK	124
2522	6mer-2-122	RVITKK	125	2822	6mer-2-422	RLITRR	154
2523	6mer-2-123	RQFTKR	146	2823	6mer-2-423	RLQYRK	154
2524	6mer-2-124	KWQLKR	126	2824	6mer-2-424	RLYCKK	139
2525	6mer-2-125	KVQLRR	142	2825	6mer-2-425	KLQTKK	145
2526	6mer-2-126	KWLYRR	148	2826	6mer-2-426	KGQRRK	141
2527	6mer-2-127	RLYLRK	136	2827	6mer-2-427	RLQRRR	147
2528	6mer-2-128	KSYYRR	147	2828	6mer-2-428	KVFLKK	142
2529	6mer-2-129	KSVLRK	139	2829	6mer-2-429	RWRQRK	123
2530	6mer-2-130	RGVCRR	122	2830	6mer-2-430	RWFRRR	139
2531	6mer-2-131	KQQTKR	148	2831	6mer-2-431	KLILKR	135
2532	6mer-2-132	KLYCKK	139	2832	6mer-2-432	KVVRKR	148

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2533	6mer-2-133	KRRLKK	145	2833	6mer-2-433	RWIQKR	139
2534	6mer-2-134	RLFQRK	148	2834	6mer-2-434	RVIRRK	154
2535	6mer-2-135	RWFYKK	124	2835	6mer-2-435	RWVYKR	154
2536	6mer-2-136	RWRYKR	194	2836	6mer-2-436	KVLYKR	148
2537	6mer-2-137	KVFCKK	135	2837	6mer-2-437	KQVCKK	121
2538	6mer-2-138	KQRRRK	153	2838	6mer-2-438	RLLCRK	131
2539	6mer-2-139	KLFRKK	149	2839	6mer-2-439	KWFSKR	153
2540	6mer-2-140	KGRLKK	142	2840	6mer-2-440	KQLSKK	153
2541	6mer-2-141	KWYQKK	154	2841	6mer-2-441	KSQRKR	139
2542	6mer-2-142	RWVLRR	121	2842	6mer-2-442	RLVQKR	139
2543	6mer-2-143	RRVCRR	128	2843	6mer-2-443	RQYCRR	122
2544	6mer-2-144	KSIRRK	133	2844	6mer-2-444	RQRLKK	141
2545	6mer-2-145	RQYYKK	128	2845	6mer-2-445	RLVCKR	145
2546	6mer-2-146	KQLLKR	135	2846	6mer-2-446	RQLQKK	153
2547	6mer-2-147	RQYTKR	133	2847	6mer-2-447	RVYTKK	139
2548	6mer-2-148	KGQYKK	145	2848	6mer-2-448	RSFRRR	128
2549	6mer-2-149	KGQQRK	127	2849	6mer-2-449	RGRCRR	154
2550	6mer-2-150	KRILKR	136	2850	6mer-2-450	RQRYRK	123
2551	6mer-2-151	KQLRKR	142	2851	6mer-2-451	RGRCKK	148
2552	6mer-2-152	RQFYKR	139	2852	6mer-2-452	KGLYKR	146
2553	6mer-2-153	RVYSRR	124	2853	6mer-2-453	RLVRKK	141

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2554	6mer-2-154	KRVTKR	148	2854	6mer-2-454	RSVQKK	133
2555	6mer-2-155	KGVYKK	139	2855	6mer-2-455	RWYSKR	135
2556	6mer-2-156	KGLQRR	127	2856	6mer-2-456	KSVTKR	147
2557	6mer-2-157	RSYRKK	153	2857	6mer-2-457	RRVYKR	146
2558	6mer-2-158	RSFLRR	145	2858	6mer-2-458	RRFQRR	122
2559	6mer-2-159	RQYYRK	127	2859	6mer-2-459	KLFSRK	139
2560	6mer-2-160	RVRRKK	121	2860	6mer-2-460	RSQCRK	139
2561	6mer-2-161	KWRRKK	154	2861	6mer-2-461	KSVCRR	149
2562	6mer-2-162	KVISKR	136	2862	6mer-2-462	KQICKR	145
2563	6mer-2-163	KWFYRR	149	2863	6mer-2-463	KLLTRR	124
2564	6mer-2-164	KRQRRK	135	2864	6mer-2-464	KSFRKK	135
2565	6mer-2-165	KWFTRR	139	2865	6mer-2-465	KGVSKR	122
2566	6mer-2-166	RWLRKR	125	2866	6mer-2-466	RLLTRR	142
2567	6mer-2-167	KLFQKR	145	2867	6mer-2-467	KQYSRR	142
2568	6mer-2-168	RVFLKR	135	2868	6mer-2-468	RSFSKR	133
2569	6mer-2-169	KRQSRR	123	2869	6mer-2-469	RLRTKK	153
2570	6mer-2-170	RQYQKK	128	2870	6mer-2-470	RLRRRK	153
2571	6mer-2-171	RQQTRR	139	2871	6mer-2-471	KWISRR	136
2572	6mer-2-172	KVIRKK	128	2872	6mer-2-472	RSRLRR	148
2573	6mer-2-173	RQQCKK	127	2873	6mer-2-473	RGRLRK	131
2574	6mer-2-174	KLLRKR	142	2874	6mer-2-474	RWQQRR	128

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6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2575	6mer-2-175	KVYLRK	137	2875	6mer-2-475	KRFCRR	139
2576	6mer-2-176	RWIYRR	144	2876	6mer-2-476	KGIRKK	148
2577	6mer-2-177	RSVTKK	136	2877	6mer-2-477	RSRTRR	135
2578	6mer-2-178	KWLLRR	133	2878	6mer-2-478	KWYTRK	145
2579	6mer-2-179	RRVYRR	121	2879	6mer-2-479	KWRLKK	154
2580	6mer-2-180	RLRLKR	142	2880	6mer-2-480	RRFTKK	147
2581	6mer-2-181	RWQQKK	139	2881	6mer-2-481	RQRYKK	131
2582	6mer-2-182	KLFYKK	139	2882	6mer-2-482	KGQTRR	154
2583	6mer-2-183	RLQLRR	154	2883	6mer-2-483	RRYLKK	121
2584	6mer-2-184	KWVSRR	136	2884	6mer-2-484	RWYTKR	148
2585	6mer-2-185	RGYQKR	137	2885	6mer-2-485	RQIQKR	148
2586	6mer-2-186	KQICRK	127	2886	6mer-2-486	KQQSKK	121
2587	6mer-2-187	KRRRRK	145	2887	6mer-2-487	KSYTKR	121
2588	6mer-2-188	RGYTKR	142	2888	6mer-2-488	KVYRRK	146
2589	6mer-2-189	RWQCKK	121	2889	6mer-2-489	RVISKK	142
2590	6mer-2-190	KVYLKR	148	2890	6mer-2-490	RRYQKK	145
2591	6mer-2-191	RQLLKR	154	2891	6mer-2-491	KRICKR	135
2592	6mer-2-192	RWFSKK	133	2892	6mer-2-492	RLIQKK	148
2593	6mer-2-193	KWISKR	127	2893	6mer-2-493	KGVRRK	123
2594	6mer-2-194	KLRLRK	154	2894	6mer-2-494	KGLLRR	144
2595	6mer-2-195	KSRQKR	154	2895	6mer-2-495	KLLCKK	121

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2596	6mer-2-196	KSQRKK	121	2896	6mer-2-496	RVRYRK	144
2597	6mer-2-197	RGQYRR	126	2897	6mer-2-497	KSYTRR	148
2598	6mer-2-198	KWYYRK	139	2898	6mer-2-498	KGLCRR	127
2599	6mer-2-199	RGQYKR	137	2899	6mer-2-499	RLFTKR	145
2600	6mer-2-200	RGVQRK	121	2900	6mer-2-500	KRICRR	146
2601	6mer-2-201	KLFLRR	148	2901	6mer-2-501	KSYSKK	144
2602	6mer-2-202	RLIYKK	122	2902	6mer-2-502	KSFCKR	144
2603	6mer-2-203	KSRTKR	135	2903	6mer-2-503	KVQTKK	154
2604	6mer-2-204	RRVQKR	142	2904	6mer-2-504	RGLTRK	154
2605	6mer-2-205	KSFQRK	147	2905	6mer-2-505	KRQCKK	148
2606	6mer-2-206	KWQYKK	148	2906	6mer-2-506	KSLLKK	135
2607	6mer-2-207	KWVSKR	153	2907	6mer-2-507	RGICKR	145
2608	6mer-2-208	RSQQRK	128	2908	6mer-2-508	RVFLKK	121
2609	6mer-2-209	RLYYRK	148	2909	6mer-2-509	RGFYRK	136
2610	6mer-2-210	RSQSRR	128	2910	6mer-2-510	KRVLKK	146
2611	6mer-2-211	RGLSRR	135	2911	6mer-2-511	RVFCRR	126
2612	6mer-2-212	KWQLRR	148	2912	6mer-2-512	RWFTRR	148
2613	6mer-2-213	KSILRR	142	2913	6mer-2-513	RRLTRK	121
2614	6mer-2-214	RWRSRK	139	2914	6mer-2-514	KGLQKK	124
2615	6mer-2-215	RLYYRR	123	2915	6mer-2-515	RWYCRK	123
2616	6mer-2-216	KGILKK	126	2916	6mer-2-516	RQQQKK	146

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6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2617	6mer-2-217	KLFQKK	135	2917	6mer-2-517	KLRTKK	153
2618	6mer-2-218	KGVSKK	147	2918	6mer-2-518	KLVTKK	151
2619	6mer-2-219	RGVSKR	153	2919	6mer-2-519	KQIQRR	135
2620	6mer-2-220	KVYSKR	135	2920	6mer-2-520	KSYCKR	144
2621	6mer-2-221	KQVRKK	153	2921	6mer-2-521	KQYTRK	144
2622	6mer-2-222	RVVYRK	127	2922	6mer-2-522	RWLRK	124
2623	6mer-2-223	KQLTRR	142	2923	6mer-2-523	RGRYKR	146
2624	6mer-2-224	RLFLKR	148	2924	6mer-2-524	RGIQKR	128
2625	6mer-2-225	KRLLRR	145	2925	6mer-2-525	KWVRKK	145
2626	6mer-2-226	RLLCKR	154	2926	6mer-2-526	RVLLRK	144
2627	6mer-2-227	KLQRRK	147	2927	6mer-2-527	RGQTRR	145
2628	6mer-2-228	KGQCKK	141	2928	6mer-2-528	KGFRKK	151
2629	6mer-2-229	RWQSKK	127	2929	6mer-2-529	KQQRKR	124
2630	6mer-2-230	RWIQRR	135	2930	6mer-2-530	RSYSKR	139
2631	6mer-2-231	KGISKK	144	2931	6mer-2-531	KVIYKR	148
2632	6mer-2-232	KQFTRK	135	2932	6mer-2-532	KSITKR	147
2633	6mer-2-233	KWRQKR	190	2933	6mer-2-533	KRLLKR	142
2634	6mer-2-234	RSQTKR	142	2934	6mer-2-534	RVQLRR	139
2635	6mer-2-235	KLVRKK	136	2935	6mer-2-535	KLFCRR	133
2636	6mer-2-236	KWQQKK	131	2936	6mer-2-536	RWQRKK	125
2637	6mer-2-237	RLVYKR	123	2937	6mer-2-537	KVLCKR	153

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2638	6mer-2-238	RRRRRK	142	2938	6mer-2-538	KQFCKK	125
2639	6mer-2-239	RGQYKK	125	2939	6mer-2-539	KWYTKK	127
2640	6mer-2-240	RRRCRK	142	2940	6mer-2-540	KRLTRR	142
2641	6mer-2-241	KQLTKR	135	2941	6mer-2-541	KGQCRK	126
2642	6mer-2-242	KSQRRR	135	2942	6mer-2-542	RQIYRR	148
2643	6mer-2-243	KRVLKR	148	2943	6mer-2-543	RRQYRR	144
2644	6mer-2-244	RRFSKR	139	2944	6mer-2-544	KVIQKR	147
2645	6mer-2-245	RSLSKR	135	2945	6mer-2-545	KLYCRK	125
2646	6mer-2-246	KWISKK	123	2946	6mer-2-546	RVFTKK	127
2647	6mer-2-247	KGYQKK	146	2947	6mer-2-547	RWQCKR	135
2648	6mer-2-248	RSYTRR	154	2948	6mer-2-548	RLQCRR	142
2649	6mer-2-249	RGLRKR	136	2949	6mer-2-549	KQLCKK	142
2650	6mer-2-250	KRRRKK	145	2950	6mer-2-550	RSFTKK	148
2651	6mer-2-251	KSQTKR	142	2951	6mer-2-551	KWYTKR	141
2652	6mer-2-252	KVFRKK	148	2952	6mer-2-552	RGLLRR	148
2653	6mer-2-253	KLRSRR	145	2953	6mer-2-553	RSLQKK	124
2654	6mer-2-254	KRIQRR	148	2954	6mer-2-554	RWRCRR	121
2655	6mer-2-255	RLRRKK	139	2955	6mer-2-555	RSVSKK	154
2656	6mer-2-256	KSQQKR	142	2956	6mer-2-556	RSICKK	148
2657	6mer-2-257	KRFCRK	144	2957	6mer-2-557	KWVLRK	123
2658	6mer-2-258	KRIYRR	125	2958	6mer-2-558	KSVCKK	154

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2659	6mer-2-259	RVQSKR	128	2959	6mer-2-559	KGQLRR	121
2660	6mer-2-260	RRFCKR	142	2960	6mer-2-560	RQYTRR	153
2661	6mer-2-261	RWYTKK	121	2961	6mer-2-561	RRVLKK	142
2662	6mer-2-262	KWILKR	142	2962	6mer-2-562	RQQRKR	136
2663	6mer-2-263	RRICKR	145	2963	6mer-2-563	KGYQKR	131
2664	6mer-2-264	KSQLKR	127	2964	6mer-2-564	KQVYRK	148
2665	6mer-2-265	RRQTRK	135	2965	6mer-2-565	KSRRRR	147
2666	6mer-2-266	RWQTKK	131	2966	6mer-2-566	KRLSKK	139
2667	6mer-2-267	KLYSRR	141	2967	6mer-2-567	KLYYRK	146
2668	6mer-2-268	RQICKK	139	2968	6mer-2-568	KGFQKK	142
2669	6mer-2-269	KWVQRK	123	2969	6mer-2-569	RWQLRK	135
2670	6mer-2-270	KSRLRR	148	2970	6mer-2-570	RVYYKR	148
2671	6mer-2-271	RLFQKK	131	2971	6mer-2-571	RGYQRR	135
2672	6mer-2-272	KWRSRK	154	2972	6mer-2-572	KSQRRK	148
2673	6mer-2-273	KLRQRR	131	2973	6mer-2-573	KLYLRR	121
2674	6mer-2-274	KLRTKR	148	2974	6mer-2-574	KGVYRK	153
2675	6mer-2-275	KLITRR	135	2975	6mer-2-575	RGYSRK	139
2676	6mer-2-276	RLVCRK	153	2976	6mer-2-576	KGVSRR	139
2677	6mer-2-277	RLRYRK	128	2977	6mer-2-577	KRVQRR	139
2678	6mer-2-278	RQIQKK	135	2978	6mer-2-578	RSVLRK	135
2679	6mer-2-279	KSLQRK	148	2979	6mer-2-579	RWQYRK	135

