# PHARMACEUTICAL COMBINATION, COMPOSITION AND COMPOUND PREPARATION COMPRISING GLUCOKINASE ACTIVATOR AND DPP-IV INHIBITOR, AND PREPARATION METHOD AND USE THEREOF

## PRIORITY APPLICATION

**[0001]** This application claims the priority of the Chinese patent application No. 201810556685.6 filed on May 31, 2018, the entire disclosure of which is incorporated herein by reference.

## TECHNICAL FIELD

**[0002]** The present disclosure relates to a pharmaceutical combination, a composition and a fixed dose combination (FDC) formulation comprising a glucokinase activator (GKA) drug and a partner drug, to a preparation method thereof and to a use thereof in the treatment of some diseases.

**[0003]** More specifically, the present disclosure relates to a pharmaceutical combination, a pharmaceutical composition, or an oral solid formulation of a fixed dose combination comprising a glucokinase activator drug and a partner drug, and a preparation method thereof. The present disclosure also relates to the use of a pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation comprising a glucokinase activator for the treatment and/or prevention of one or more diseases and medical disorders, including but not limited to type I diabetes, type II diabetes, diabetic cognitive dysfunction, memory dysfunction, senile dementia, impaired glucose tolerance, impaired fasting blood glucose, obesity and hypertension. In addition, the present disclosure also relates to a method for treating and/or preventing one or more diseases and medical disorders, comprising administering a therapeutically effective amount of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation disclosed herein to a subject in need thereof.

## BACKGROUND

**[0004]** Diabetes mellitus has become a prevalent disease worldwide, with 425 million

patients over the world, and 120 million patients in China (International Diabetes Federation, Diabetes Atlas, 2015). Type II diabetes, i.e., non-insulin dependent diabetes mellitus (NIDDM), accounts for more than 90% of the patients with diabetes. Type II diabetes is a hyperglycemic, chronic, metabolic dysfunction resulting from an imbalance of blood glucose homeostasis in human body caused by insulin secretion disorder and insulin resistance. The blood glucose balance of the human body is mainly coordinated by two hormones that control blood glucose, including insulin and glucagon.

**[0005]** Glucose sensor glucokinase (GK) senses blood glucose changes, regulates the secretion of the messenger glucose-controlling hormones, insulin and glucagon, and GLP-1 (glucagon-like peptide-1), and constitutes a sensing system for steady-state regulation of human blood glucose. Glucose-controlling hormones control glucose storage during glucose uptake and glucose supply during fasting, constituting the steady-state regulation of human blood glucose. Organs involved in glucose storage are mainly liver, muscle and fat. Under the action of blood glucose and insulin, glucose is taken up and converted into liver glycogen, muscle glycogen and triglycerides. The main organ involved in glucose supply is liver. Under the action of blood glucose and glucagon, liver supplies glucose to a human body through liver glucose synthesis and liver glucose output. Insulin can also effectively regulate the activity of sodium-glucose cotransporter SGLT-2. When blood glucose rises, the glucose excreted by kidneys is reabsorbed for body's glucose storage. Glucose uptake and liver glucose output, as well as the use of glucose by various organs, constitute an operating system for a steady-state balance of the human blood glucose. The coordinated operation of the sensing system and the operating system of glucose constitute a random regulation of a steady-state of the human blood glucose.

**[0006]** In diabetic patients, the impaired function and expression of glucokinase, and the dysfunction of the sensor, result in the dysfunction of the early phase secretion of glucose-controlling hormones, affecting glucose uptake and output, and resulting in post-prandial hyperglycemia and pre-prandial hypoglycemia. Abnormal signaling of glucose-controlling hormones cause abnormal functions and expressions of key proteins in the execution system of glucose uptake and output, forming abnormal operating state, leading to type II diabetes.

**[0007]** Existing oral hypoglycemic drugs for diabetes usually act on a single glucose-controlling organ and cannot effectively treat the problem of imbalanced blood glucose homeostasis. Glucokinase activators represent a class of new drugs developed to treat or improve the disease state of patients with type II diabetes. For example, ((S)-2-[4-((2-chloro-phenoxy)-2-oxo-2,5-dihydro-pyrrol-1-yl]-4-methyl-pentanoic acid [1-((R)-2,3-dihydroxy-propyl)-1H-pyrazol-3-yl]-amide (referred to as HMS5552 hereinafter) can effectively improve the function of the glucose sensor in diabetic patients, and is currently the most promising drug for the treatment of diabetes to solve the above clinical needs.

