

Non-Radioisotopic Kit for Measuring AGE-RAGE Interaction *in vitro*

# CircuLex AGE-RAGE *in vitro* Binding Assay Kit

Cat# CY-8151

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## Intended Use

The MBL Research Product **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** is primarily designed to screening inhibitors of AGE2 (glyceraldehyde-modified AGE)-sRAGE (soluble RAGE) interaction *in vitro*. In addition, this kit can be used for the rapid and sensitive evaluation of inhibitor candidates as well as characterization of AGE2-sRAGE interaction *in vitro*. The recombinant sRAGE used in this assay kit was specially designed for keeping the correct conformation to bind efficiently to AGE2-BSA but not to BSA, which are immobilized on the microplate surface. This technique allows us measuring the interaction of recombinant sRAGE to AGE2-BSA in a solid-phase assay system such as a conventional ELISA system.

Applications for this kit include:

- 1) Screening inhibitors of AGE-sRAGE interaction *in vitro*.
- 2) Characterization of inhibitor candidates of AGE2-sRAGE interaction *in vitro*.
- 3) Screening monoclonal antibodies that inhibit AGE2-sRAGE interaction *in vitro*.
- 4) Characterization of AGE2-sRAGE interaction *in vitro*.

## Storage

- Upon receipt, store all other components at 4°C.
- Do not expose reagents to excessive light.

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## Introduction

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Advanced glycation end products (AGEs) are important biochemical compounds found in diabetes and may be associated with inflammatory processes. In the vessel wall, AGEs are bound to specific receptors to modulate many cellular properties by activating several signaling pathways. One of these receptors is called "Receptor for Advanced Glycation End product" (RAGE).

RAGE is a multi-ligand member of the immunoglobulin superfamily of cell surface molecules that is expressed in a variety of cell lines, including endothelial cells, smooth muscle cells, mononuclear phagocytes, pericytes, neurons, cardiac myocytes, mesangial cells and hepatocytes (1,2). RAGE interacts with different structures to transmit a signal into the cell and recognizes three-dimensional structures rather than specific amino acid sequences. Therefore, RAGE seems to fulfill the requirements of a pattern-recognition receptor. As a member of the immunoglobulin superfamily, it interacts with a diverse class of ligands, including AGEs (1,3), HMGB1 (also known as Amphoterin) (4), amyloid  $\beta$ -peptide (5), amyloid A (6), leukocyte adhesion receptors (7), prions (8), *Escherichia coli* curli operons (9),  $\beta$ -sheet fibrils (10) and several members of the S100 protein superfamily including S100/calgranulins (11). Thus RAGE may have potential involvement in several pathological processes including inflammation, diabetes, Alzheimer's disease (AD), systemic amyloidosis and tumor growth (12).

AGE-RAGE interaction enhances the expression of genes encoding cytokines, growth factors and adhesion molecules, and increases the classical acute phase proteins. Potential approaches to prevention and treatment of diabetes and its complications include inhibition of AGE formation, breakage of preformed AGE-proteins crosslink, blockade of AGE-RAGE interactions with RAGE competitors, antibody antagonists and RAGE specific metabolic inhibition. Inhibition of AGE-RAGE complex formation is able to suppress the levels of pro-inflammatory cytokines and growth factors and may be considered as a target for overcoming diabetic complications.