(continued)

6mer-2 Top sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
2680	6mer-2-280	KSIYRR	153	2980	6mer-2-580	KWQQRR	121
2681	6mer-2-281	KGQRKK	149	2981	6mer-2-581	RVQQKR	139
2682	6mer-2-282	RQQYRK	151	2982	6mer-2-582	RWQTRK	148
2683	6mer-2-283	KLISKR	148	2983	6mer-2-583	KSVTKK	154
2684	6mer-2-284	KLRSKR	151	2984	6mer-2-584	KRLTRK	148
2685	6mer-2-285	RRIQRR	142	2985	6mer-2-585	RSFRRK	136
2686	6mer-2-286	KRRYKK	139	2986	6mer-2-586	RWLSRK	121
2687	6mer-2-287	RLYLKR	124	2987	6mer-2-587	KRISKR	148
2688	6mer-2-288	KSRLRK	122	2988	6mer-2-588	KWFYKK	149
2689	6mer-2-289	RLLQKK	146	2989	6mer-2-589	RWQQRK	153
2690	6mer-2-290	RQLYRK	135	2990	6mer-2-590	KGRLRK	148
2691	6mer-2-291	RRYRKR	154	2991	6mer-2-591	KGILRR	146
2692	6mer-2-292	RQLCKR	121	2992	6mer-2-592	RWVLRK	122
2693	6mer-2-293	KQQSKR	153	2993	6mer-2-593	RSQLKR	139
2694	6mer-2-294	KLYYRR	135	2994	6mer-2-594	RWYRRR	139
2695	6mer-2-295	KVRYKK	145	2995	6mer-2-595	KLRCKK	154
2696	6mer-2-296	KWYRRK	135	2996	6mer-2-596	KGIQKK	153
2697	6mer-2-297	RSLSRR	139	2997	6mer-2-597	KQFLRK	154
2698	6mer-2-298	KWICKK	149	2998	6mer-2-598	KVFRRR	146
2699	6mer-2-299	RWYYRK	141	2999	6mer-2-599	RRRYRK	121
2700	6mer-2-300	RWRLKK	153	3000	6mer-2-600	RSQLKK	139
Average Binding affinity							139.09

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6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3001	6mer-2-601	KNSHKK	25	3301	6mer-2-901	RYWDRK	34
3002	6mer-2-602	RNTPKR	24	3302	6mer-2-902	KPDVRK	26
3003	6mer-2-603	KFHARR	32	3303	6mer-2-903	KKNPKK	40
3004	6mer-2-604	KEPIRK	16	3304	6mer-2-904	KCCFKK	30
3005	6mer-2-605	KNCGKK	17	3305	6mer-2-905	RPKERR	26
3006	6mer-2-606	RKPFRR	15	3306	6mer-2-906	KYCDKK	40
3007	6mer-2-607	KKWVKR	31	3307	6mer-2-907	RTMNRR	25
3008	6mer-2-608	RCNHKK	32	3308	6mer-2-908	KYKKKR	33
3009	6mer-2-609	RDSDRR	24	3309	6mer-2-909	RCNPRR	42
3010	6mer-2-610	RKNPKR	32	3310	6mer-2-910	RHEHRR	21
3011	6mer-2-611	RIKMRR	22	3311	6mer-2-911	KMSGKR	21
3012	6mer-2-612	RDCVRK	17	3312	6mer-2-912	RAPIRR	27
3013	6mer-2-613	KAANRR	18	3313	6mer-2-913	KFKNRR	25
3014	6mer-2-614	KAWIRR	19	3314	6mer-2-914	KDDIKK	25
3015	6mer-2-615	KDNGRK	27	3315	6mer-2-915	KNCWKR	29
3016	6mer-2-616	REPHRK	26	3316	6mer-2-916	KTTEKR	22
3017	6mer-2-617	RCNGRR	32	3317	6mer-2-917	RFCWRK	23
3018	6mer-2-618	KHHKKR	12	3318	6mer-2-918	KNWMRK	35
3019	6mer-2-619	RPPDRR	26	3319	6mer-2-919	KAKHKR	27
3020	6mer-2-620	RHTGRR	33	3320	6mer-2-920	RMTIKK	26
3021	6mer-2-621	RHEPKR	32	3321	6mer-2-921	RPKAKK	22

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3022	6mer-2-622	RYTNKR	13	3322	6mer-2-922	KDNVRR	41
3023	6mer-2-623	KHAHRR	13	3323	6mer-2-923	RCCAKK	33
3024	6mer-2-624	KPPIRK	33	3324	6mer-2-924	RFDHKK	28
3025	6mer-2-625	RFPDKK	33	3325	6mer-2-925	RASVKR	23
3026	6mer-2-626	KNSEKK	33	3326	6mer-2-926	RPTVKR	31
3027	6mer-2-627	KKTARR	33	3327	6mer-2-927	RFNPRK	39
3028	6mer-2-628	RKSFKR	30	3328	6mer-2-928	KFCIRR	28
3029	6mer-2-629	RFCWKK	32	3329	6mer-2-929	KNHMRK	26
3030	6mer-2-630	RYAFRR	27	3330	6mer-2-930	RTWIKR	37
3031	6mer-2-631	KYCMKR	16	3331	6mer-2-931	RYCFKR	29
3032	6mer-2-632	KYDIKR	12	3332	6mer-2-932	RIPWRR	35
3033	6mer-2-633	KYAVKR	17	3333	6mer-2-933	RYSMKR	34
3034	6mer-2-634	RYEHRK	33	3334	6mer-2-934	KYKDRR	26
3035	6mer-2-635	KECVRR	11	3335	6mer-2-935	KKCNKK	22
3036	6mer-2-636	KMAPKR	21	3336	6mer-2-936	KPPAKK	21
3037	6mer-2-637	RPPVRK	32	3337	6mer-2-937	RASHRR	35
3038	6mer-2-638	RCWAKR	30	3338	6mer-2-938	RIEHKR	40
3039	6mer-2-639	KHTVKK	23	3339	6mer-2-939	KKCARR	22
3040	6mer-2-640	KFKKKR	21	3340	6mer-2-940	RNENKK	41
3041	6mer-2-641	REEFRR	12	3341	6mer-2-941	RDEDKR	33
3042	6mer-2-642	KTENKK	16	3342	6mer-2-942	KTDKRK	22

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3043	6mer-2-643	KANPKK	12	3343	6mer-2-943	KIDHRR	41
3044	6mer-2-644	REPNRR	12	3344	6mer-2-944	KPEDKK	35
3045	6mer-2-645	RIKVKK	15	3345	6mer-2-945	KKCERK	42
3046	6mer-2-646	RAAPRR	32	3346	6mer-2-946	KPCEKK	21
3047	6mer-2-647	KTEPKR	19	3347	6mer-2-947	KTNWRK	41
3048	6mer-2-648	RYPDRK	23	3348	6mer-2-948	RPPFRR	28
3049	6mer-2-649	KFDVRK	31	3349	6mer-2-949	RPNARR	39
3050	6mer-2-650	RFKARK	18	3350	6mer-2-950	KYNKRR	26
3051	6mer-2-651	KNADRR	21	3351	6mer-2-951	RADEKK	42
3052	6mer-2-652	RTTMRK	16	3352	6mer-2-952	KYWGRR	24
3053	6mer-2-653	KIEMKR	20	3353	6mer-2-953	KESVKK	25
3054	6mer-2-654	RMPEKR	20	3354	6mer-2-954	KCTIRK	32
3055	6mer-2-655	KIWFRR	31	3355	6mer-2-955	RMPERR	29
3056	6mer-2-656	KADPRR	11	3356	6mer-2-956	KFCWRR	28
3057	6mer-2-657	RKHERK	32	3357	6mer-2-957	RDTHRR	40
3058	6mer-2-658	RYWVKK	23	3358	6mer-2-958	KFKARK	28
3059	6mer-2-659	KIPNKR	22	3359	6mer-2-959	RTNARK	35
3060	6mer-2-660	RHKDRK	16	3360	6mer-2-960	RDCVKR	29
3061	6mer-2-661	RMKAKK	29	3361	6mer-2-961	KNTKKR	21
3062	6mer-2-662	KAHPKK	11	3362	6mer-2-962	KKSNRK	30
3063	6mer-2-663	KFAGRR	24	3363	6mer-2-963	KAKHRR	37

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3064	6mer-2-664	KCCWKK	11	3364	6mer-2-964	KCEDRK	41
3065	6mer-2-665	KCAERR	18	3365	6mer-2-965	KPWFKR	36
3066	6mer-2-666	KPMDRR	25	3366	6mer-2-966	KEDAKR	41
3067	6mer-2-667	KHDMRR	25	3367	6mer-2-967	RTSNKK	35
3068	6mer-2-668	RFCNKK	13	3368	6mer-2-968	RHWEKK	39
3069	6mer-2-669	KNMWRK	15	3369	6mer-2-969	KATHKR	33
3070	6mer-2-670	RKWHKR	33	3370	6mer-2-970	KDDVRR	27
3071	6mer-2-671	RDWIRR	27	3371	6mer-2-971	KEMFRK	29
3072	6mer-2-672	KIDDRK	20	3372	6mer-2-972	KAMFRR	38
3073	6mer-2-673	RFCGRK	23	3373	6mer-2-973	KCPIKK	41
3074	6mer-2-674	KKWERK	26	3374	6mer-2-974	RFDDRR	38
3075	6mer-2-675	RMKWRK	14	3375	6mer-2-975	KKTMKK	38
3076	6mer-2-676	KCTAKK	14	3376	6mer-2-976	RTTGKK	26
3077	6mer-2-677	RENWKK	28	3377	6mer-2-977	REMKRK	30
3078	6mer-2-678	KEWWRR	32	3378	6mer-2-978	KEPHRR	28
3079	6mer-2-679	RYSAKK	20	3379	6mer-2-979	KKAFKK	22
3080	6mer-2-680	KNHGKR	15	3380	6mer-2-980	KESGKR	34
3081	6mer-2-681	RDTWRR	33	3381	6mer-2-981	RCEIRK	32
3082	6mer-2-682	RNMERR	33	3382	6mer-2-982	RMHAKK	38
3083	6mer-2-683	KTEIRK	33	3383	6mer-2-983	RTWHRR	37
3084	6mer-2-684	RYTMKK	14	3384	6mer-2-984	KDMWKK	43

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3085	6mer-2-685	KFHNRK	15	3385	6mer-2-985	REMNKR	34
3086	6mer-2-686	KTWEKK	21	3386	6mer-2-986	KNWARR	27
3087	6mer-2-687	KADGRK	16	3387	6mer-2-987	RCHPKK	22
3088	6mer-2-688	RPMFRK	13	3388	6mer-2-988	KMCEKK	41
3089	6mer-2-689	RDKERR	24	3389	6mer-2-989	KAHNKR	22
3090	6mer-2-690	KFTMRK	13	3390	6mer-2-990	RKKMKR	41
3091	6mer-2-691	RHKMRK	15	3391	6mer-2-991	KCHFRR	30
3092	6mer-2-692	KYTNRR	29	3392	6mer-2-992	RMHFRR	33
3093	6mer-2-693	KNTIRR	16	3393	6mer-2-993	RHDVKK	29
3094	6mer-2-694	KDSIRK	22	3394	6mer-2-994	KYCIKK	41
3095	6mer-2-695	KCWWRR	28	3395	6mer-2-995	KFWEKK	38
3096	6mer-2-696	KFTKKK	20	3396	6mer-2-996	RHDARK	40
3097	6mer-2-697	KCAVKK	19	3397	6mer-2-997	KISFKK	30
3098	6mer-2-698	KCEDKK	27	3398	6mer-2-998	KEMWKK	43
3099	6mer-2-699	KNAGKR	23	3399	6mer-2-999	RATIKR	31
3100	6mer-2-700	RPWHKK	15	3400	6mer-2-1000	KCHDKK	41
3101	6mer-2-701	KTWAKR	23	3401	6mer-2-1001	RKKFKK	37
3102	6mer-2-702	KEMIKR	18	3402	6mer-2-1002	RCNDKR	42
3103	6mer-2-703	RTMHKR	14	3403	6mer-2-1003	KPEWKR	42
3104	6mer-2-704	KDWHRK	20	3404	6mer-2-1004	RDTHKR	38
3105	6mer-2-705	RENFKK	11	3405	6mer-2-1005	RFKARR	23

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3106	6mer-2-706	KFTDRK	23	3406	6mer-2-1006	RATMRR	30
3107	6mer-2-707	RTWKRK	21	3407	6mer-2-1007	RHTNKK	42
3108	6mer-2-708	RAWVKK	29	3408	6mer-2-1008	RAWKKR	38
3109	6mer-2-709	RIWPKR	31	3409	6mer-2-1009	KINPRK	34
3110	6mer-2-710	RNKKKK	14	3410	6mer-2-1010	RANHKK	36
3111	6mer-2-711	KECGRR	29	3411	6mer-2-1011	RAEFRR	22
3112	6mer-2-712	KIPHRR	29	3412	6mer-2-1012	KASAKK	30
3113	6mer-2-713	RASWRR	24	3413	6mer-2-1013	KPPDKR	23
3114	6mer-2-714	KIDVRK	30	3414	6mer-2-1014	RPPMRR	34
3115	6mer-2-715	RATHRK	32	3415	6mer-2-1015	RDEMKR	29
3116	6mer-2-716	RTWKKR	18	3416	6mer-2-1016	RNEEKR	41
3117	6mer-2-717	KCPGKR	15	3417	6mer-2-1017	RAPVRR	40
3118	6mer-2-718	KYTFKR	12	3418	6mer-2-1018	RPTKKK	24
3119	6mer-2-719	KIKPRR	29	3419	6mer-2-1019	RNTWKK	23
3120	6mer-2-720	RATNRK	29	3420	6mer-2-1020	KHDKKR	21
3121	6mer-2-721	RHSKKK	26	3421	6mer-2-1021	RYTPKR	39
3122	6mer-2-722	RNEHRR	21	3422	6mer-2-1022	KCNPRR	22
3123	6mer-2-723	KEDMKR	23	3423	6mer-2-1023	KAEFKR	26
3124	6mer-2-724	KYTMKK	24	3424	6mer-2-1024	RFHNKR	37
3125	6mer-2-725	KAHMKK	25	3425	6mer-2-1025	RCSHRR	39
3126	6mer-2-726	KHHKKK	25	3426	6mer-2-1026	KENHRK	33