## SUMMARY

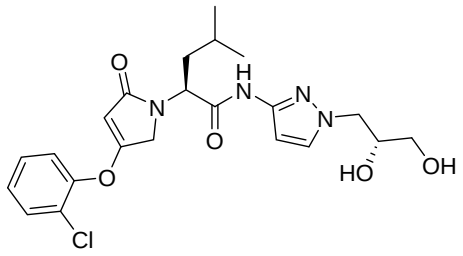
**[0008]** Diabetic patients often encounter such a situation during treatment that DPP-IV inhibitors alone are not effective, and blood glucose cannot be controlled to an ideal level, especially after a period of use. In this regard, the inventors found that the combination of a DPP-IV inhibitor and a glucokinase activator can significantly improve the hypoglycemic effect of the DPP-IV inhibitor and reduce the safety risk, thus the pharmaceutical combination, composition and combination formulation comprising a glucokinase activator and a DPP-IV inhibitor disclosed herein were obtained.

**[0009]** More specifically, the combined use of oral diabetic drugs with different actions can improve the function of multiple organs of patients in middle and late stages, and diabetes and accompanying diseases and complications were well treated. The number of pills taken by patients was reduced and the compliance of patients was improved, the total dose of drugs that achieve the same therapeutic effect was reduced, and the maximum efficacy was achieved with the lowest dose. It has a good effect and practical significance for the treatment or prevention of one or more of type I diabetes, type II diabetes, hyperglycemia, impaired glucose tolerance, obesity and other symptoms.

**[0010]** On the other hand, the fixed dose combination formulation comprising a glucokinase activator and a partner drug (the second or more active pharmaceutical ingredients) disclosed herein not only has better therapeutic effects than the single use of each of these two or more drugs, but also solves the technical challenges that usually exist in combination formulations.

The fixed dose combination formulation disclosed herein can provide the simultaneous release of two or more active ingredients with uniform content, and can optimize the dissolution rate of active ingredients contained in the formulation, especially making the active ingredients contained in the formulation quickly released in the pH environment of a small intestine. This is beneficial to the timely or simultaneous arrival of drugs in gut, pancreatic islet and liver target organs, achieving clinical advantages of multi-organs targeting, and synergistic hypoglycemic effect, and exhibiting a better therapeutic effect and reduced toxic or side effects. In addition, the fixed dose combination formulation comprising a glucokinase activator and a partner drug (the second or more active pharmaceutical ingredients) disclosed herein also has a short disintegration time, and good dissolution characteristics, and/or gives high bioavailability of the glucokinase activator in patients.

**[0011]** The present disclosure provides a pharmaceutical combination, a pharmaceutical composition, and a fixed dose combination formulation comprising a glucokinase activator, such as HMS5552 with following structure, or an isotope labeled analogue thereof, or a pharmaceutically acceptable salt thereof, and other oral hypoglycemic drug, especially a solid formulation, such as an oral solid formulation such as a tablet,




HMS5552

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**[0012]** Specifically, the present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation comprising a glucokinase activator drug such as HMS5552 or a pharmaceutically acceptable salt thereof and a DPP-IV inhibitor. Further, examples of the DPP-IV inhibitor include but are not limited to: sitagliptin, saxagliptin, vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin, and pharmaceutically acceptable salts thereof, wherein sitagliptin, saxagliptin, vildagliptin and linagliptin are preferred.

**[0013]** More specifically, the present disclosure also provides a fixed dose combination

solid formulation comprising a glucokinase activator drug such as HMS5552 or a pharmaceutically acceptable salt thereof and a partner drug such as sitagliptin. The solid formulation is alternatively a tablet, and yet alternatively a coated tablet. In one embodiment, the glucokinase activator, such as HMS5552, is in the form of a solid dispersion.

**[0014]** More specifically, the present disclosure also provides a fixed dose combination solid formulation comprising a glucokinase activator drug such as HMS5552 or a pharmaceutically acceptable salt thereof and a partner drug such as vildagliptin. The solid formulation is alternatively a tablet, and yet alternatively a coated tablet. In one embodiment, the glucokinase activator, such as HMS5552, is in the form of a solid dispersion.

**[0015]** More specifically, the present disclosure also provides a fixed dose combination solid formulation comprising a glucokinase activator drug such as HMS5552 or a pharmaceutically acceptable salt thereof and a partner drug such as saxagliptin. The solid formulation is alternatively a tablet, and yet alternatively a coated tablet. In one embodiment, the glucokinase activator, such as HMS5552, is in the form of a solid dispersion.

**[0016]** More specifically, the present disclosure also provides a fixed dose combination solid formulation comprising a glucokinase activator drug such as HMS5552 or a pharmaceutically acceptable salt thereof and a partner drug such as linagliptin. The solid formulation is alternatively a tablet, and yet alternatively a coated tablet. In one embodiment, the glucokinase activator, such as HMS5552, is in the form of a solid dispersion.

**[0017]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation of a glucokinase activator drug and a partner drug (the second or more active pharmaceutical ingredients) prepared by a dry or wet processing method. The release mode of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation disclosed herein is rapid release of the two or more active pharmaceutical ingredients.