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## Principle of the Assay

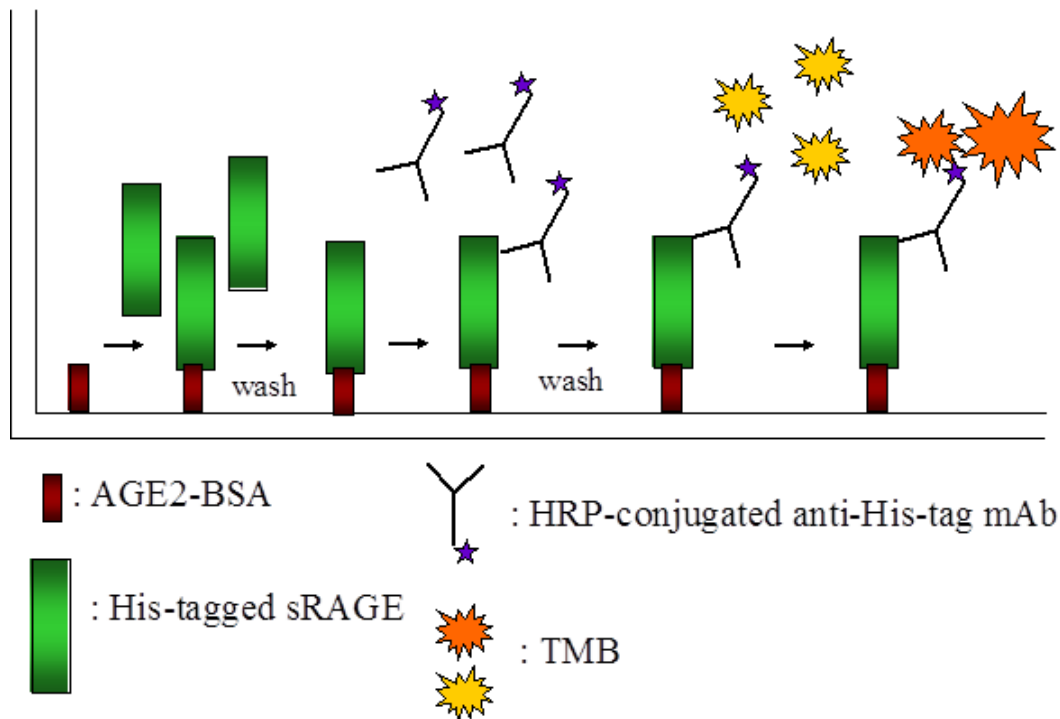
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The MBL Research Products **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** is a semi-quantitative solid phase binding assay between recombinant His-tagged sRAGE and AGE2-BSA. A plate is pre-coated with AGE2-BSA, which is able to bind to recombinant His-tagged sRAGE. Horse radish peroxidase (HRP)-conjugated anti-His-tag antibody specifically reacts with recombinant His-tagged sRAGE that is trapped with AGE2-BSA immobilized on microplate well surface. The **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** may be used to characterize AGE-RAGE interaction as well as to screen inhibitors of AGE-RAGE interaction *in vitro*.

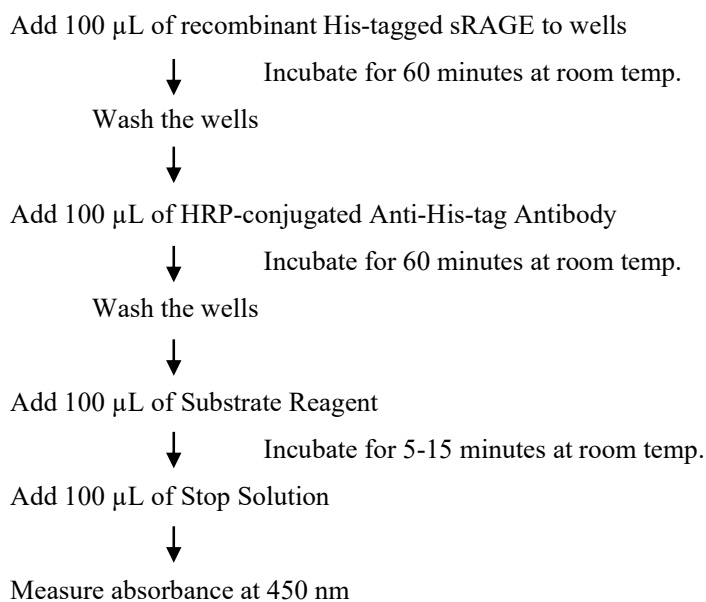
To perform the test, the recombinant His-tagged sRAGE is diluted with Reaction Buffer, pipetted into microplate wells and allowed to bind to AGE2-BSA immobilized on the wells. After wash the wells, the amount of bound recombinant His-tagged sRAGE is measured by binding it with HRP-conjugated anti-His-tag antibody, which then catalyzes the conversion of the chromogenic substrate tetra methylbenzidine (TMB) from a colorless solution to a blue solution (or yellow after the addition of stopping reagent). The color is quantitated by spectrophotometry and reflects the relative amount of recombinant His-tagged sRAGE that binds to AGE2-BSA on the wells.

For screening inhibitors of AGE-RAGE interaction *in vitro*, test compounds or inhibitor candidates including monoclonal antibodies are added to appropriate amount of His-tagged sRAGE in wells pre-coated with AGE2-BSA in a similar fashion as described above, followed by evaluation of inhibitory effect on AGE-RAGE interaction by measuring the amount of His-tagged sRAGE2 on the wells.

### Schematic Representation of Assay Principle



### Summary of Assay Procedure



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## Materials Provided

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All samples should be assayed in duplicate. The following components are supplied and are sufficient for the one 96-well microtiter plate kit.

**AGE2-BSA coated Microplate:** One microplate supplied ready to use, with 96 wells (12 strips of 8-well) in a foil, zip-lock bag with a desiccant pack. Wells are coated with AGE2-BSA (glyceraldehyde-modified BSA).

**BSA coated Microplate:** One microplate supplied ready to use, with 96 wells (12 strips of 8-well) in a foil, zip-lock bag with a desiccant pack for non-specific binding control. Wells are coated with BSA.