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3127	6mer-2-727	RDMIKR	11	3427	6mer-2-1027	KTPVKK	32
3128	6mer-2-728	RMTMKK	23	3428	6mer-2-1028	KPEHRR	41
3129	6mer-2-729	RCPDKR	30	3429	6mer-2-1029	KEEFKK	40
3130	6mer-2-730	RNTHKR	26	3430	6mer-2-1030	RAPFKK	28
3131	6mer-2-731	KASWKK	19	3431	6mer-2-1031	RAWERK	33
3132	6mer-2-732	KPTWRK	24	3432	6mer-2-1032	KETVKR	31
3133	6mer-2-733	RTPARK	29	3433	6mer-2-1033	KMDEKK	28
3134	6mer-2-734	KHCHRR	17	3434	6mer-2-1034	KHSWRR	38
3135	6mer-2-735	KMNAKK	21	3435	6mer-2-1035	RPPVKK	39
3136	6mer-2-736	KNNHKK	29	3436	6mer-2-1036	KAKNKR	25
3137	6mer-2-737	KDSVRR	19	3437	6mer-2-1037	KIHWKK	26
3138	6mer-2-738	KPWFKK	29	3438	6mer-2-1038	KHWERK	33
3139	6mer-2-739	RIHAKK	17	3439	6mer-2-1039	RNHFRK	26
3140	6mer-2-740	KIDIRR	12	3440	6mer-2-1040	KYAWRK	36
3141	6mer-2-741	KNEKKR	30	3441	6mer-2-1041	RACDKR	22
3142	6mer-2-742	KNNWRR	32	3442	6mer-2-1042	KKMFRK	36
3143	6mer-2-743	KHTMKR	18	3443	6mer-2-1043	RDKGKK	40
3144	6mer-2-744	KDHPRK	19	3444	6mer-2-1044	KHTDKK	41
3145	6mer-2-745	KNTERR	17	3445	6mer-2-1045	RHAHRR	41
3146	6mer-2-746	RIKVRK	26	3446	6mer-2-1046	RNSEKR	39
3147	6mer-2-747	RANFRR	29	3447	6mer-2-1047	RHDDKR	28

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3148	6mer-2-748	RFDKKR	28	3448	6mer-2-1048	RIHNRK	22
3149	6mer-2-749	KMWKRK	20	3449	6mer-2-1049	KMSPRR	26
3150	6mer-2-750	RKCVKR	29	3450	6mer-2-1050	KPPPRK	26
3151	6mer-2-751	RPHWKR	12	3451	6mer-2-1051	RKHMRR	24
3152	6mer-2-752	KINWRR	29	3452	6mer-2-1052	KAPARK	23
3153	6mer-2-753	RYEHRR	18	3453	6mer-2-1053	KEMGKK	34
3154	6mer-2-754	KADGRR	12	3454	6mer-2-1054	KKNKKR	43
3155	6mer-2-755	RYNDKK	18	3455	6mer-2-1055	KPDFKR	30
3156	6mer-2-756	KPTNRK	26	3456	6mer-2-1056	RNDERK	22
3157	6mer-2-757	RIPNKR	19	3457	6mer-2-1057	RKKKKK	25
3158	6mer-2-758	RFSFKK	18	3458	6mer-2-1058	RMPWKK	24
3159	6mer-2-759	RFDEKK	18	3459	6mer-2-1059	RFADRR	35
3160	6mer-2-760	KIPVKK	15	3460	6mer-2-1060	KTNERK	35
3161	6mer-2-761	RTEPRK	29	3461	6mer-2-1061	KPPIKK	38
3162	6mer-2-762	KFEERK	24	3462	6mer-2-1062	KYNIRK	35
3163	6mer-2-763	KMKERR	19	3463	6mer-2-1063	RFNVRK	24
3164	6mer-2-764	RNAVKK	31	3464	6mer-2-1064	RCMKRR	39
3165	6mer-2-765	KHSPRK	23	3465	6mer-2-1065	RIANRK	27
3166	6mer-2-766	RPTFRK	23	3466	6mer-2-1066	KPEHKR	29
3167	6mer-2-767	RICGRK	13	3467	6mer-2-1067	RDEIRK	29
3168	6mer-2-768	KYMGRK	22	3468	6mer-2-1068	RIHVKK	26

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3169	6mer-2-769	RCPFRK	13	3469	6mer-2-1069	KHDMKK	36
3170	6mer-2-770	KPNMKK	24	3470	6mer-2-1070	RPHVRR	31
3171	6mer-2-771	KITARR	26	3471	6mer-2-1071	RTTWRK	25
3172	6mer-2-772	RHPAKK	15	3472	6mer-2-1072	KPHWKR	29
3173	6mer-2-773	KPDARR	11	3473	6mer-2-1073	KYSWRK	24
3174	6mer-2-774	KFDARK	17	3474	6mer-2-1074	RPMGRK	33
3175	6mer-2-775	KMSMKK	26	3475	6mer-2-1075	RHMERK	31
3176	6mer-2-776	RFPWRK	12	3476	6mer-2-1076	RYCIRR	34
3177	6mer-2-777	KNDVRR	31	3477	6mer-2-1077	KMTIKK	34
3178	6mer-2-778	RNAPKK	21	3478	6mer-2-1078	KDTFRR	40
3179	6mer-2-779	KAAHRR	13	3479	6mer-2-1079	KCNEKK	40
3180	6mer-2-780	KITIRK	31	3480	6mer-2-1080	RKHKKK	23
3181	6mer-2-781	KTMNRK	28	3481	6mer-2-1081	KYKMRR	32
3182	6mer-2-782	KPWPKR	18	3482	6mer-2-1082	KYTERR	31
3183	6mer-2-783	RDMVRK	32	3483	6mer-2-1083	KTKGKR	39
3184	6mer-2-784	KAEWRK	26	3484	6mer-2-1084	REKPRK	29
3185	6mer-2-785	RHCHRR	31	3485	6mer-2-1085	RPEIRK	42
3186	6mer-2-786	RMEMRK	30	3486	6mer-2-1086	KNDWRK	21
3187	6mer-2-787	RIWHKK	19	3487	6mer-2-1087	KEEMRR	21
3188	6mer-2-788	KKEKKK	30	3488	6mer-2-1088	RPCEKK	39
3189	6mer-2-789	KNENRK	24	3489	6mer-2-1089	RKTDRR	43

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3190	6mer-2-790	RCAGRR	23	3490	6mer-2-1090	KEMHKK	33
3191	6mer-2-791	KNMNRK	27	3491	6mer-2-1091	RFDNKR	31
3192	6mer-2-792	RAEDKR	13	3492	6mer-2-1092	RAKFRR	21
3193	6mer-2-793	RMHKKR	29	3493	6mer-2-1093	KTTDKK	43
3194	6mer-2-794	KAEMRR	19	3494	6mer-2-1094	KAWERK	43
3195	6mer-2-795	RTHNKR	16	3495	6mer-2-1095	KYSMRR	39
3196	6mer-2-796	RMMARR	32	3496	6mer-2-1096	RANVKR	39
3197	6mer-2-797	RHCIKR	19	3497	6mer-2-1097	RFWEKK	23
3198	6mer-2-798	RDTPKK	17	3498	6mer-2-1098	KHPKRR	28
3199	6mer-2-799	KCSAKK	13	3499	6mer-2-1099	REDWRR	21
3200	6mer-2-800	RTAWKK	11	3500	6mer-2-1100	RTAPKK	24
3201	6mer-2-801	RPNIRK	24	3501	6mer-2-1101	RTKMRR	38
3202	6mer-2-802	KETKRR	24	3502	6mer-2-1102	KHKGKR	32
3203	6mer-2-803	RNKERK	18	3503	6mer-2-1103	RDAWRK	42
3204	6mer-2-804	RNCGKR	21	3504	6mer-2-1104	RYTKKR	38
3205	6mer-2-805	RDTMKK	12	3505	6mer-2-1105	RNNAKK	28
3206	6mer-2-806	KHCVRK	30	3506	6mer-2-1106	KDKVKR	28
3207	6mer-2-807	KIWNRK	28	3507	6mer-2-1107	RAHERK	29
3208	6mer-2-808	RKKFKK	21	3508	6mer-2-1108	KKKVRR	36
3209	6mer-2-809	REPWRR	18	3509	6mer-2-1109	KEDMRK	26
3210	6mer-2-810	KHAKKK	18	3510	6mer-2-1110	RMTKKK	37

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3211	6mer-2-811	KAMKRK	16	3511	6mer-2-1111	REDEKK	23
3212	6mer-2-812	KPPEKR	33	3512	6mer-2-1112	RASWRK	26
3213	6mer-2-813	KKMDRR	29	3513	6mer-2-1113	KPNFRK	43
3214	6mer-2-814	RYMERK	28	3514	6mer-2-1114	RKKFRK	34
3215	6mer-2-815	KICGRK	30	3515	6mer-2-1115	KYSPRK	39
3216	6mer-2-816	RKMGKR	15	3516	6mer-2-1116	KMEVKK	31
3217	6mer-2-817	KCNDKK	22	3517	6mer-2-1117	RMHVKR	21
3218	6mer-2-818	KTPERK	13	3518	6mer-2-1118	RFDGRR	42
3219	6mer-2-819	KFSVRR	23	3519	6mer-2-1119	KCTVRK	39
3220	6mer-2-820	RPNNKK	24	3520	6mer-2-1120	RDMMKK	28
3221	6mer-2-821	RPTMKR	33	3521	6mer-2-1121	KPSKRR	21
3222	6mer-2-822	RCTAKK	13	3522	6mer-2-1122	RCNFKK	22
3223	6mer-2-823	REDWRK	25	3523	6mer-2-1123	RITARR	36
3224	6mer-2-824	RITNKR	26	3524	6mer-2-1124	RKTWRK	39
3225	6mer-2-825	KIHARK	11	3525	6mer-2-1125	RDAFKK	30
3226	6mer-2-826	RNTPRK	11	3526	6mer-2-1126	RHEVRR	23
3227	6mer-2-827	KYAEKK	13	3527	6mer-2-1127	KAAEKK	42
3228	6mer-2-828	RMKKKR	32	3528	6mer-2-1128	KNCMRK	36
3229	6mer-2-829	KKKIRR	22	3529	6mer-2-1129	RITGKR	42
3230	6mer-2-830	RMKFKR	21	3530	6mer-2-1130	RHSFRK	29
3231	6mer-2-831	RMTWRK	29	3531	6mer-2-1131	RTNAKR	26

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3232	6mer-2-832	KYHNRR	32	3532	6mer-2-1132	RPWERR	32
3233	6mer-2-833	RKTWRR	14	3533	6mer-2-1133	KMKMKK	22
3234	6mer-2-834	RFWWKR	28	3534	6mer-2-1134	KYENRK	30
3235	6mer-2-835	RHCGKR	20	3535	6mer-2-1135	RANWKR	29
3236	6mer-2-836	KNTMKR	26	3536	6mer-2-1136	KMKKKR	36
3237	6mer-2-837	REDFRR	32	3537	6mer-2-1137	RTDFKR	22
3238	6mer-2-838	RCTVRK	13	3538	6mer-2-1138	KAHFKK	42
3239	6mer-2-839	KNHNRR	32	3539	6mer-2-1139	KAKAKK	39
3240	6mer-2-840	KDWDRK	15	3540	6mer-2-1140	KMNKKR	29
3241	6mer-2-841	KPNHRK	33	3541	6mer-2-1141	KCTGKR	32
3242	6mer-2-842	KPKMRR	22	3542	6mer-2-1142	KKAMKR	30
3243	6mer-2-843	KAPDRK	33	3543	6mer-2-1143	KACIKK	42
3244	6mer-2-844	RDPKKK	22	3544	6mer-2-1144	RFEDRK	39
3245	6mer-2-845	KMKEKR	14	3545	6mer-2-1145	RIKNRR	23
3246	6mer-2-846	RFSFKR	30	3546	6mer-2-1146	REWGRK	32
3247	6mer-2-847	RYCHKR	22	3547	6mer-2-1147	KFMKKK	35
3248	6mer-2-848	RMTERK	29	3548	6mer-2-1148	KEKGKR	34
3249	6mer-2-849	RNTAKK	13	3549	6mer-2-1149	KIDFRR	21
3250	6mer-2-850	KTSMKR	16	3550	6mer-2-1150	KTDVKK	42
3251	6mer-2-851	KFWWRR	19	3551	6mer-2-1151	RYPVRK	43
3252	6mer-2-852	RNCERR	28	3552	6mer-2-1152	RNWAKK	37