**[0018]** The present disclosure also provides a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug (the second or more active pharmaceutical ingredients), which has a short disintegration time, and good dissolution characteristics and/or gives high bioavailability of the glucokinase activator in patients. The present disclosure also provides a method of preparing a pharmaceutical composition or a

pharmaceutical formulation of a fixed dose combination of a glucokinase activator drug and a partner drug (the second or more active pharmaceutical ingredients, such as sitagliptin, saxagliptin, vildagliptin and linagliptin) by a dry or wet processing method. The dry processing method includes dry compression (tableting) and dry granulation; and the wet processing method includes wet granulation.

**[0019]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug (the second or more active pharmaceutical ingredients), and a method for preventing, slowing down, delaying, or treating a metabolic disorder (especially type II diabetes).

**[0020]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug (the second or more active pharmaceutical ingredients), and a method for improving blood glucose control in patients in need thereof, especially patients with type II diabetes.

**[0021]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug, and a method for improving blood glucose control in patients with insufficient blood glucose control.

**[0022]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug, and a method for preventing, slowing down, or delaying diabetic cognitive dysfunction, memory dysfunction, senile dementia, impaired glucose tolerance (IGT), impaired fasting blood glucose (IFG), hypertension, insulin resistance and/or progression of metabolic syndrome to type II diabetes.

**[0023]** The present disclosure also provides a pharmaceutical combination, a pharmaceutical composition and a pharmaceutical formulation comprising a glucokinase activator drug and a partner drug, and a method for preventing, slowing down, delaying, or treating a disease or a disorder including diabetes complications.

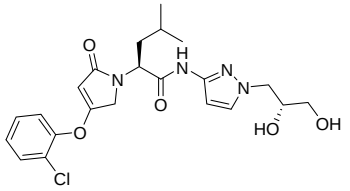
**[0024]** Other objects of the present disclosure will be apparent to those skilled in the art

from the description and examples.

## BRIEF DESCRIPTION OF THE EMBODIMENTS

**[0025]** The first aspect of the present disclosure provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising the following components, a preparation method thereof, and a use thereof for treating diabetes and related diseases:

(a) a glucokinase activator, which is a compound selected from the following, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof; alternatively, the glucokinase activator is HMS5552; yet alternatively, HMS5552 exists in the form of a solid dispersion,




HMS5552 ;

(b) a DPP-IV inhibitor; and

(c) one or more excipients.

**[0026]** Another aspect of the present disclosure provides a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation comprising the following components, a preparation method thereof, and a use thereof for the treatment of diabetes and related diseases:

(a) a glucokinase activator, which is HMS5552 compound, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof; alternatively, the glucokinase activator is HMS5552; yet alternatively, HMS5552 exists in the form of a solid dispersion;

(b) sitagliptin, vildagliptin, saxagliptin, linagliptin, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof; and

(c) one or more excipients.

**[0027]** In particular, one aspect of the present disclosure also relates to a pharmaceutical combination, a pharmaceutical composition, and a pharmaceutical formulation comprising a fixed dose combination of a HMS5552 solid dispersion and a partner drug (e.g., sitagliptin, vildagliptin, saxagliptin, linagliptin), and a preparation method thereof and a use thereof.

**DEFINITION**

**[0028]** Unless otherwise specified, all technical and scientific terms used herein have the same meanings as commonly understood by those skilled in the art to which the present disclosure belongs, but in case of conflict, the definitions in this specification shall prevail.

**[0029]** As used in the specification and claims, the singular forms "a", "an" and "the (said)" include plural forms, unless the context clearly dictates otherwise.

**[0030]** Unless otherwise specified, the percentages (%) in the specification are all weight percentages (% by weight).

**[0031]** All numerical values or expressions related to component amounts, process conditions, etc. used in the specification and claims should be understood to be modified by "about" in all cases. The term "about" when referring to a quantity or a range of numerical values means that the quantity or the range of numerical values referred to is an approximate value within experimental variability (or within statistical experimental error). Therefore, the quantity or the range of numerical values can be varied between, for example, ±5 percent of the quantity or the range of numerical values.

**[0032]** All ranges involving the same components or properties include endpoints, which can be independently combined. Since these ranges are continuous, they include every value between the minimal and maximal values. It should also be understood that any numerical range cited in this application is intended to include all sub-ranges within that range.

**[0033]** When the present disclosure uses a range to define physical properties such as molecular weight or chemical properties, it shall include all combinations and sub-combinations of the range and specific embodiments therein. The term "comprising" (and related terms such as "containing" or "including" or "having") includes embodiments which are, for example, any combinations of substances, compositions, methods, or processes, etc., and are "consisted of the described features" or "essentially consisted of the described

features".