**Recombinant His-tagged sRAGE:** One vial containing X\* AU of lyophilized recombinant His-tagged human sRAGE.

**\*The amount is changed depending on lot. See the real "User's Manual" included in the kit box.**

**Reaction Buffer:** One bottle containing 50 mL of 1X buffer; used for reconstitution and dilution of Recombinant His-tagged sRAGE, and binding reaction. Ready to use.

**20X Inhibitor Control Compound:** One vial containing 200 µL of compound DP, which was discovered in commercial chemical library by MBL using this kit, in DMSO. The inhibitory mechanism and optimum conditions of the compound have not been fully elucidated. The compound is suspected to be carcinogenic and may be irritating to the skin, eyes and upper respiratory tract and hazardous in case of ingestion.

**HRP conjugated Anti-His-tag Antibody:** One bottle containing 30 mL of HRP (horseradish peroxidase) conjugated anti-His-tag antibody. Ready to use.

**10X Wash Buffer:** One bottle containing 100 mL of 10X buffer containing Tween®-20

**Substrate Reagent:** One bottle containing 20 mL of the chromogenic substrate, tetra methylbenzidine (TMB). Ready to use.

**Stop Solution:** One bottle containing 20 mL of 1 N H<sub>2</sub>SO<sub>4</sub>. Ready to use.

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## Materials Required but not Provided

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- **Pipettors:** 2-20  $\mu\text{L}$ , 20-200  $\mu\text{L}$  and 200-1,000  $\mu\text{L}$  precision pipettors with disposable tips.
- **Precision repeating pipettor**
- **Orbital microplate shaker**
- **Microcentrifuge and tubes** for sample preparation.
- **Vortex mixer**
- **(Optional) Microplate washer:** Manual washing is possible but not preferable.
- **Plate reader** capable of measuring absorbance in 96-well plates at dual wavelengths of 450 nm/540 nm. Dual wavelengths of 450/550 or 450/595 nm can also be used. The plate can also be read at a single wavelength of 450 nm, which will give a somewhat higher reading.
- **(Optional) Software package facilitating data generation and analysis**
- **500 or 1,000 mL graduated cylinder.**
- **Reagent reservoirs**
- **Deionized water of the highest quality**
- **Disposable paper towels**

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## Precautions and Recommendations

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- **Although we suggest to conduct experiments as outlined below, the optimal experimental conditions will vary depending on the parameters being investigated, and must be determined by the individual user.**
- Allow all the components to come to room temperature before use.
- All microplate strips that are not immediately required should be returned to the zip-lock pouch, which must be carefully resealed to avoid moisture absorption.
- Do not use kit components beyond the indicated kit expiration date.
- Use only the microtiter wells provided with the kit.
- Rinse all detergent residue from glassware.
- Use deionized water of the highest quality.
- Do not mix reagents from different kits.
- The buffers and reagents in this kit may contain preservatives or other chemicals. Wear gloves and eye protection when handling these reagents. In case of contact, wash skin thoroughly with water and seek medical attention, when necessary.
- Do not mouth pipette or ingest any of the reagents.
- Do not smoke, eat, or drink when performing the assay or in areas where samples or reagents are handled.
- Dispose of tetra-methylbenzidine (TMB) containing solutions in compliance with local regulations.
- Avoid contact with Substrate Solution which contains hydrogen peroxide.
- **CAUTION: Biological samples may be contaminated with infectious agents. Do not ingest, expose to open wounds or breathe aerosols. Wear protective gloves and dispose of biological samples properly.**
- **CAUTION: Stop Solution is a strong acid. Wear disposable gloves and eye protection when handling the solution.**

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## Detailed Protocol

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The MBL Research Product **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** is provided with removable strips of wells so the assay can be carried out on separate occasions using only the number of strips required for the particular determination. Since conditions may vary, individual user should optimize the amount of Recombinant His-tagged sRAGE for inhibitor screening from dose-response curve. Disposable pipette tips and reagent troughs should be used for all transfers to avoid cross-contamination of reagents or samples.

### I. Preparation of Working Solutions

1. Prepare a working solution of **Wash Buffer** by adding 100 mL of the **10X Wash Buffer** to 900 mL of deionized (distilled) water (**ddH<sub>2</sub>O**). Mix well. Store at 4°C for two weeks or -20°C for long-term storage.
2. Reconstitute **Recombinant His-tagged sRAGE** with X\* mL of **Reaction Buffer** by gently mixing. After reconstitution, immediately dispense it in small aliquots (e.g. 200 µL) to plastic micro-centrifuge tubes and store below -70°C to avoid non-specific adsorption to glass surface and multiple freeze-thaw cycles. The concentration of the recombinant His-tagged sRAGE in vial should be **2,000 AU/mL**, which is referred to as a **Master Solution** of recombinant His-tagged sRAGE.  
**\*The amount is changed depending on lot. See the real "User's Manual" included in the kit box.**
3. Prepare **His-tagged sRAGE Solutions** by 2-fold serially diluting the **Master Solution** (2,000 AU/mL) to an appropriate concentration (usually 100-1.56 AU/mL only for drawing dose-response curve) with **Reaction Buffer** at the time of assay (See "II. Standard Assay for Drawing Dose-Response Curve" below.).