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3253	6mer-2-853	KHTGRR	29	3553	6mer-2-1153	KHKPKR	27
3254	6mer-2-854	RCNWKR	23	3554	6mer-2-1154	RYEARR	30
3255	6mer-2-855	REMIKR	19	3555	6mer-2-1155	RNTNRK	25
3256	6mer-2-856	KEPMRR	14	3556	6mer-2-1156	KMNARR	35
3257	6mer-2-857	KHTEKK	20	3557	6mer-2-1157	RNTDRK	37
3258	6mer-2-858	KEEHRR	30	3558	6mer-2-1158	RDNIRK	37
3259	6mer-2-859	RMDFRK	21	3559	6mer-2-1159	KDMGKR	40
3260	6mer-2-860	KPNFRR	31	3560	6mer-2-1160	RITVKK	23
3261	6mer-2-861	KDTDRK	21	3561	6mer-2-1161	RHSFKK	27
3262	6mer-2-862	RHTFKK	29	3562	6mer-2-1162	KMSERR	34
3263	6mer-2-863	RKHWRR	17	3563	6mer-2-1163	KCHFKK	37
3264	6mer-2-864	RKCAKK	12	3564	6mer-2-1164	RYNHKR	33
3265	6mer-2-865	RHCNRK	16	3565	6mer-2-1165	RIKAKK	30
3266	6mer-2-866	RDNPKK	24	3566	6mer-2-1166	KCSIKK	26
3267	6mer-2-867	KYWEKK	32	3567	6mer-2-1167	RCAPKR	27
3268	6mer-2-868	RTPNRR	30	3568	6mer-2-1168	KMKPKK	41
3269	6mer-2-869	RHDHKR	18	3569	6mer-2-1169	KICERK	21
3270	6mer-2-870	KMTEKK	21	3570	6mer-2-1170	KFTIRR	25
3271	6mer-2-871	REMPKR	31	3571	6mer-2-1171	KMPARR	40
3272	6mer-2-872	KTHFRK	28	3572	6mer-2-1172	KNCERR	36
3273	6mer-2-873	KNWGRR	11	3573	6mer-2-1173	KCCNKK	38

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3274	6mer-2-874	KIHFRK	33	3574	6mer-2-1174	RCEPRK	21
3275	6mer-2-875	RIDHRK	13	3575	6mer-2-1175	RYSKRR	34
3276	6mer-2-876	KEDNKR	17	3576	6mer-2-1176	RYTEKK	43
3277	6mer-2-877	KPPERR	17	3577	6mer-2-1177	RASEKR	41
3278	6mer-2-878	KETVRR	24	3578	6mer-2-1178	KTTVRK	30
3279	6mer-2-879	RTMDRR	19	3579	6mer-2-1179	KACVKK	34
3280	6mer-2-880	RTHHKK	12	3580	6mer-2-1180	RAANRR	34
3281	6mer-2-881	KDTEKK	33	3581	6mer-2-1181	KACWKR	32
3282	6mer-2-882	RTPAKR	15	3582	6mer-2-1182	RHNDKR	30
3283	6mer-2-883	RTNEKR	22	3583	6mer-2-1183	RENNRK	35
3284	6mer-2-884	KMTMKK	11	3584	6mer-2-1184	KFWVRR	22
3285	6mer-2-885	KCMVRR	17	3585	6mer-2-1185	RIDAKK	42
3286	6mer-2-886	KTWVRR	13	3586	6mer-2-1186	KEKFRR	27
3287	6mer-2-887	RCPKKR	18	3587	6mer-2-1187	RTADRK	36
3288	6mer-2-888	RIAKRK	17	3588	6mer-2-1188	RAPARR	22
3289	6mer-2-889	REWDKK	12	3589	6mer-2-1189	KTAPKK	40
3290	6mer-2-890	RDNPKR	30	3590	6mer-2-1190	KACIRR	32
3291	6mer-2-891	RTSIRK	28	3591	6mer-2-1191	KKADRK	35
3292	6mer-2-892	KDENRK	27	3592	6mer-2-1192	KHKNKR	40
3293	6mer-2-893	REHVRR	17	3593	6mer-2-1193	REKIRR	43
3294	6mer-2-894	RFHWRR	22	3594	6mer-2-1194	KYCDRK	35

(continued)

6mer-2 Bottom sequence							
SEQ ID NO:	Unique No.	Sequence	Binding affinity	SEQ ID NO:	Unique No.	Sequence	Binding affinity
3295	6mer-2-895	KYMAKK	28	3595	6mer-2-1195	KMTERK	25
3296	6mer-2-896	RTCARR	30	3596	6mer-2-1196	RESKKR	39
3297	6mer-2-897	RPAHKK	17	3597	6mer-2-1197	KNCIKK	23
3298	6mer-2-898	KKKDKK	16	3598	6mer-2-1198	RMSHRR	27
3299	6mer-2-899	KKMVKR	13	3599	6mer-2-1199	RCTNKR	27
3300	6mer-2-900	RFSAKK	11	3600	6mer-2-1200	RHHNRR	30
Average Binding affinity							27.07

[0111] According to Table 8, the binding affinity for acetylcholine receptor of SEQ ID NO: 73, 5mer-73, with the sequence RRQRR, was significantly higher than other 5mers (binding affinity of 179). Consequently, extended 6mer sequences XRRQRR and RRQRRX were created based on SEQ ID NO: 73 to check the binding affinity for acetylcholine receptor, and the results are presented as relative value to the RRQRR sequence in Table 14.

TABLE 14

XRRQRR-6mer			RRQRRX-6mer		
SEQ ID NO:	Sequence	Binding affinity	SEQ ID NO:	Sequence	Binding affinity
3601	GRRQRR	132	3 621	RRQRRG	109
3602	ARRQRR	129	3622	RRQRRA	113
3603	VRRQRR	135	3623	RRQRRV	120
3604	CRRQRR	123	3624	RRQRRC	126
3605	PRRQRR	133	3625	RRQRRP	137
3606	LRRQRR	144	3626	RRQRRL	141
3607	IRRQRR	121	3627	RRQRRI	133
3608	MRRQRR	119	3628	RRQRRM	122
3609	WRRQRR	138	3629	RRQRRW	129
3610	FRRQRR	143	3630	RRQRRF	132
3611	SRRQRR	121	3631	RRQRRS	113
3612	TRRQRR	103	3632	RRQRRT	117
3613	YRRQRR	130	3633	RRQRRY	105
3614	NRRQRR	113	3634	RRQRRN	109
3615	QRRQRR	105	3635	RRQRRQ	101
3616	KRRQRR	173	3636	RRQRRK	175
3617	RRRQRR	189	3637	RRQRRR	192
3618	HRRQRR	164	3638	RRQRRH	158

(continued)

XRRQRR-6mer			RRQRRX-6mer		
SEQ ID NO:	Sequence	Binding affinity	SEQ ID NO:	Sequence	Binding affinity
3619	DRRQRR	63	3639	RRQRRD	65
3620	ERRQRR	47	3640	RRQRRE	37

[0112] As shown in Table 14, most sequences of XRRQRR and RRQRRX, which are both extended sequences of RRQRR, had high binding affinity for acetylcholine receptor.

[0113] Furthermore, the binding affinity of SEQ ID NO: 1410, 6mer-1-210, with the sequence RRGVRR for the acetylcholine receptor was very high compared to other 6mers (binding affinity of 184). Therefore, the extended 7mer sequences XRRGVRR and RRGVRRX were created based on SEQ ID NO: 1410 to check binding affinity for acetylcholine receptor, and the results are presented as values relative to the RRGVRR sequence in Table 15.

TABLE 15

XRRGVRR-7mer			RRGVRRX-7mer		
SEQ ID NO:	Sequence	Binding affinity	SEQ ID NO:	Sequence	Binding affinity
3641	GRRGVRR	137	3661	RRGVRRG	105
3642	ARRGVRR	134	3662	RRGVRRA	118
3643	VRRGVRR	140	3663	RRGVRRV	149
3644	CRRGVRR	128	3664	RRGVRRC	131
3645	PRRGVRR	138	3665	RRGVRRP	142
3646	LRRGVRR	149	3666	RRGVRRL	146
3647	IRRGVRR	126	3667	RRGVRRI	138
3648	WRRGVRR	124	3668	RRGVRRM	127
3649	WRRGVRR	134	3669	RRGVRRW	134
3650	FRRGVRR	139	3670	RRGVRRF	137
3651	SRRGVRR	117	3671	RRGVRRS	118
3652	TRRGVRR	105	3672	RRGVRRT	113
3653	YRRGVRR	145	3673	RRGVRRY	101
3654	NRRGVRR	109	3674	RRGVRRN	105
3655	QRRGVRR	101	3675	RRGVRRQ	105
3656	KRRGVRR	169	3676	RRGVRRK	171
3657	RRRGVRR	185	3677	RRGVRRR	188
3658	HRRGVRR	160	3678	RRGVRRH	154
3659	DRRGVRR	59	3679	RRGVRRD	61
3660	ERRGVRR	43	3680	RRGVRRE	33

[0114] As shown in Table 15, most sequences of XRRGVRR and RRGVRRX, which are both extended sequences of RRGVRR, had very high binding affinity for acetylcholine receptor.

<EXAMPLE 7. Comparison of Binding Affinity between Top 2 Peptides in Each Library and Positive Control >

[0115] Representative peptides identified in Example 6, two in each library, including 5mers (73, 311) and 6mers-1 (43, 210) and 6mers-2 (136, 233), were compared with the pre-optimized 6mer, 5mer-ND, and Synake. The results are presented in Table 16 and FIG. 8. As can be seen in Table 16 and FIG. 8, the optimized shortened peptides of 5mer

and 6mer for XYZ in Example 6 exhibited higher binding affinity for acetylcholine receptor than the pre-optimized ESP-2 short peptides as well as Synake.

[0116] Of the optimized shortened peptides, 6mer-1-43 peptide was measured for binding affinity, and the measurement is shown in FIG. 9. The affinity of 6mer-1-43 peptide according to the present disclosure for acetylcholine receptor was 609 nM.

TABLE 16

No.	Name	Sequence	Binding affinity (RU)
1	5mer-ND	KSLLR	23
2	Synake	-	14
3	5mer-73	RRQRR	179
4	5mer-311	RSYSR	167
5	Spep 6mer	RKSLLR	35
6	6mer-1-43	RKRIRR	548
7	6mer-1-210	RRGVRR	184
8	6mer-2-136	RWRYKR	194
9	6mer-2-233	KWRQKR	190

<EXAMPLE 8. Acetylcholine Receptor Inhibition by Six Peptides with High Binding Affinity>

[0117] The 5mer (73, 311), 6mer-1 (43, 210), and 6mer-2 (136, 233) peptides, which were confirmed to have excellent binding affinity for AchR in Example 5, were examined for inhibitory effects on AchR action.

[0118] Acetylcholine receptor-overexpressing TE671 cells were cultured at 37°C in DMEM medium supplemented with 10% FBS and 1% P/S under 5% CO2. After the TE671 cells were sufficiently grown for 4 days, the cells were detached using trypsin and the cell culture was plated in an amount of 1 ml at a density of 2×104 cells/well into 12-well cell culture plate with an 18mm cover-slip lined therein, and cultured for 4 days.

[0119] The cover-slip on which the cells had grown was transferred to a fresh 12-well cell culture plate, and 997 μl of HBSS buffer and 3 μl of Fura-2-AM were added and gently mixed, followed by incubation at 37°C, 5% CO2 for 15 minutes. After incubation, the remaining Fura-2-AM was removed by washing 3-4 times with 1 ml of HBSS buffer, and an additional 1 ml was added. The cover-slip with the grown cells was placed in a chamber, and 500 μl of HBSS buffer was dispensed. The final concentration of nicotine was adjusted to 400 μM to observe the calcium imaging reaction. Then, while keeping the nicotine concentration fixed, the concentration of the sample was adjusted to find the inhibiting concentration. Synake was used as a control and the results are presented in FIGS. 10-13.

[0120] As shown in FIGS. 10-13, Synake inhibited acetylcholine receptors at 500 μM, while the precursor peptide 11mer did at 5 μM. Meanwhile, the optimized shortened peptides according to the present disclosure, 5mer (73, 311), 6mer-1 (43, 210), and 6mer-2 (136, 233), were found to exhibit inhibition at 10 μM. These newly discovered 6mer peptides showed similar inhibitory ability to the precursor 11mer peptide while being approximately 100 times more potent on average than Synake, and the 5mer peptides showed about 33 times more potent inhibitory ability.

<EXAMPLE 9. Assay for Acetylcholine Receptor Inhibition by Modifying Peptide Terminal >

[0121] The terminals of the optimized shortened peptides according to the present disclosure were modified with palmitate to examine inhibitory ability against the acetylcholine receptor. The inhibitory ability of the Palmitate-6mer-1-43 and Palmitate-5mer-73 peptides on the acetylcholine receptor was examined in the same manner as in Example 6. As a result, the peptides exhibited 100% inhibition at 1μM, and the measurements are presented in FIGS. 14 and 15. Additionally, the inhibitory ability (IC50) of the optimized short peptides and the palmitate-modified peptides according to the present disclosure against acetylcholine receptor was compared with Synake and is depicted in FIG. 16. As shown in FIGS. 14 to 16, when the termini of the optimized shortened peptides were modified with palmitate, there was a significant increase in inhibitory ability on the acetylcholine receptor compared to the unmodified shortened peptides.

<EXAMPLE 10. Assay for Cytotoxicity of Optimized Short Peptides>

[0122] The optimized shortened peptides according to the present disclosure were assayed for cytotoxicity. In this

regard, the cytotoxicity was assessed by the MTT [(3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] method using dermal fibroblast cells isolated from human skin. The pre-cultured cells were seeded at a concentration of 1×105 cells/mL in a 24-well plate and cultured for 18 hours. Subsequently, the medium was removed and the diluted sample was added to the medium free of FBS and incubated for 24 hours, after which the medium was removed and MTT solution was added at a concentration of 1 ug/mL and reacted for 3 hours. Unreacted MTT was removed, and DMSO 100 μL was added to dissolve the formed formazan, and the absorbance at 540 nm was read on an ELISA reader.

[0123] As shown in FIG. 17, the cytotoxicity levels of the 6mer-1-43 (6mer peptide), 5mer-73 (5mer peptide), Pal-6mer-1-43, AND Pal-5mer-73 peptides on dermal fibroblast cells were measured using the MTT method, and all the peptides were evaluated as non-toxic at concentrations ranging from 100nM to 100μM.

<EXAMPLE 11. Analysis of Skin Permeability According to Peptide Length>

[0124] Using the Franz diffusion cell system, comparison was made of skin permeability between the precursor peptide, 11mer, and the optimized shortened peptides of the present disclosure.

[0125] To the receptor chamber of the Franz diffusion cell system was added 5ml of PBS (pH 7.4 containing 0.05% polysorbate 80), followed by insertion of one or two sheets of cellulose acetate membrane, which acts as artificial skin, between the receptor and donor chambers. After fixation of the chambers, the existing 11mer and optimized 5mer-73 (RRQRR) peptides were added to the donor chamber of the Franz cell. The receptor chamber was controlled to have the condition of 37°C and 600 rpm, and samples were collected every 0.5, 1, 2, 4, 8, 12, 18, and 24 hours in 500 μl quantities to measure the amount of drug that permeated through the skin over time using HPLC, and the results were displayed in FIG. 18. As seen in FIG. 18, the skin permeability of the optimized short peptide, 5mer, according to the present disclosure was confirmed to be 66.87% after 8 hours, whereas the 11mer did not permeate at all.