**[0034]** As used in the specification and claims, "and/or" should be understood as "alternative or both" of the associated components, that is, the components coexist in some cases and exist separately in other cases. Multiple components listed with "and/or" should be understood in the same way, that is, "one or more" of the associated components. In addition to the components specifically identified in the "and/or" clause, other components may optionally be present, whether associated or not associated with those specifically identified components. Therefore, as a non-limiting example, when "A and/or B" is used to connect an open ending word such as "comprising", in one embodiment, it may only refer to A (optionally comprising components other than B); in another embodiment, it can only refer to B (optionally comprising components other than A); in yet another embodiment, it refers to A and B (optionally comprising other components), etc.

**[0035]** It should be understood that, unless explicitly indicated to the contrary, in any method that includes more than one step or one act claimed herein, the order of the steps and acts of the method is not necessarily limited to the order of the steps and acts of the method described.

**[0036]** The abbreviations used in the present disclosure have the common meanings in the fields of chemistry, biology and formulation.

**[0037]** Unless otherwise specified, the term "DPP-IV inhibitor" or any kind thereof (such as "sitagliptin, vildagliptin, saxagliptin, linagliptin") in the context of the present disclosure is also intended to include any pharmaceutically acceptable salt, crystalline form, hydrate, solvate, diastereomer or enantiomer thereof.

**[0038]** HMS5552 (its former name is RO5305552, and English name is Dorzagliatin) has a chemical name of (S)-2-[4-(2-chloro-phenoxy)-2-oxo-2,5-dihydro-pyrrol-1-yl]-4-methyl-pentanoic acid [1-((R)-2,3-dihydroxy-propyl)-1H-pyrazol-3-yl]-amide.

**[0039]** Unless otherwise specified, % by weight (wt %) represents a percentage of the total weight of a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation.

**[0040]** A solid dispersion (SD) refers to a solid dispersion system formed by highly

dispersing one or more active pharmaceutical ingredients into inactive adjuvants or carriers.

**[0041]** EUDRAGIT is the trade name of a synthetic pharmaceutical adjuvant. It includes copolymers of methacrylic acid and copolymers of methacrylate ester, collectively referred to as polyacrylic resins. Adjuvants based on polyacrylic resin are divided into different models according to their composition, proportion and degree of polymerization. Among them, Eudragit E is a polymer of dimethylaminoethyl methacrylate and methacrylate; Eudragit L is a polymer of methacrylic acid and methyl methacrylate with free carboxyl : ester of 1:1; and Eudragit S is a polymer of methacrylic acid and methyl methacrylate with free carboxyl : ester of 1:2.

**[0042]** The term "tablet" as used herein is intended to include compressed pharmaceutical formulations of all shapes and sizes, whether coated or not.

**[0043]** The terms “effective amount” or “therapeutically effective amount” refer to an amount of the agent sufficient to provide the desired biological result. The biological result may be a reduction and/or alleviation of the signs, symptoms, or causes of a disease, or any other desired alteration of a biological system. For example, an “effective amount” for therapeutic use is the necessary amount of the composition comprising a compound as the active ingredient as disclosed herein for providing a clinically significant decrease in a disease. An appropriate “effective” amount in any individual embodiment may be determined by one of ordinary skill in the art using routine experimentation. Thus, the expression “effective amount” generally refers to the quantity for which the active substance has therapeutic effects.

**[0044]** As used herein, the terms “treat” or “treatment” are synonymous with the term “prevent” and are meant to indicate a postponement of development of diseases, preventing the development of diseases, and/or reducing severity of such symptoms that will or are expected to develop. Thus, these terms include ameliorating existing disease symptoms, preventing additional symptoms, ameliorating or preventing the underlying metabolic causes of symptoms, inhibiting the disorder or disease, e.g., preventing the development of the disorder or disease, relieving the disorder or disease, causing a regression of the disorder or disease, relieving a condition caused by the disease or disorder, or stopping the symptoms of the disease or disorder.

**[0045]** By “pharmaceutically acceptable” or “pharmacologically acceptable”, it is meant a material which is not biologically or otherwise undesirable, i.e., the material may be

administered to an individual without causing a minimum of undesirable biological effects or interacting in a deleterious manner with any other components of the composition in which it is contained.

**[0046]** As used herein, the term “subject” encompasses mammals and non-mammals. Examples of mammals include, but are not limited to, any member of the mammalian class: humans, non-human primates such as chimpanzees, and other apes and monkey species; farm animals such as cattle, horses, sheep, goats, swine; domestic animals such as rabbits, dogs, and cats; laboratory animals including rodents, such as rats, mice and guinea pigs, and the like. Examples of non-mammals include, but are not limited to, birds, fish and the like. In one embodiment of the present disclosure, the mammal is a human.