**Note-1:** For an inhibitor screening assay, the **Master Solution** should be diluted with **Reaction Buffer** to appropriate concentration, which shows OD value does not exceed plateau range in dose-response curve.

**Note-2:** Prepare appropriate volume for your assay. Discard any unused **His-tagged sRAGE Solutions** after diluted.

## II. Standard Assay for Drawing Dose-Response Curve

1. Remove the appropriate number of microtiter wells of **AGE2-BSA coated Microplate** from the foil pouch and place them into the well holder. Return any unused wells to the foil pouch, refold, seal with tape and store at 4°C.
2. Prepare 2-fold serially diluted **His-tagged sRAGE Solutions** (100-1.56 AU/mL and Reaction Buffer only).
3. Pipette **100 µL** of the **His-tagged sRAGE Solutions** and **Reaction Buffer** in duplicates, into the wells. Cover with plate sealer or lid, and incubate **at room temperature (ca.25°C) for 60 minutes, shaking at ca. 300 rpm on an orbital microplate shaker.**
4. Wash 4-times by filling each well with **Wash Buffer** (350 µL) using a squirt bottle, multi-channel pipette, manifold dispenser or microplate washer.
5. Add **100 µL** of **HRP conjugated Anti-His-tag Antibody** into each well, cover with plate sealer or lid, and incubate **at room temperature (ca.25°C) for 60 minutes, shaking at ca. 300 rpm on an orbital microplate shaker.**
6. Wash 4-times by filling each well with **Wash Buffer** (350 µL) using a squirt bottle, multi-channel pipette, manifold dispenser or microplate washer.
7. Add **100 µL** of **Substrate Reagent** into each well. Avoid exposing the microtiter plate to direct sunlight. Covering the wells with e.g. aluminum foil is recommended. Return Substrate Reagent to 4°C immediately after the necessary volume is removed.
8. Incubate the wells **at room temperature (ca.25°C) for 5-15 minutes, shaking at ca. 300 rpm on an orbital microplate shaker.** (Appropriate incubation time may vary, and incubation time can be extended up to 30 minutes if the reaction temperature is below than 20°C).
9. Add **100 µL** of **Stop Solution** to each well in the same order as the previously added Substrate Reagent.
10. Measure absorbance in each well using a spectrophotometric plate reader at dual wavelengths of 450/540 nm. Dual wavelengths of 450/550 or 450/595 nm can also be used. Read the plate at 450 nm if only a single wavelength can be used. Wells must be read within 30 minutes of adding the Stop Solution.

**Note:** Complete removal of liquid at each step is essential to good performance. After the last wash, remove any remaining Wash Buffer by aspiration or decantation. Invert the plate and blot it against clean paper towels.



### III. Standard Assay for Inhibitor Screening

#### Special considerations when screening inhibitors of AGE-RAGE interaction

In order to estimate the inhibitory effect on AGE-RAGE interaction in the test compounds correctly, it is necessary to conduct the control experiment of “Vehicle Control” for every experiment, and “Inhibitor Control” at least once for the first experiment, in addition to “Test Compound”, as indicated in the following table. When test compounds cause an inhibitory effect on AGE-RAGE interaction, the level of A450 is weakened as compared with “Vehicle Control”.

#### For inhibitor screening

Assay Reagents	Inhibitor Control	Test Compound	Vehicle Control
Reaction Buffer	85 µL	85 µL	85 µL
20X Inhibitor Control Compound *	5 µL	-	
20X Test Compound(s)	-	5 µL	-
Vehicle for 20X Test Compound(s)	-	-	5 µL
10X His-tagged sRAGE Solution **	10 µL	10 µL	10 µL

\* 20X Inhibitor Control Compound: See the section “Materials Provided” above.

\*\* 10x concentrated solution of the His-tagged sRAGE Solution, which shows OD value does not exceed plateau range in dose-response curve. Usually, it will be 200-400 AU/mL, of which final concentration is 20-40 AU/mL. See “I. Preparation of Working Solutions” above.