[0126] As above, the optimized shortened 5mer peptides of the present disclosure showed a similar acetylcholine receptor inhibitory activity to the 11mer peptide, which had shown excellent inhibitory effects on acetylcholine receptors in previous research, but dramatically increased in skin permeability and significantly decreased in production cost due to its shortened length to the half of the original length.

<EXAMPLE 12. Clinical Evaluation of Efficacy of Peptide Cosmetic Formulation on Eye Wrinkles>

[0127] The clinical efficacy of the optimized shortened peptides according to the present disclosure on eye skin wrinkles was evaluated. Test products containing the optimized shortened peptides of the present disclosure and a control group were manufactured as described in Table 17, and human application tests were conducted. Twenty-one participants who met the selection criteria and did not fall under any exclusion criteria were recruited, and after one withdrew their consent to participate, the final number of participants was 20. All measurements were taken after the participants had rested for at least 30 minutes under constant temperature and humidity conditions (22±2°C, 50±10% RH) without direct sunlight or air movement. Selected participants visited the clinical institution before using the product (week 0) to measure eye skin texture (wrinkles) and conduct demographic surveys. They applied the test product twice daily (morning and evening) for 6 weeks and revisited the clinical institution at weeks 3 and 6 after using the product for evaluation under the same conditions as week 0.

TABLE 17

No	TRADE NAME	INCI NAME	시험제품 WT%	대조군 WT%
1	Distilled water1	WATER	50~80	50~80
2	Adenosine	Adenosine	0.01~0.1	0.01~0.1
3	PANTHENOL	PANTHENOL	0.1~1.0	0.1~1.0
4	KMO-6	1,2-Hexandiol	1~5	1~5
5	1,3 BG	BUTYLENE GLYCOL	2~8	2~8
6	DPG-FC	DIPROPYLENE GLYCOL	2~8	2~8
7	GLYCERINE	GLYCERIN	3~15	3~15
8	Viscomate NP 700	SODIUM POLYACRYA|LATE	0.01~0.1	0.01~0.1
9	KELTROL F	XANTHAN GUM	0.1~1.0	0.1~1.0
10	SIMULGEL NS	Hydroxyethyl Acrylate / Sodium	1~5	1~5

(continued)

No	TRADE NAME	INCI NAME	시험제품 WT%	대조군 WT%
11	Na-HYALURONATE	Sodium Hyaluronate	0.5~5.0	0.5~5.0
12	Glucan Real	Beta-Glucan	0.5~5.0	0.5~5.0
13	Peptide	-	Suitable amount	-
14	Perfume	Fragrance	Suitable amount	Suitable amount

[0128] The evaluation items included the overall size of wrinkle depth, and maximum depth, which were measured and analyzed for eye skin wrinkles using ANTERA 3D® CS (Miravex, Ireland), and the results were compared to those at week 0 and displayed in Table 18 and FIG. 19. The control group did not show any significant differences in all evaluation items.

TABLE 18]

Item	Week	Mean ± SD.	Change(%)	p -value
Overall size (AU)	0	21.536 ± 1.5225	-	-
	3	17.181 ± 1.0693	▼19.1	<0.001***
	6	14.600 ± 1.0447	▼31.5	<0.001***
Depth (mm)	0	0.075 ± 0.0048	-	-
	3	0.058 ± 0.0033	▼21.0	<0.001***
	6	0.051 ± 0.0027	▼30.1	<0.001***
Maximum depth (mm)	0	0.130 ± 0.0059	-	-
	3	0.111 ± 0.0066	▼14.2	<0.004***
	6	0.092 ± 0.0048	▼27.9	<0.001***

[0129] As shown in Table 18 and FIG. 19, the overall size of eye wrinkles decreased by 19.1% at week 3 ($p<0.001$) and 31.5% at week 6 ($p<0.001$) compared to before product use. Depth decreased by 21.0% at week 3 ($p<0.001$) and 30.1% at week 6 ($p<0.001$), and maximum depth decreased by 14.2% at week 3 ($p<0.001$) and 27.9% at week 6 ($p<0.001$) compared to before product use.

<EXAMPLE 13. Clinical Evaluation of Efficacy of Peptide Cosmetic Formulation on Skin Elasticity>

[0130] The clinical efficacy on skin elasticity (Ur/Ue) was evaluated in the same manner as in Example 12. The dermal density was measured using an ultrasound device, DUB® Skinscanner (tpm, Germany). The dermal density of the participants' cheeks was measured before product use (week 0), and at 3 and 6 weeks after product use, and the results were compared and presented in FIG. 20.

[0131] As shown in FIG. 20, skin elasticity (Ur/Ue) increased by 6.9% at week 3 ($p<0.001$) and 17.8% at week 6 ($p<0.001$) compared to before product use. The dermal density increased by 18.9% at 3 weeks ($p<0.001$) and 28.5% at 6 weeks ($p<0.001$) compared to before product use.

<Example 14. Clinical Evaluation of the Efficacy of Peptide Cosmetic Formulation on Forehead Wrinkles>

[0132] The clinical efficacy of the optimized short peptide cosmetic formulation according to the present disclosure on forehead wrinkles was evaluated. Forehead wrinkle areas were photographed using Antera 3D and DSLR before product use. Then, gauze (5cm×5cm) soaked with the test product and control group mentioned in Table 17 was applied to the forehead wrinkle area for 8 hours, after which the gauze was removed and the forehead wrinkle area was photographed again using Antera 3D and DSLR at 40 minutes and 2 hours and 40 minutes post removal, and the results are displayed in Figure 21.

[0133] As shown in FIG. 21, compared to before the removal of the product, a significant improvement in forehead wrinkles was observed, and the wrinkle improvement effect was maintained even after more than 2 hours.

Claims

1. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 1:

[Chemical Formula 1] (R/K) XXX (R/K)

(wherein R/K is arginine or lysine, X is any amino acid).

2. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 1-1:

[Chemical Formula 1-1] (R/K) XYZ (R/K)

(wherein R/K represents either arginine or lysine, and XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T).

3. The acetylcholine receptor-binding peptide of claim 2, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 1 to 600.

4. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 1-2:

[Chemical Formula 1-2] XRRQRR

(wherein R represents arginine, Q represents glutamine, and X represents any one amino acid).

5. The acetylcholine receptor-binding peptide of claim 4, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3601 to 3620.

6. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 1-3:

[Chemical Formula 1-3] RRQRRX

(wherein R represents arginine, Q represents glutamine, and X represents any one amino acid).

7. The acetylcholine receptor-binding peptide of claim 6, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3621 to 3640.

8. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 2:

[Chemical Formula 2] (R/K) (R/K) XXX (R/K)

(wherein R/K represents either arginine or lysine, and X represents any one amino acid).

9. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 2-1:

[Chemical Formula 2-1] (R/K) (R/K) XYZ (R/K)

(wherein R/K represents either arginine or lysine, XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T).

10. The acetylcholine receptor-binding peptide of claim 9, wherein the peptide comprises an amino acid sequence

selected from the group consisting of the amino acid sequences of SEQ ID NO: 1201 to 1800.

11. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 2-2:

[Chemical Formula 2-2] XRRGVRR

(wherein R represents arginine, G represents glycine, V represents valine, and X represents any one amino acid).

12. The acetylcholine receptor-binding peptide of claim 11, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3641 to 3660.

13. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 2-3:

[Chemical Formula 2-3] RRGVRRX

(wherein R represents arginine, G represents glycine, V represents valine, and X represents any one amino acid).

14. The acetylcholine receptor-binding peptide of claim 13, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 3661 to 3680.

15. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 3:

(R/K) XXX (R/K) (R/K)

(wherein R/K represents either arginine or lysine, and X represents any one amino acid).

16. An acetylcholine receptor-binding peptide, comprising the amino acid sequence represented by the following Chemical Formula 3-1:

[Chemical Formula 3-1] (R/K)XYZ(R/K)(R/K)

(wherein R/K represents either arginine or lysine, XYZ represents a sequence of any three consecutive amino acids, with X being an amino acid selected from R, Q, G, V, L, S, and W, Y being an amino acid selected from R, Q, L, I, F, V, and Y, and Z being an amino acid selected from R, S, L, C, Y, Q, and T).

17. The acetylcholine receptor-binding peptide of claim 16, wherein the peptide comprises an amino acid sequence selected from the group consisting of the amino acid sequences of SEQ ID NOS: 2401 to 3000.

18. The acetylcholine receptor-binding peptide of any one of claims 1 to 17, wherein the peptide has a modification to the N-terminus or C-terminus thereof.

19. The acetylcholine receptor-binding peptide of claim 18, the modification to the N-terminus or C-terminus is palmitoylation, acetylation, formylation, PEGylation, or conjugation with 2-mercaptoacetic acid, 3-mercaptopropionic acid, 6-mercaptohexanoic acid, pyroglutamic acid, succinimide acid, amide, cystramine, methyl ester, ethyl ester, benzyl ester, or a fatty acid, such as at least one selected from the group consisting of myristic acid, stearic acid, palmitic acid, cholesterol, 6-amino hexanoic acid, and 8-amino octanoic acid.

20. A polynucleotide, coding for the peptide of any one of claims 1 to 17.

21. A cosmetic composition for relief of skin wrinkles, comprising the peptide of any one of claims 1 to 17.

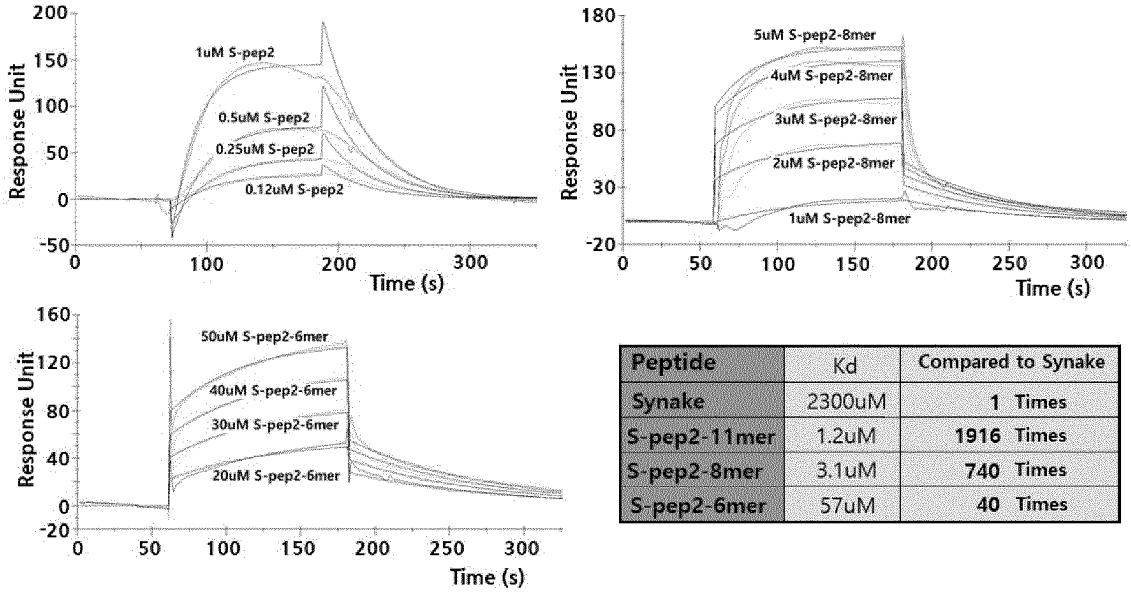
22. A composition for prevention or treatment of an acetylcholine receptor hyperactivity-associated disease, comprising the peptide of any one of claims 1 to 17.

23. The composition of claim 22, wherein the acetylcholine receptor hyperactivity-associated disease is at least one

selected from the group consisting of cervical dystonia, limb dystonia, truncal dystonia, blepharospasm, spasticity, hemifacial spasm, strabismus, nystagmus, tics, chronic pain, chronic migraine, neurogenic bladder, detrusor-sphincter dyssynergia, achalasia cardia, hyperhidrosis, neuropathic pain, skin wrinkles, square jaw, and sialorrhea.

24. The health functional food composition for alleviation of an acetylcholine receptor hyperactivity-associated disease, comprising the peptide of any one of claims 1 to 17.

25. A composition for a medical device, comprising the acetylcholine receptor-binding peptide of any one of claims 1 to 17.