**[0047]** A compound as an active ingredient in a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation (e.g., a fixed dose combination formulation) comprising a glucokinase activator disclosed herein may form a salt. Reference to a compound disclosed herein is understood to include reference to salts thereof, unless otherwise indicated. The term "salt(s)", as used herein, denotes acidic salts formed with inorganic and/or organic acids, as well as basic salts formed with inorganic and/or organic bases. In addition, when a compound contains both a basic moiety, such as, but not limited to a pyridine or imidazole, and an acidic moiety, such as, but not limited to a carboxylic acid, zwitterions ("inner salts") may be formed and are included within the term "salt(s)" as used herein. Pharmaceutically acceptable (i.e., non-toxic, physiologically acceptable) salts are preferred, although other salts are also useful. Salts of the compound may be formed, for example, by reacting the compound with an amount, such as an equivalent amount, of acid or base in a medium such as a medium from which the salt precipitates or in an aqueous medium (lyophilization after reaction).

**[0048]** Various compounds and salts, solvates, esters and prodrugs thereof, and polymorphs thereof are intended to be included in the disclosure.

**[0049]** It is to be understood that the terminology employed herein is for the purpose of describing particular embodiments, and is not intended to be limiting. Further, although any methods, devices and materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods, devices and materials are described below.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0050]** Figure 1 shows the dissolution results of Example 4B and a single tablet with the same dose; and

**[0051]** Figure 2 shows the results of an animal study on pharmacodynamics of HMS5552 combined with sitagliptin in rat model of type 2 diabetes.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0052]** One aspect of the present disclosure relates to a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation such as a fixed dose combination formulation of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue or a pharmaceutically acceptable salt thereof) and a partner drug (e.g., sitagliptin, vildagliptin, saxagliptin, linagliptin). The formulation can be powder, granule, tablet, capsule, sachet or other solid forms. Specifically, one aspect of the present disclosure relates to a tablet comprising a fixed dose combination of a glucokinase activator and a partner drug (e.g., sitagliptin, vildagliptin, saxagliptin, linagliptin).

**[0053]** In a specific aspect of the present disclosure, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation comprises:

(1) a glucokinase activator or a pharmaceutically acceptable salt thereof, or an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof; alternatively, the glucokinase activator is HMS5552; yet alternatively, HMS5552 is in the form of a solid dispersion, such as a solid dispersion (e.g., a spray-dried powder) comprising a polymer carrier;

(2) a DPP-IV inhibitor; alternatively selected from: sitagliptin, vildagliptin, saxagliptin, linagliptin, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof; and/or

(3) filler(s); and/or

(4) binder(s); and/or

(5) disintegrant(s); and/or

(6) lubricant(s) or glidant(s); and/or

(7) coating agent(s).

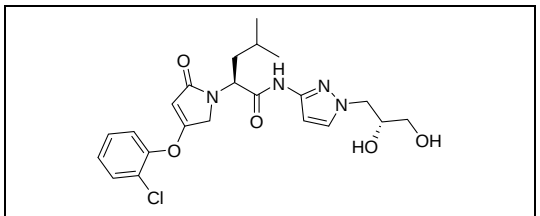
**[0054]** In one embodiment disclosed herein, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation may also contain one or more excipients selected from the group consisting of one or more binders; one or more diluents (fillers); one or more disintegrants; one or more lubricants; one or more glidants; one or more surfactants or wetting agents; one or more antioxidants; and one or more coating agents.

## Pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation

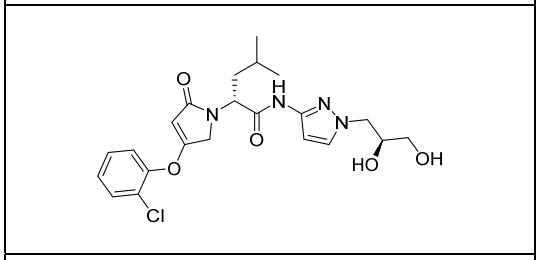
### Glucokinase activator + DPP-IV inhibitor drug

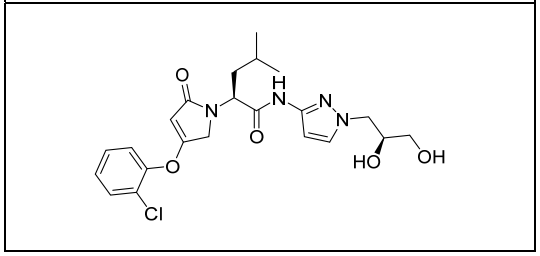
**[0055]** In one embodiment, the present disclosure relates to a pharmaceutical combination, a pharmaceutical composition or a pharmaceutical formulation (alternatively, a fixed dose combination formulation), which comprises:

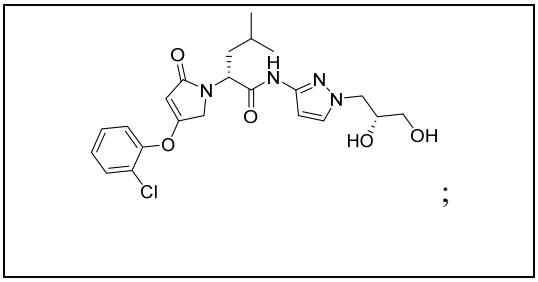
(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof;



HMS5552







;