- Following the above table, add the “**Reaction buffer**” and “**20X Test Compound**” or “**Vehicle for Inhibitor**” or **20X Inhibitor Control compound** to each well of AGE2-BSA coated Microplate and BSA coated Microplate.
- Initiate reaction by adding 10 µL of “**10X His-tagged sRAGE solution**” to each well and mixing thoroughly. Cover with plate sealer or lid, and incubate at room temperature for 60 minutes, shaking at ca. 300 rpm on an orbital microplate shaker.
- Follow the steps 4-10 of “II. Standard Assay for Drawing Dose-Response Curve” above.

**Note-1:** The optimal experimental conditions must be determined by the individual user. Especially, appropriate concentration of 10X His-tagged sRAGE Solution must be determined by drawing dose-response curve, which shows OD value does not exceed plateau range in the dose-response curve.

**Note-2:** To obtain an accurate inhibition percentage of test compounds, draw and calculate form a dose-response curve with appropriate serial dilutions of 10X His-tagged sRAGE Solution in parallel with the inhibition assay of the test compounds.

**Note-3:** Inhibition percentage of “Inhibitor Control Compound” provided in “Inhibitor Control” of the above table will be approximately 50% or more.

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## Evaluation of Results

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To obtain an accurate inhibition percentage of test compounds, it's required to draw and calculate form a dose-response curve with serial dilutions of 10X His-tagged sRAGE Solution in parallel with the inhibition assay of the test compounds.

1. Average the duplicate readings for each “Inhibitor Control”, “Test Compound”, “Vehicle Control” and “serial dilutions of 10X His-tagged sRAGE Solution” in AGE2-BSA coated Microplate and BSA coated Microplate. Subtract the average readings in BSA coated Microplate from those in AGE2-BSA coated Microplate.
2. Inhibition percentage of test compounds should be calculated from the dose-response curve. It is important to make an appropriate mathematical adjustment to accommodate for inhibition percentage.
3. The dose-response curve of this assay may fit to a sigmoidal four-parameter logistic equation. Most microtiter plate readers perform automatic calculations of analyte concentration. The calibration curve is constructed by plotting the absorbance (Y) of calibrators versus log of the known concentration (X) of calibrators, using the four-parameter function. Alternatively, the logit log function can be used to linearize the calibration curve (i.e. logit of absorbance (Y) is plotted versus log of the known concentration (X) of calibrators).

**Note:** The MBL Research Product **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** has been shown to measure AGE-RAGE interaction *in vitro*. The assay may be used to screen and characterize inhibitors of AGE-RAGE interaction *in vitro*. Please consider whether your experimental condition is appropriate by drawing a direct line with the results of the section “Assay Characteristics” below.

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## Troubleshooting

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1. All samples should be run in duplicate, when a standard assay is being performed, using the protocol described in the **Detailed Protocol**. Incubation times or temperatures significantly different from those specified may give erroneous results.
2. Poor duplicates, accompanied by elevated values for wells containing no sample, indicate insufficient washing. If all instructions in the **Detailed Protocol** were followed accurately, such results indicate a need for washer maintenance.
3. Overall low signal may indicate that desiccation of the plate has occurred between the final wash and addition of Substrate Reagent. Do not allow the plate to dry out. Add Substrate Reagent immediately after wash.

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## Reagent Stability

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All of the reagents included in the MBL Research Product **CircuLex AGE-RAGE *in vitro* Binding Assay Kit** have been tested for stability. Reagents should not be used beyond the stated expiration date.