Peptide	Kd	Compared to Synake
Synake	2300uM	1 Times
S-pep2-11mer	1.2uM	1916 Times
S-pep2-8mer	3.1uM	740 Times
S-pep2-6mer	57uM	40 Times

FIG. 1

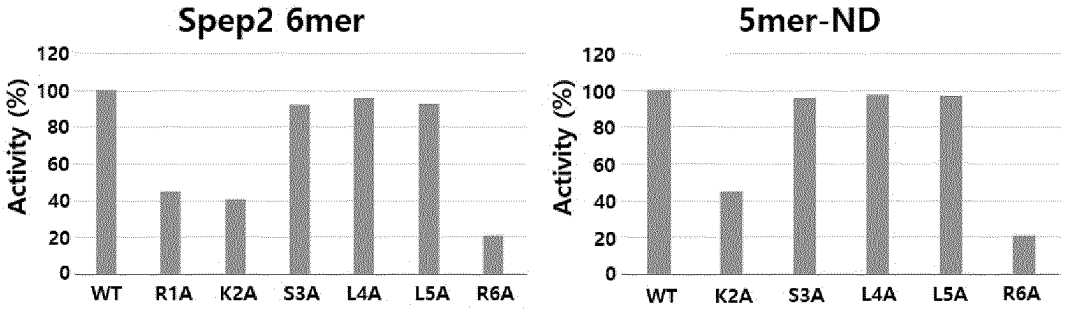


FIG. 2

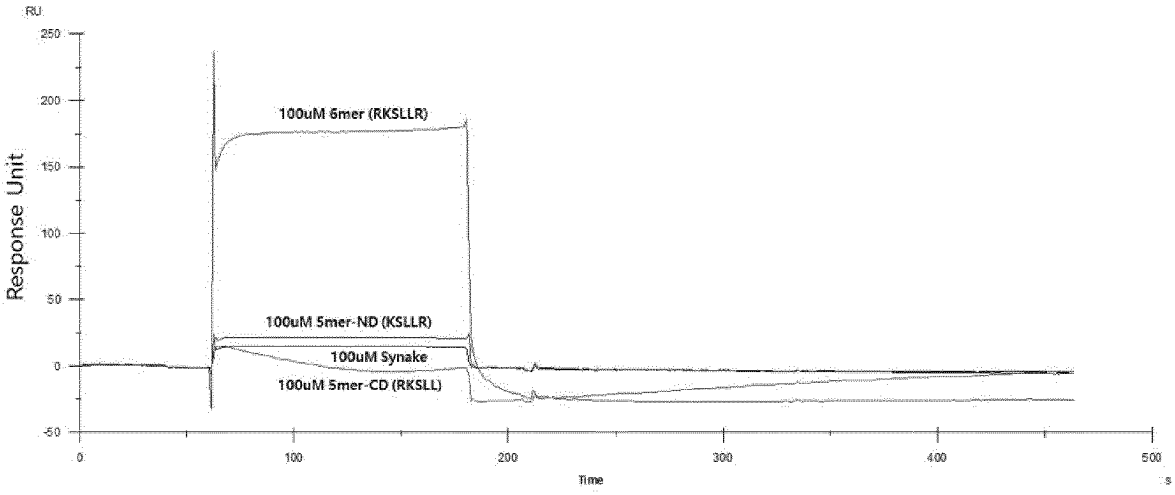


FIG. 3

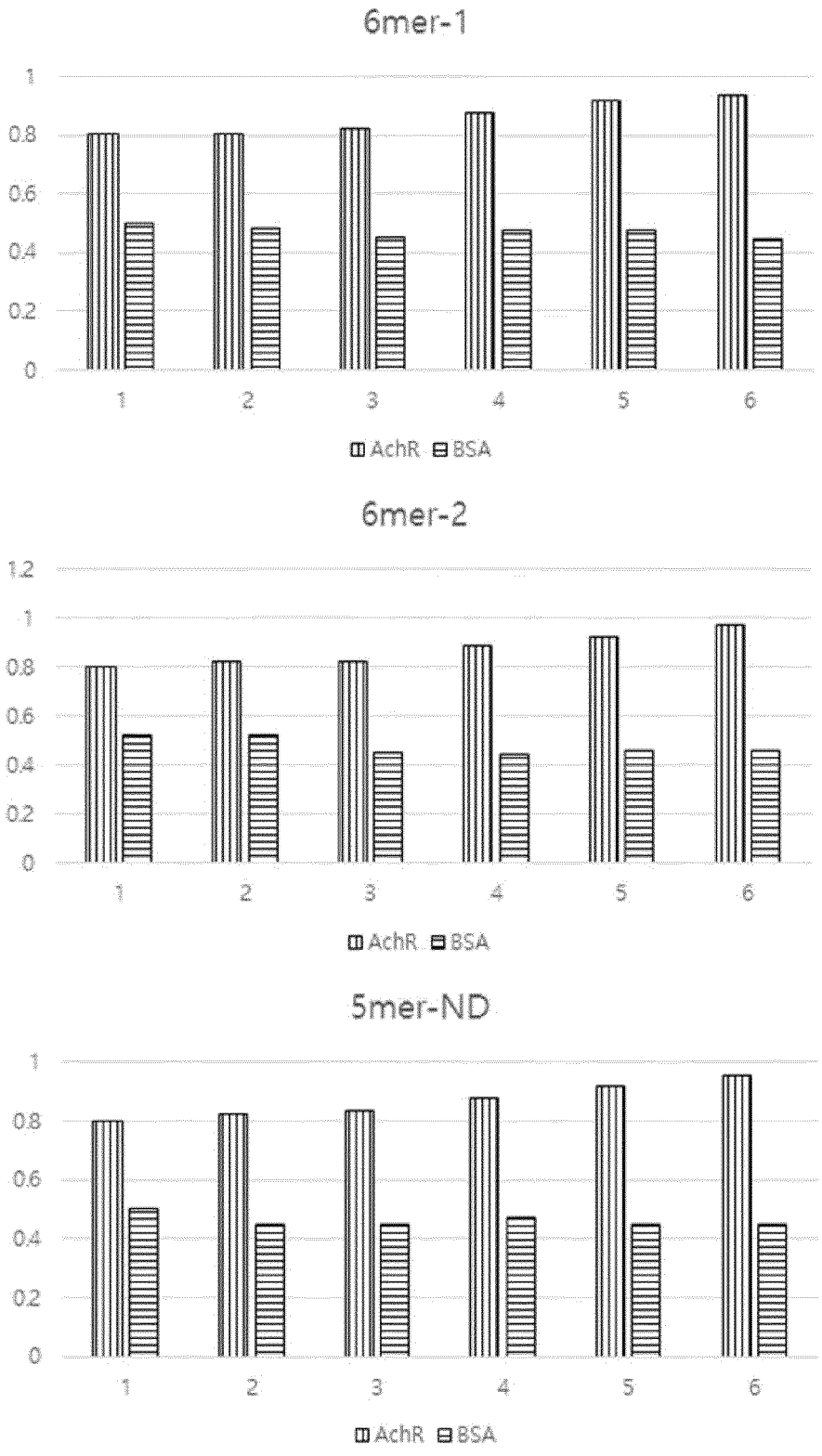

6mer-1
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
AchR
BSA
6mer-2
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
AchR
BSA
5mer-ND
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
AchR
BSA

FIG. 4

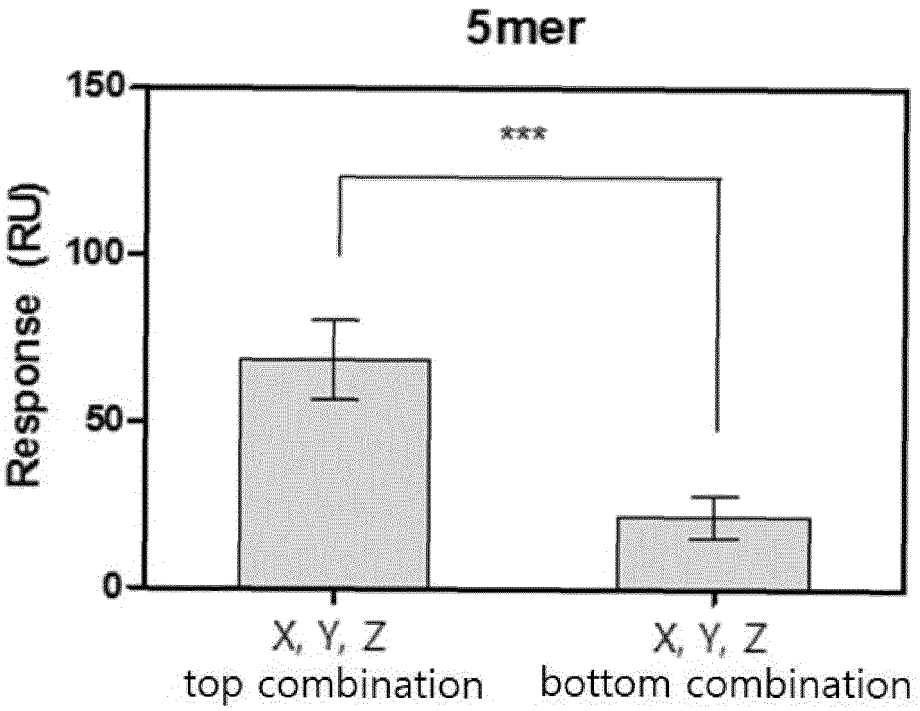

5mer
150
100
50
0
Response (RU)
***
X, Y, Z
top combination
X, Y, Z
bottom combination

FIG. 5

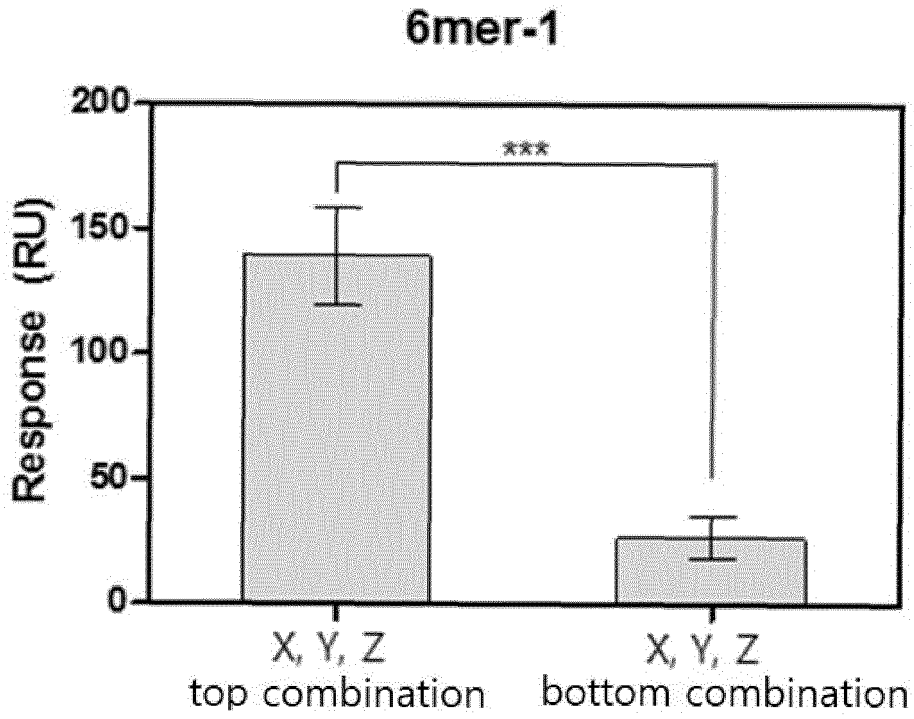

6mer-1
200
150
100
50
0
Response (RU)
***
X, Y, Z
top combination
X, Y, Z
bottom combination

FIG. 6

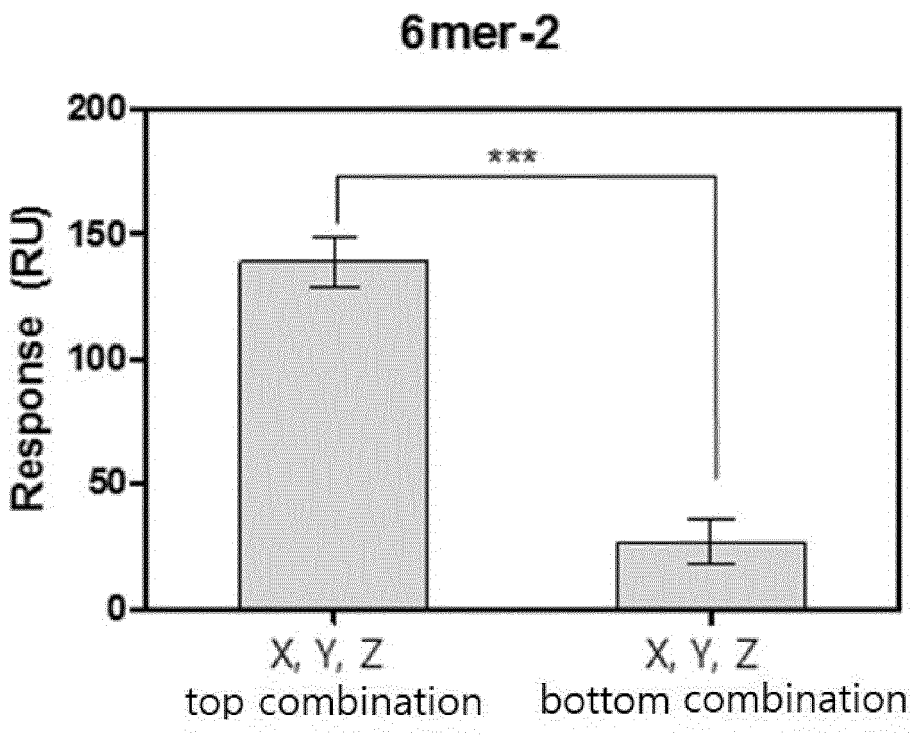

6mer-2
200
150
100
50
0
Response (RU)
***
X, Y, Z
top combination
X, Y, Z
bottom combination

FIG. 7

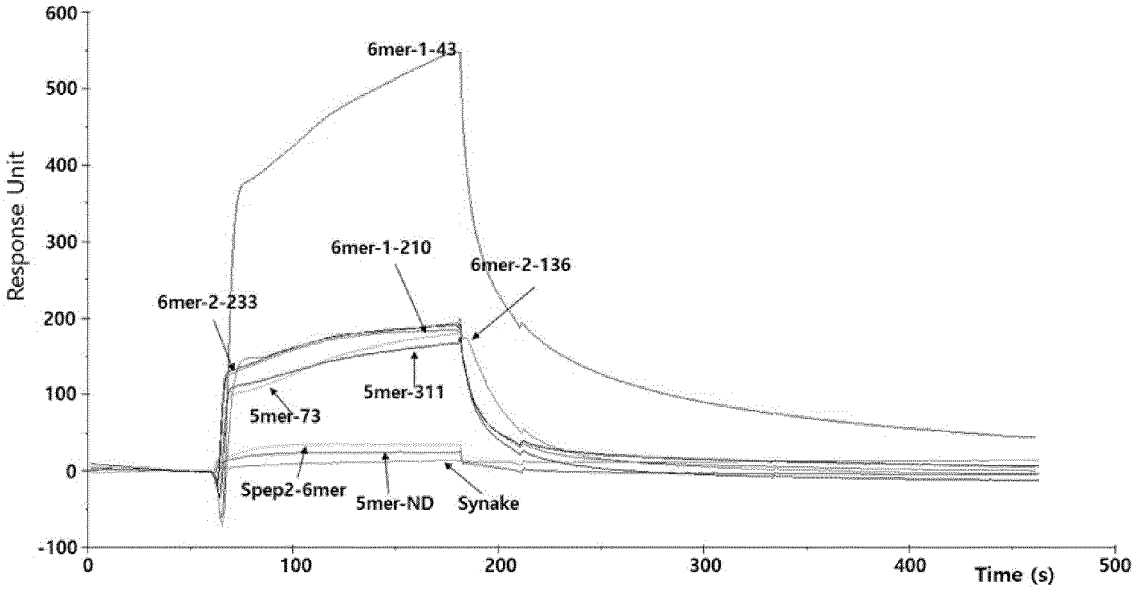
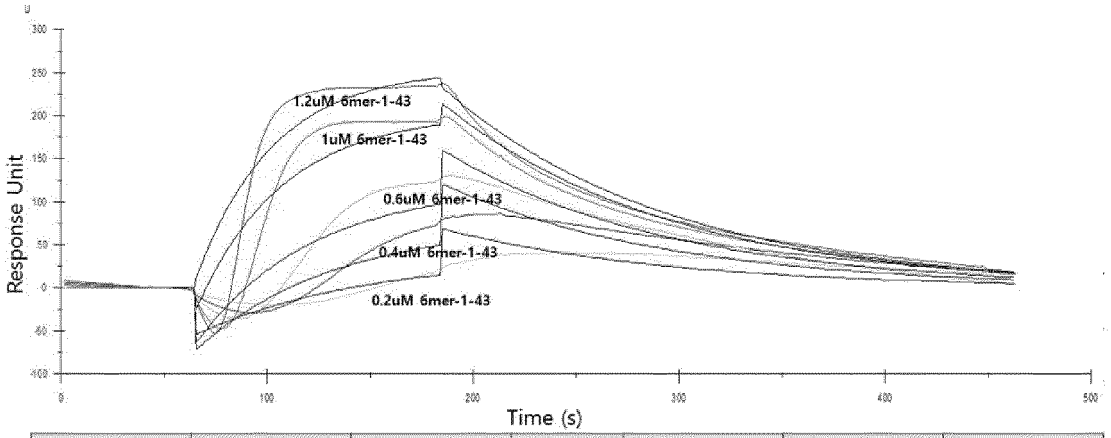