(b) a DPP-IV inhibitor;

alternatively, it is selected from the group consisting of sitagliptin, saxagliptin, vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin, and a pharmaceutically acceptable salt thereof. Among them, sitagliptin, saxagliptin, vildagliptin and linagliptin are preferred; and

(c) one or more excipients;

wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

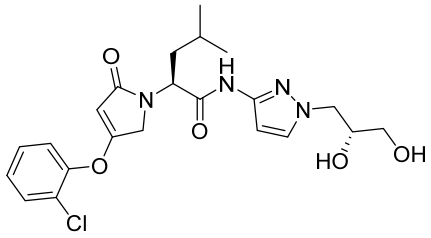
**[0056]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 100:1, alternatively about 1:4 to 40:1, and yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1, or about 40:1.

**[0057]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively from about 25 mg to about 100 mg, and alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg or about 100 mg.

**[0058]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation, the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, alternatively, wherein the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or

about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively, about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

**[0059]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the above-mentioned glucokinase activator is the compound HMS5552, or an isotope labeled analogue or a pharmaceutically acceptable salt thereof,




HMS5552 .

**[0060]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the glucokinase activator is in the form of a solid dispersion.

**[0061]** In one embodiment, the solid dispersion is obtained by spray drying, hot melting or freeze drying of a glucokinase activator, or an isotope labeled analogue, or a pharmaceutically acceptable salt thereof, together with a polymer carrier.

**[0062]** In one embodiment, the content of the glucokinase activator in the solid dispersion may vary from about 1% to about 99% by weight, and alternatively 10% to 90% by weight, based on the total weight of the solid dispersion. In one embodiment, the content of the

glucokinase activator is about 1% by weight, about 2% by weight, about 3% by weight, about 4% by weight, about 5% by weight, about 6% by weight, about 7% by weight, about 8% by weight, about 9% by weight, about 10% by weight, about 11% by weight, about 12% by weight, about 13% by weight, about 14% by weight, about 15% by weight, about 16% by weight, about 17% by weight, about 18% by weight, about 19% by weight, about 20% by weight, about 21% by weight, about 22% by weight, about 23% by weight, about 24% by weight, about 25% by weight, about 26% by weight, about 27% by weight, about 28% by weight, about 29% by weight, about 30% by weight, about 31% by weight, about 32% by weight, about 33% by weight, about 34% by weight, about 35% by weight, about 36% by weight, about 37% by weight, about 38% by weight, about 39% by weight, about 40% by weight, about 41% by weight, about 42% by weight, about 43% by weight, about 44% by weight, about 45% by weight, about 46% by weight, about 47% by weight, about 48% by weight, about 49% by weight, about 50% by weight, about 51% by weight, about 52% by weight, about 53% by weight, about 54% by weight, about 55% by weight, about 56% by weight, about 57% by weight, about 58% by weight, about 59% by weight, about 60% by weight, about 61% by weight, about 62% by weight, about 63% by weight, about 64% by weight, about 65% by weight, about 66% by weight, about 67% by weight, about 68% by weight, about 69% by weight, about 70% by weight, about 71% by weight, about 72% by weight, about 73% by weight, about 74% by weight, about 75% by weight, about 76% by weight, about 77% by weight, about 78% by weight, about 79% by weight, about 80% by weight, about 81% by weight, about 82% by weight, about 83% by weight, about 84% by weight, about 85% by weight, about 86% by weight, about 87% by weight, about 88% by weight, about 89% by weight, about 90% by weight, about 91% by weight, about 92% by weight, about 93% by weight, about 94% by weight, about 95% by weight, about 96% by weight, about 97% by weight, about 98% by weight, or about 99% by weight, or any range therebetween.

**[0063]** In one embodiment, the content of the glucokinase activator in the solid dispersion is about 1% to about 20% by weight, about 2% to about 40% by weight, about 30% to about 60% by weight, about 60% to about 80% by weight, about 70% to about 90% by weight, or about 80% to about 100% by weight, based on the total weight of the solid dispersion.

**[0064]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the glucokinase activator is in the form of a solid dispersion. In the solid dispersion, the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4, or about 5:6 to 6:5, yet alternatively about 1:1, about 2:3, about 3:4, about 4:5, or about 5:6 or any range therebetween.

**[0065]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the glucokinase activator is the compound HMS5552, an isotope labeled analogue thereof, or a pharmaceutically acceptable salt thereof, which is combined with a polymer carrier to obtain a solid dispersion by spray drying, hot melting or freeze drying.

**[0066]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the polymer carrier in the solid dispersion is selected from a polypropylene resin-based polymer, which is a polymeric compound derived from the polymerization of acrylic acid (or methacrylic acid and esters thereof such as methyl ester, ethyl esters and the like) (as monomer), or derived from the polymerization of two monomers (binary polymerization) or three monomers (ternary polymerization) in a certain ratio using acrylic acid and methacrylic acid (or its ester such as methyl ester, ethyl ester, dimethylaminoethyl ester, etc.).