## Assay Characteristics

Fig.1 Typical dose-response curve of recombinant His-tagged sRAGE

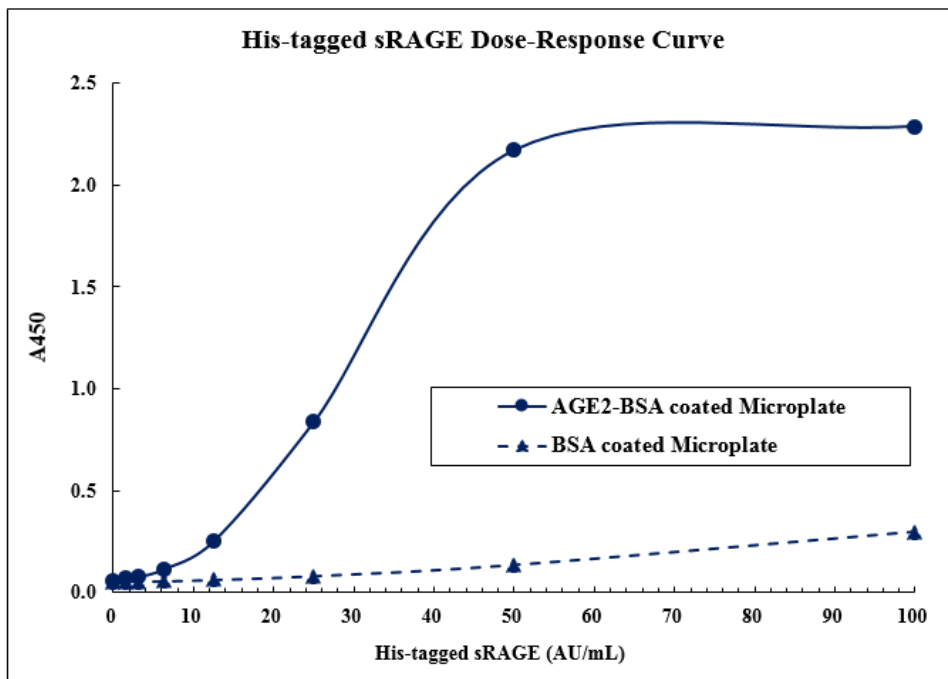


Fig.2 Effect of pH on AGE-RAGE binding *in vitro*

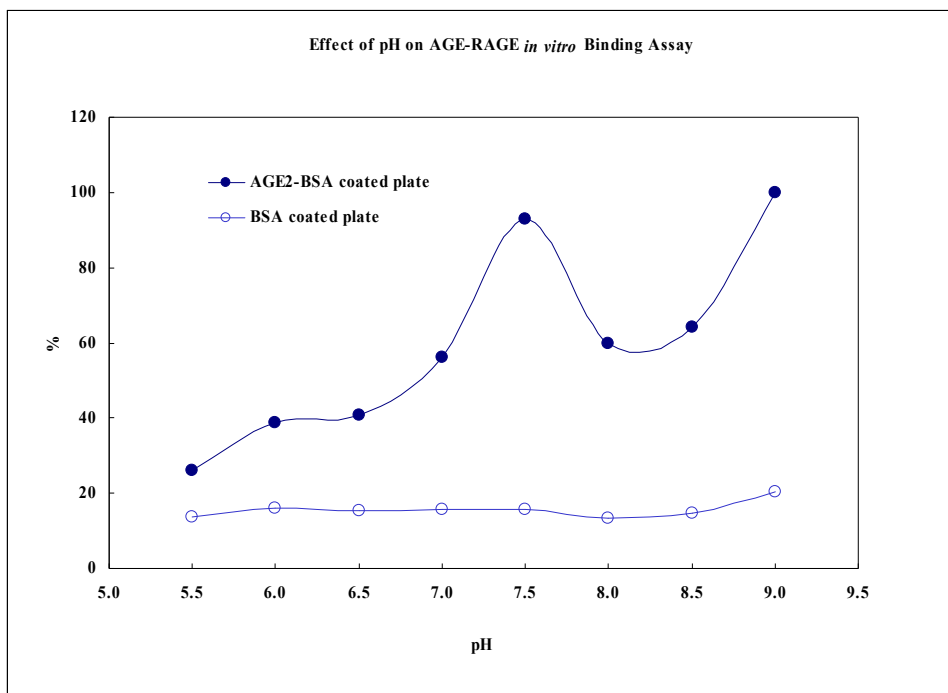


Fig.3 Effect of DMSO on AGE-RAGE binding *in vitro*