600
500
400
300
200
100
0
-100
Response Unit
6mer-1-43
6mer-1-210
6mer-2-136
6mer-2-233
5mer-311
5mer-73
Spep2-6mer
5mer-ND
Synake
0
100
200
300
400
500
Time (s)

FIG. 8



ka (1/Ms)	kd (1/s)	Rmax (RU)	RI (RU)	Conc of analyte	KA (1/M)	KD (M)
1.49E+04	9.06E-03	369			1.64E+06	6.09E-07

FIG. 9

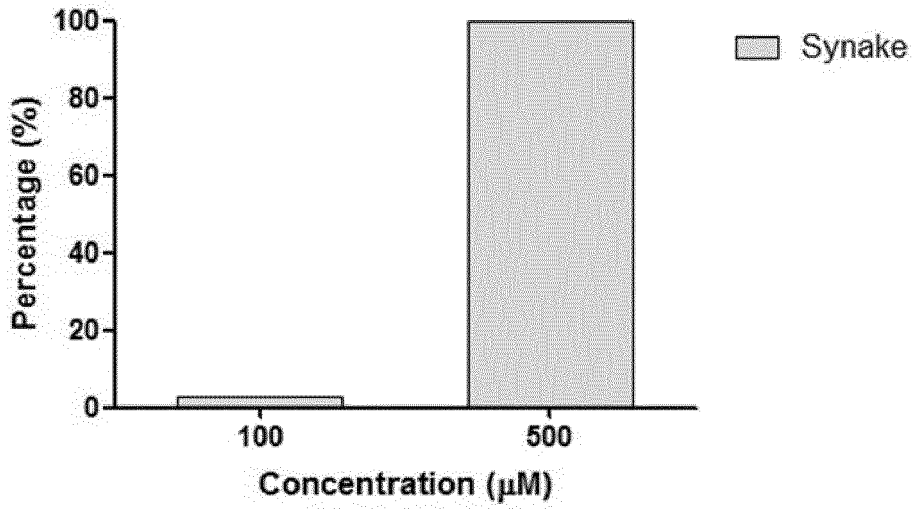


FIG. 10

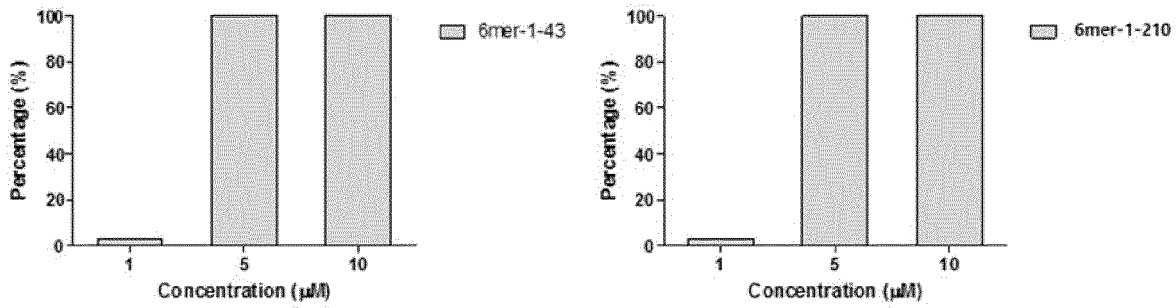


FIG. 11

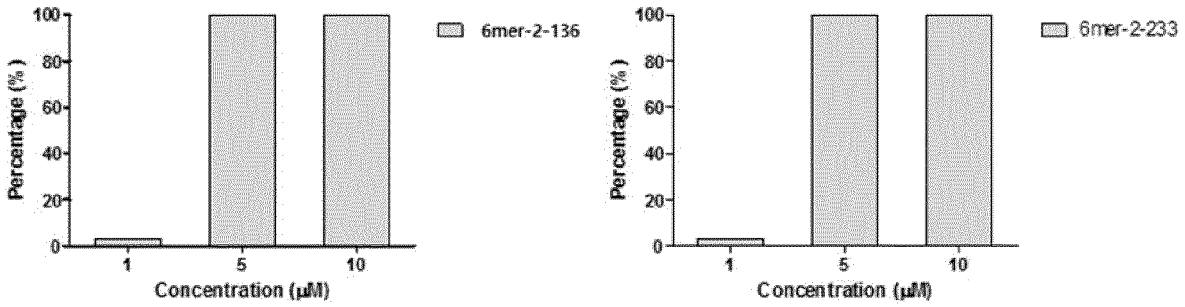


FIG. 12

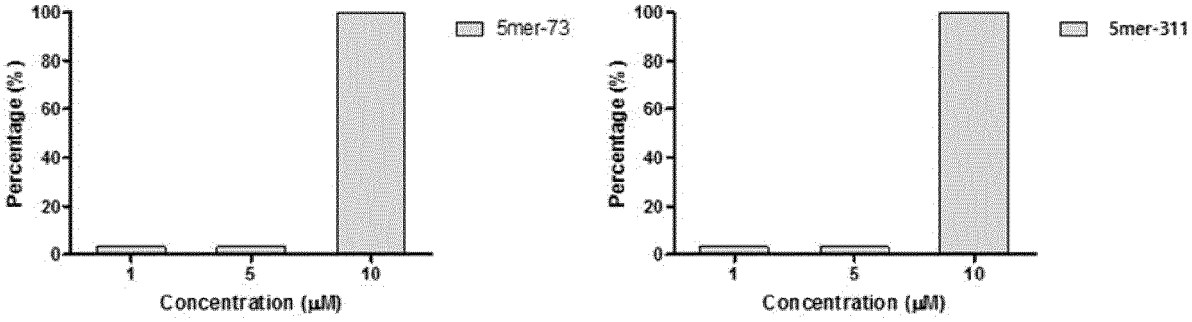


FIG. 13

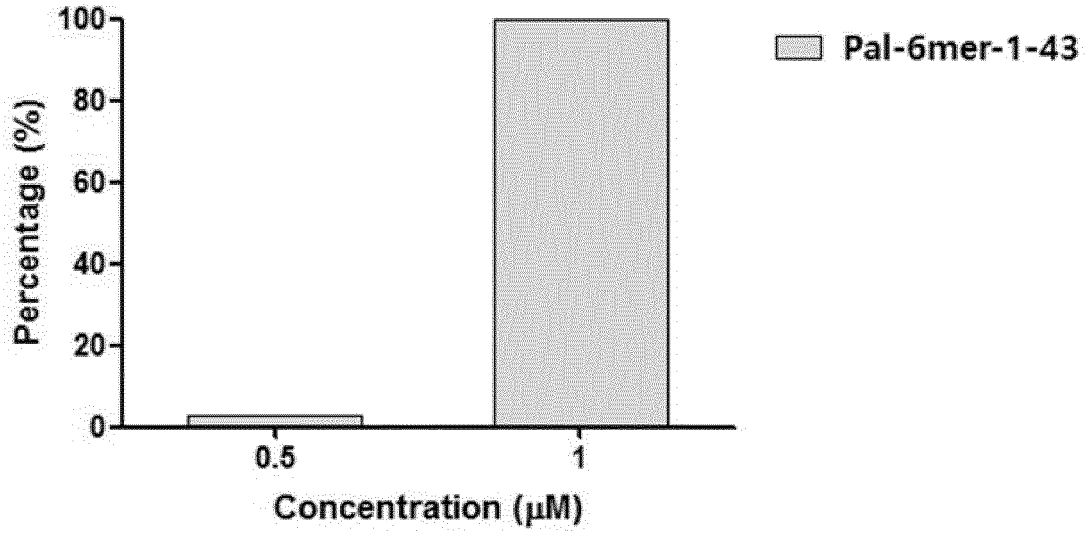


FIG. 14

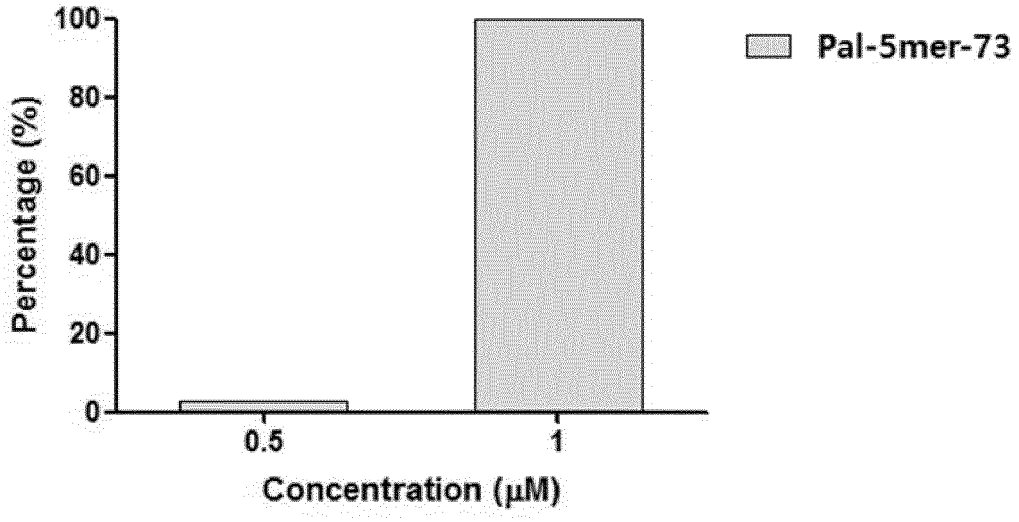
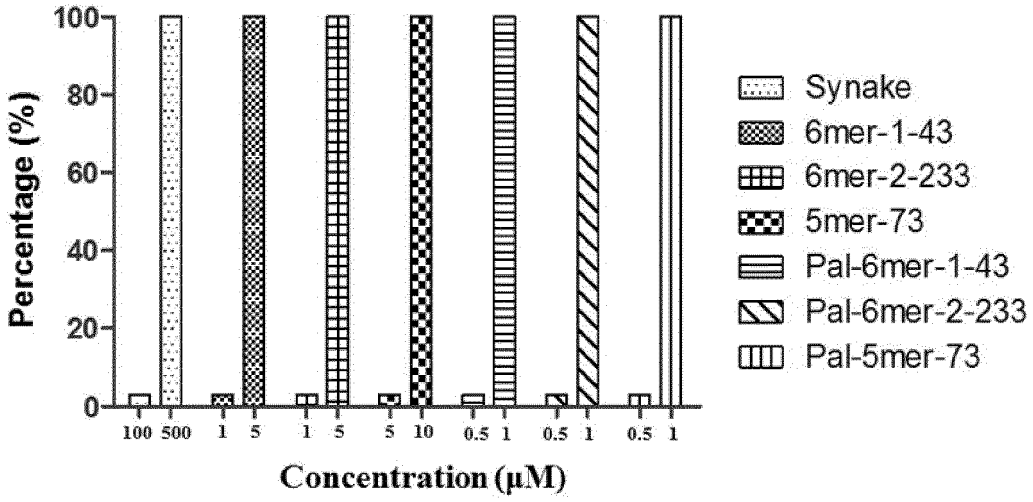


FIG. 15



	Synake	6mer (1-43)	6mer (2-233)	5mer (73)	Pal-6mer (1-43)	Pal-6mer (2-233)	Pal-5mer (73)
IC50	250uM	2.5uM	2.5uM	7.5uM	0.75uM	0.75uM	0.75uM
Fold	1	100	100	33	330	330	330

FIG. 16

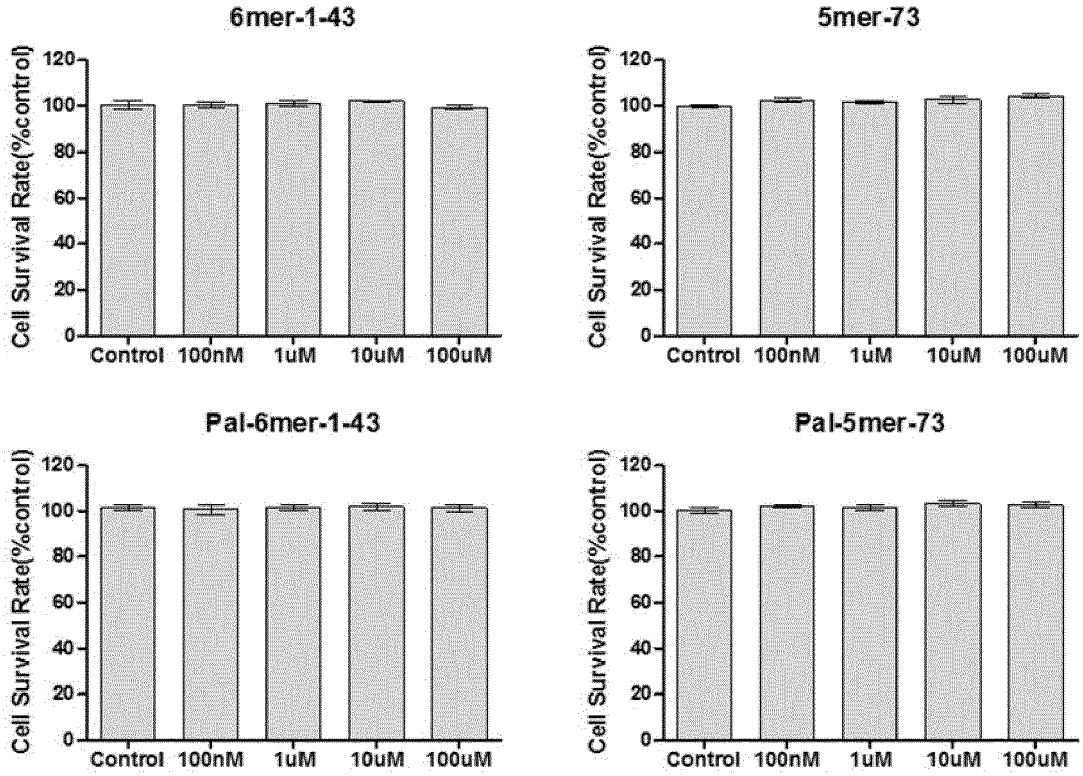

6mer-1-43
5mer-73
Pal-6mer-1-43
Pal-5mer-73
Cell Survival Rate(%control)
0
20
40
60
80
100
120
Control
100nM
1uM
10uM
100uM