**[0067]** In one embodiment, the polymer carrier used in the solid dispersion in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is selected from the group consisting of copolymer of butyl methacrylate, dimethylaminoethyl methacrylate and methyl methacrylate; copolymer of methacrylic acid and ethyl acrylate; copolymer of methacrylic acid and methyl methacrylate; copolymer of ethyl acrylate, methyl methacrylate and chlorotrimethylamino ethyl methacrylate; copolymer of ethyl acrylate and methyl methacrylate; copolymer of methacrylic acid, methyl acrylate and methyl

methacrylate, and copolymer of methacrylic acid and butyl acrylate.

**[0068]** In one embodiment, the above-mentioned polymer carrier is selected from the group consisting of copolymer of butyl methacrylate, dimethylaminoethyl methacrylate and methyl methacrylate (1:2:1), copolymer of methacrylic acid and ethyl acrylate (1:1), copolymer of methacrylic acid and methyl methacrylate (1:2), copolymer of ethyl acrylate, methyl methacrylate and chlorotrimethylamino ethyl methacrylate (1:2:0.2), copolymer of ethyl acrylate, methyl methacrylate and chlorotrimethylamino ethyl methacrylate (1:2:0.1), copolymer of ethyl acrylate and methyl methacrylate (2:1), copolymer of methacrylic acid and butyl acrylate (35:65), copolymer of methacrylic acid and methyl methacrylate (1:1), copolymer of methacrylic acid and methyl methacrylate (35:65).

**[0069]** In one embodiment, the above-mentioned polymer carrier is Eudragit, including Eudragit E, Eudragit L, Eudragit S, Eudragit RL and Eudragit RS, wherein Eudragit E is produced by the polymerization of dimethylamino methacrylate and other neutral methacryates, including copolymers of dimethylaminoethyl methacrylate and methacrylate; Eudragit L and Eudragit S is produced by the polymerization of methacrylic acid and methacrylates in various ratios, including methacrylic acid and methyl methacrylate, free carboxyl : ester=1:1 or methacrylic acid and methyl methacrylate, free carboxyl : ester=1:2; Eudragit RL and Eudragit RS type is a copolymer of acrylic acid containing some quaternary amine groups and methacrylate, including the copolymer of acrylic acid containing 10% quaternary amine group and methacrylate and the copolymer of acrylic acid containing 5% quaternary amine group and methacrylate.

**[0070]** In one embodiment, the above-mentioned polymer carrier is selected from the group consisting of:

Eudragit E100, which is copolymer of butyl methacrylate, dimethylaminoethyl methacrylate and methyl methacrylate (1:2:1), including Eudragit E PO;

Eudragit L100, methacrylic acid copolymer of type A, which is an anionic copolymer of methacrylic acid and methyl methacrylate (1:1);

Eudragit S100, which is copolymer of methacrylic acid and methyl methacrylate (1:2).

**[0071]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose

combination formulation), the polymer carrier in the solid dispersion of HMS5552 is methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

**[0072]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the weight ratio of HMS5552 to Eudragit L100 in the solid dispersion of HMS5552 is about 1:10 to 10:1, about 1:9 to 9:1, about 2:3 to 9:1, about 3:4 to 9:1, about 4:5 to 9:1, about 5:6 to 9:1, or about 1:1 to 9:1; alternatively, about 2:3 to 4:1, about 3:4 to 4:1, about 4:5 to 4:1, about 5:6 to 4:1, or about 1:1 to 4:1; alternatively, about 2:3 to 7:3, about 3:4 to 7:3, about 4:5 to 7:3, about 5:6 to 7:3, or about 1:1 to 7:3; alternatively, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4, or about 5:6 to 6:5; alternatively, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4, or about 5:6 to 6:5, or any range therebetween.

**[0073]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the weight ratio of HMS5552 to Eudragit L100 in the solid dispersion of HMS5552 is about 1:1, about 2:3, about 3:2, about 1:4, about 4:1, about 3:4, about 4:3, about 4:5, about 5:4, about 5:6, about 6:5, about 7:3, about 3:7, about 1:9, about 9:1, or any range therebetween.

**[0074]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) has sitagliptin or sitagliptin phosphate monohydrate as the second active ingredient, and contains by weight: about 1-80% of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 1-80% of sitagliptin (or sitagliptin phosphate monohydrate); about 0-55% of filler(s); about 1-25% of binder(s); about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s), about 0-3% of glidant(s) and 0-5% of coating agent(s).

**[0075]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (alternatively HMS5552 or an isotope

labeled analogue thereof or a pharmaceutically acceptable salt thereof) and sitagliptin (or sitagliptin phosphate monohydrate) contains by weight: about 5-45% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5-75% of sitagliptin or sitagliptin phosphate monohydrate; about 0-50% of filler(s); about 1-10% of binder(s); about 1-10% of disintegrant(s); about 0.1-5% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s). The pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is prepared by a wet granulation method or a dry granulation method, alternatively by a wet granulation method.