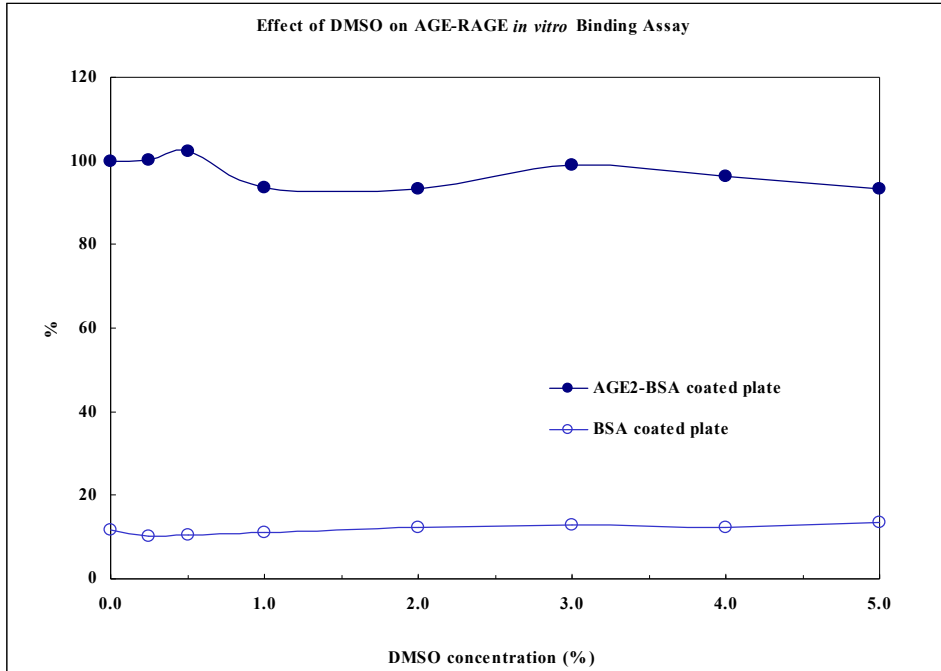


Fig.4 Effect of Calcium Ion on AGE-RAGE binding *in vitro*

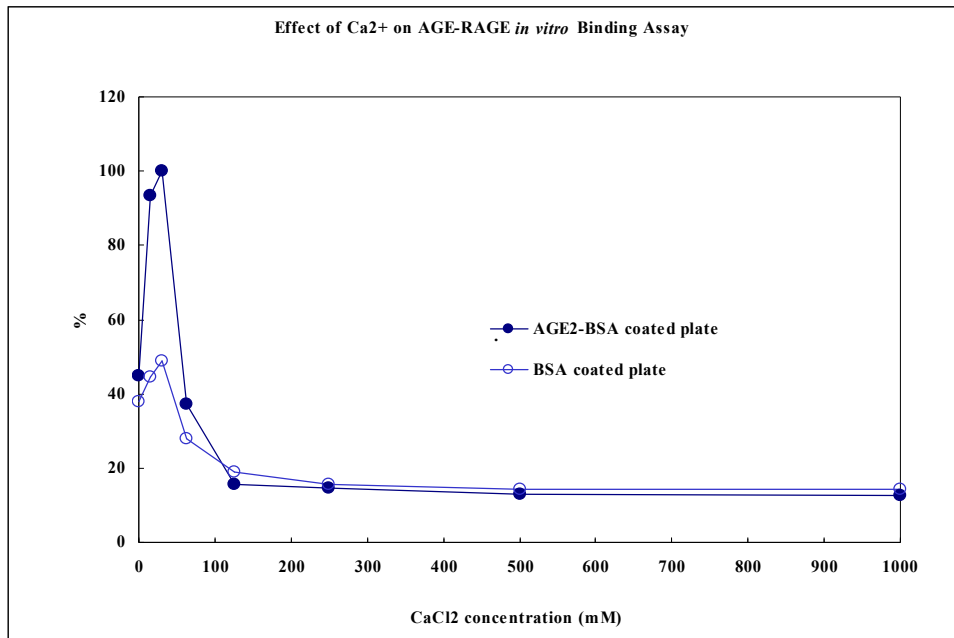


Fig.5 Effect of NaCl on AGE-RAGE binding *in vitro*

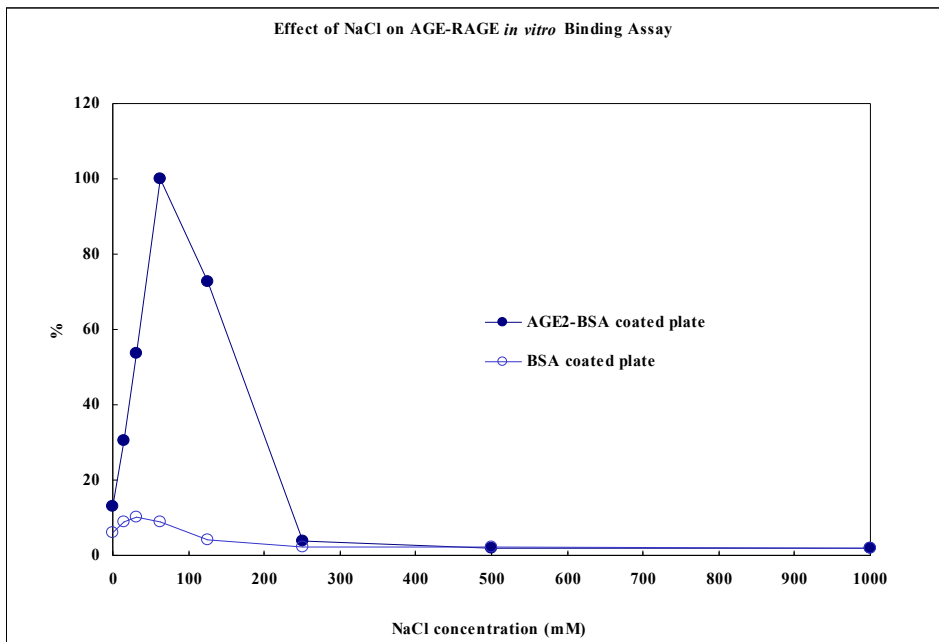
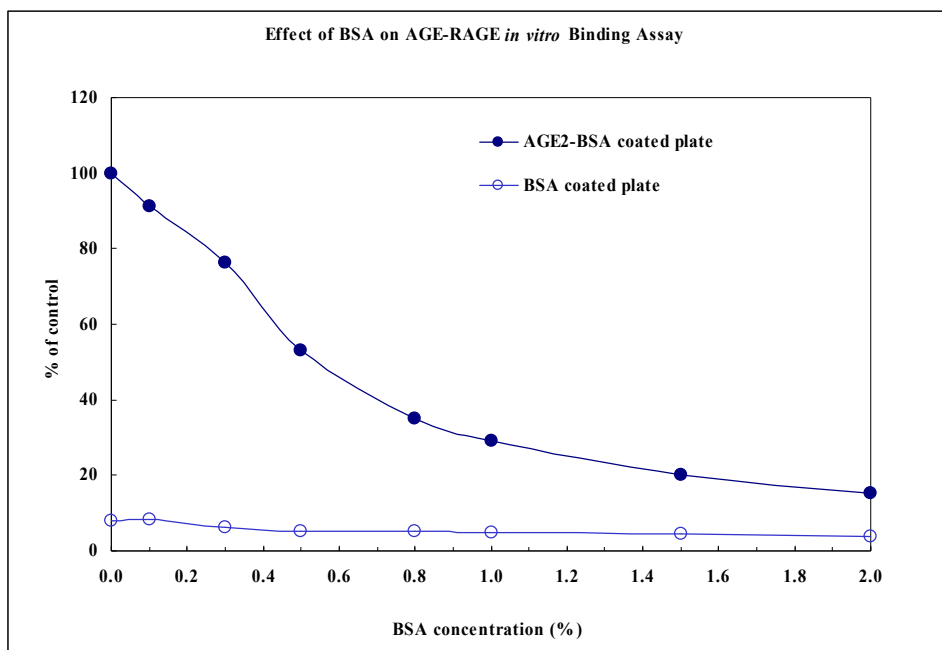