FIG. 17

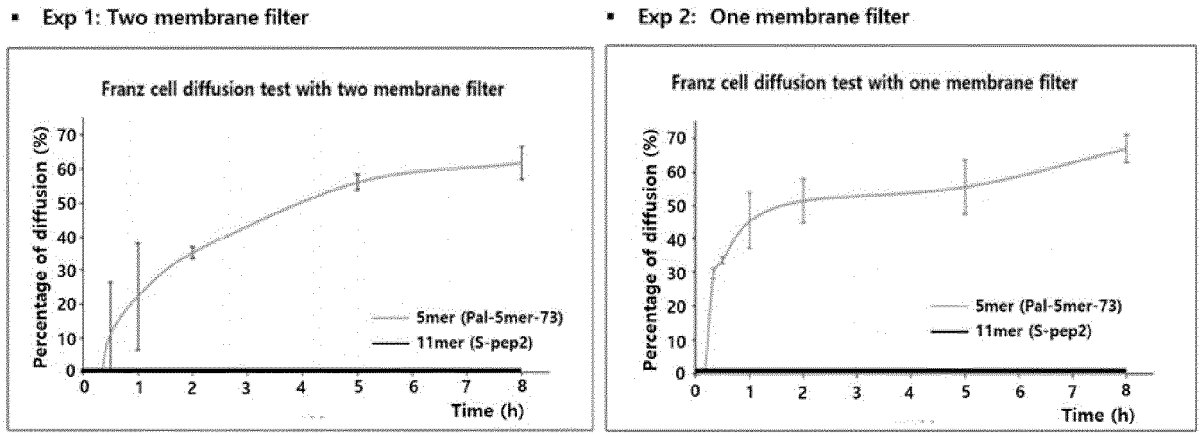

Exp 1: Two membrane filter
Exp 2: One membrane filter
Franz cell diffusion test with two membrane filter
Franz cell diffusion test with one membrane filter
Percentage of diffusion (%)
0
10
20
30
40
50
60
70
0
1
2
3
4
5
6
7
8
Time (h)
5mer (Pal-5mer-73)
11mer (S-pep2)

FIG. 18

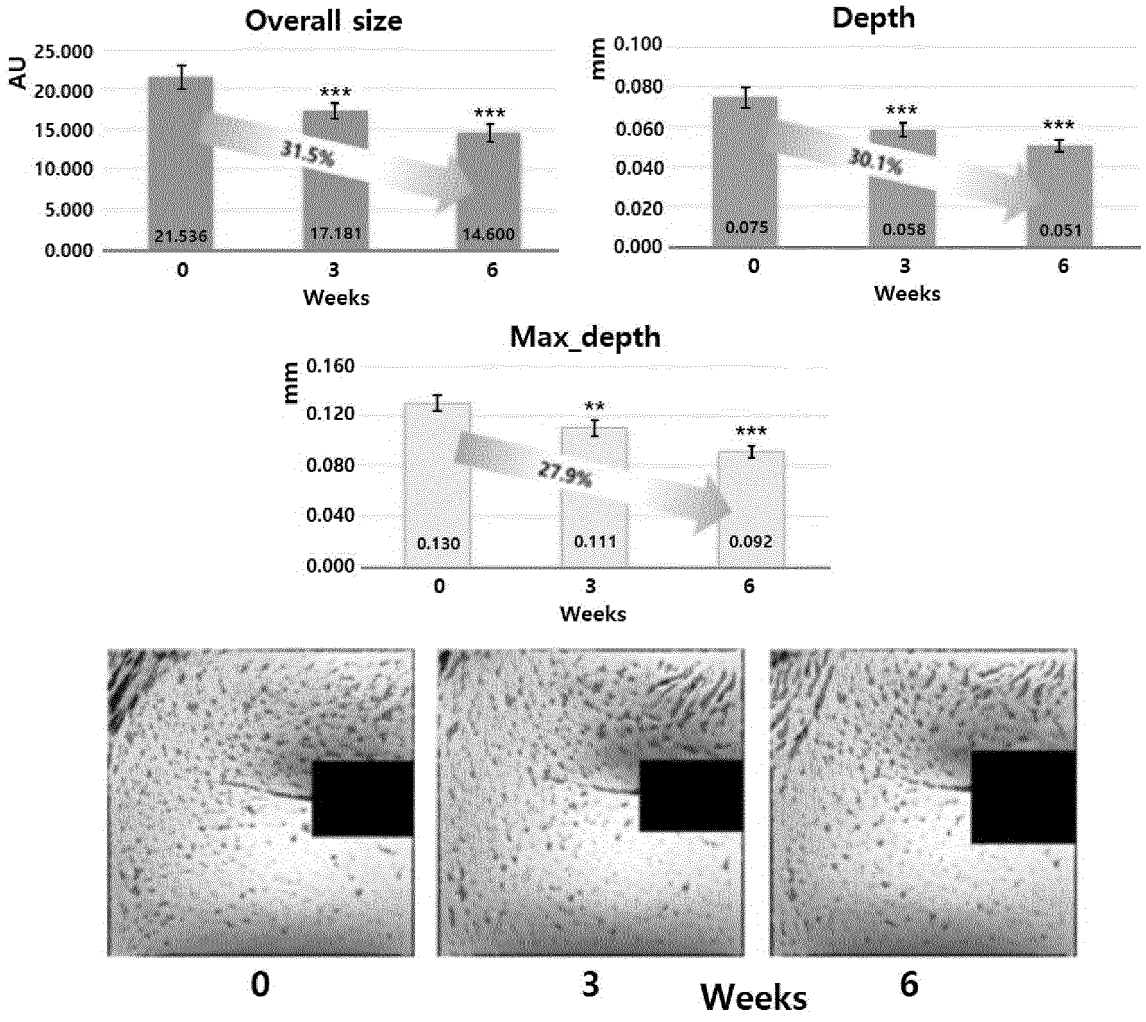

Overall size
AU
25.000
20.000
15.000
10.000
5.000
0.000
***
***
31.5%
21.536
17.181
14.600
0
3
6
Weeks
Depth
mm
0.100
0.080
0.060
0.040
0.020
0.000
***
***
30.1%
0.075
0.058
0.051
0
3
6
Weeks
Max_depth
mm
0.160
0.120
0.080
0.040
0.000
**
***
27.9%
0.130
0.111
0.092
0
3
6
Weeks
0
3
Weeks
6

FIG. 19

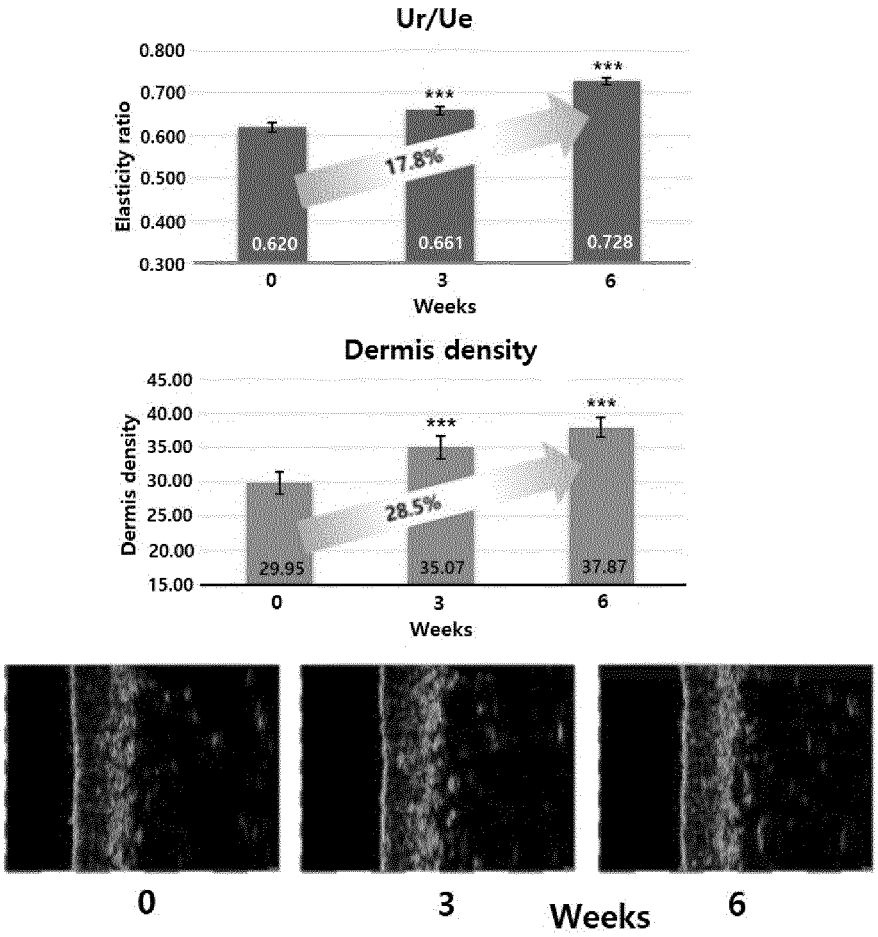

Ur/Ue
Elasticity ratio
0.800
0.700
0.600
0.500
0.400
0.300
***
***
17.8%
0.620
0.661
0.728
0
3
6
Weeks
Dermis density
Dermis density
45.00
40.00
35.00
30.00
25.00
20.00
15.00
***
***
28.5%
29.95
35.07
37.87
0
3
6
Weeks
0
3
Weeks
6

FIG. 20

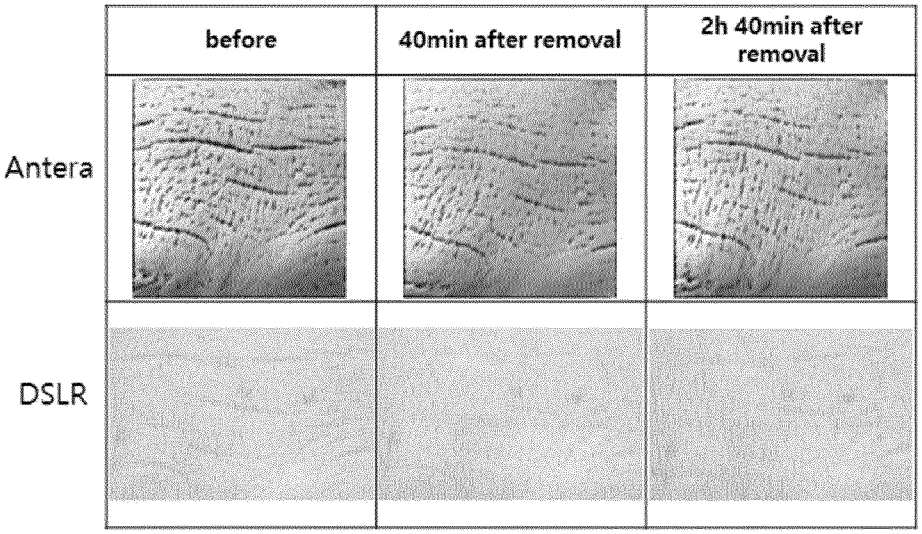

before
40min after removal
2h 40min after removal
Antera
DSLR

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/011078

A. CLASSIFICATION OF SUBJECT MATTER

C07K 7/06(2006.01)i; **A61K 8/64**(2006.01)i; **A61Q 19/00**(2006.01)i; **A61P 21/00**(2006.01)i; **A61K 38/00**(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07K 7/06(2006.01); A23L 33/18(2016.01); A61K 38/00(2006.01); A61K 8/64(2006.01); A61Q 19/08(2006.01); C07K 14/435(2006.01); C07K 14/705(2006.01); C07K 7/08(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 아세틸콜린(acetylcholine), 펩타이드(peptide), 결합(binding)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-1971092 B1 (KOREA INSTITUTE OF CERAMIC ENGINEERING AND TECHNOLOGY et al.) 23 April 2019 (2019-04-23) See abstract; and claims 1 and 6-8.	9,20-21
Y		18-19,22-25
A		1-8,10-17
DY	KR 10-2020-0080179 A (AMICOGEN, INC.) 06 July 2020 (2020-07-06) See abstract; and claims 1, 14-15 and 18-21.	18-19,22-25
A	US 2020-0115414 A1 (GLO PHARMA, LLC) 16 April 2020 (2020-04-16) See abstract; and claims 1-21.	1-25
A	US 2015-0361137 A1 (LIMITED LIABILITY COMPANY "SYNEURO") 17 December 2015 (2015-12-17) See entire document.	1-25

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 November 2022	**02 November 2022**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/011078

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016-040517 A1 (MERIAL INC. et al.) 17 March 2016 (2016-03-17) See entire document.	1-25

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/011078

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
   a. ☑ forming part of the international application as filed.
   b. ☐ furnished subsequent to the international filing date for the purposes of international search (Rule 13*ter*.1(a)),
      ☐ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.

2. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this report has been established to the extent that a meaningful search could be carried out without a WIPO Standard ST.26 compliant sequence listing.

3. Additional comments:

Form PCT/ISA/210 (continuation of first sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2022/011078

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		JP 2020-525033 A	27 August 2020
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		EP 3904368 A2	03 November 2021
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		WO 2020-138948 A3	13 August 2020
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		SG 11202103791 A	28 May 2021
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		US 10345292 B2	09 July 2019
		US 2017-067873 A1	09 March 2017

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REFERENCES CITED IN THE DESCRIPTION

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