Fig.6 Effect of BSA on AGE-RAGE binding *in vitro*



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## References

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1. Neeper M et al. Cloning and expression of a cell surface receptor for advanced glycosylation end products of proteins. *J Biol Chem.* 1992 Jul 25;267(21):14998-5004.
2. Brett J et al. Survey of the distribution of a newly characterized receptor for advanced glycation end products in tissues. *Am J Pathol.* 1993 Dec;143(6):1699-712.
3. Schmidt AM et al. Isolation and characterization of two binding proteins for advanced glycosylation end products from bovine lung which are present on the endothelial cell surface. *J Biol Chem.* 1992 Jul 25;267(21):14987-97.
4. Hori O et al. The receptor for advanced glycation end products (RAGE) is a cellular binding site for amphoterin. Mediation of neurite outgrowth and co-expression of rage and amphoterin in the developing nervous system. *J Biol Chem.* 1995 Oct 27;270(43):25752-61.
5. Du Yan S et al. Amyloid-beta peptide-receptor for advanced glycation endproduct interaction elicits neuronal expression of macrophage-colony stimulating factor: a proinflammatory pathway in Alzheimer disease. *Proc Natl Acad Sci U S A.* 1997 May 13;94(10):5296-301.
6. Yan SD et al. Receptor-dependent cell stress and amyloid accumulation in systemic amyloidosis. *Nat Med.* 2000 Jun;6(6):643-51.
7. Chavakis T et al. The pattern recognition receptor (RAGE) is a counterreceptor for leukocyte integrins: a novel pathway for inflammatory cell recruitment. *J Exp Med.* 2003 Nov 17;198(10):1507-15.
8. Sasaki N et al. Advanced glycation end products (AGE) and their receptor (RAGE) in the brain of patients with Creutzfeldt-Jakob disease with prion plaques. *Neurosci Lett.* 2002 Jun 28;326(2):117-20.
9. Chapman MR et al. Role of Escherichia coli curli operons in directing amyloid fiber formation. *Science.* 2002 Feb 1;295(5556):851-5.
10. Bierhaus A et al. Understanding RAGE, the receptor for advanced glycation end products. *J Mol Med (Berl).* 2005 Nov;83(11):876-86.
11. Hofmann MA et al. RAGE mediates a novel proinflammatory axis: a central cell surface receptor for S100/calgranulin polypeptides. *Cell.* 1999 Jun 25;97(7):889-901.
12. Stern DM et al. Receptor for advanced glycation endproducts (RAGE) and the complications of diabetes. *Ageing Res Rev.* 2002 Feb;1(1):1-15.

For more information, please visit our website at

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**CircuLex™**

AGE-RAGE *in vitro* Binding Assay Kit

User's Manual

**For Research Use Only, Not for use in diagnostic procedures**



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