**[0076]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 1 mg to 200 mg. The alternative dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg to 100 mg. Alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg, about 10 mg, about 20 mg, about 25 mg, about 30 mg, about 40 mg, about 50 mg, about 60 mg, about 75 mg, about 80 mg, about 90 mg, about 100 mg, or any range therebetween. Yet alternatively, the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 25 mg, about 50 mg, about 75 mg, or about 100 mg. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[0077]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the second active ingredient is sitagliptin (or sitagliptin phosphate monohydrate), and has a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg, calculated based on the content of sitagliptin. Alternatively, in the above-mentioned pharmaceutical combination,

pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[0078]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the embodiments of the doses (alternatively, unit doses) of HMS5552 (or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and sitagliptin (or sitagliptin phosphate monohydrate) are as follows:

(1) about 25 mg of HMS5552 and about 50 mg of sitagliptin (or about 64.25 mg of sitagliptin phosphate monohydrate);

(2) about 50 mg of HMS5552 and about 50 mg of sitagliptin (or about 64.25 mg of sitagliptin phosphate monohydrate);

(3) about 75 mg of HMS5552 and about 50 mg of sitagliptin (or about 64.25 mg of sitagliptin phosphate monohydrate);

(4) about 100 mg of HMS5552 and about 50 mg of sitagliptin (or about 64.25 mg of sitagliptin phosphate monohydrate);

(5) about 25 mg of HMS5552 and about 100 mg of sitagliptin (or about 128.5 mg of sitagliptin phosphate monohydrate);

(6) about 50 mg of HMS5552 and about 100 mg of sitagliptin (or about 128.5 mg of sitagliptin phosphate monohydrate);

(7) about 75 mg of HMS5552 and about 100 mg of sitagliptin (or about 128.5 mg of sitagliptin phosphate monohydrate);

(8) about 100 mg of HMS5552 and about 100 mg of sitagliptin (or about 128.5 mg of sitagliptin phosphate monohydrate);

**[0079]** Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion. In one embodiment, the alternative dosage form of the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation is a tablet.

**[0080]** In one embodiment, the above-mentioned tablet is a fixed dose combination tablet of the glucokinase activator (HMS5552 and an isotope labeled analogue thereof or a

pharmaceutically acceptable salt thereof) and sitagliptin or sitagliptin phosphate monohydrate.

**[0081]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 25 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively, contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0082]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 50 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0083]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 75 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0084]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 100 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0085]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg

glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/100 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 25 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 100 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0086]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/100 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 50 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 100 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0087]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/100 mg sitagliptin (or an amount of sitagliptin

phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 75 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 100 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0088]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/100 mg sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin)) contains the following components by weight: about 100 mg of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 100 mg of sitagliptin (or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin); about 0-50% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and 0-5% of coating agent(s); alternatively, the glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0089]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) has saxagliptin or saxagliptin monohydrate as the second active ingredient, and contains by weight: about 1-80% of the glucokinase activator (or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 0.5-20% of saxagliptin (or saxagliptin monohydrate); about 0-90% of filler(s); about 1-25% of binder(s);

about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s), about 0-3% of glidant(s) and about 0-5% of coating agent(s).

**[0090]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) has saxagliptin (or saxagliptin monohydrate) as the second active ingredient, and contains by weight: about 1 to 80% of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 0.5 to 20% of saxagliptin (or saxagliptin monohydrate); about 0-90% of filler(s); about 1-25% of binder(s); about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s), about 0-3% of glidant(s) and about 0-5% of coating agent(s). The pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is prepared by a wet granulation method or a dry granulation method, alternatively by a wet granulation method.

**[0091]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 1 mg to 200 mg. The alternative dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg to 100 mg. Alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg, about 10 mg, about 20 mg, about 25 mg, about 30 mg, about 40 mg, about 50 mg, about 60 mg, about 75 mg, about 80 mg, about 90 mg, about 100 mg, or any range therebetween. Yet alternatively, the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 25 mg, about 50 mg, about 75 mg, or about 100 mg. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[0092]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the second active ingredient is saxagliptin (or saxagliptin

monohydrate), and has a dose (alternatively, a unit dose) of about 1 mg to about 50 mg, alternatively about 2.5 mg, about 5 mg, about 7.5 mg or about 10 mg, and still alternatively about 2.5 mg or about 5 mg, calculated based on the content of saxagliptin. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[0093]** In the pharmaceutical composition or fixed dose combination formulation disclosed herein, the embodiments of the doses (alternatively, unit doses) of HMS5552 (or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and saxagliptin (or saxagliptin monohydrate) are as follows:

(1) about 25 mg of HMS5552 and about 2.5 mg of saxagliptin (or about 2.64 mg of saxagliptin monohydrate);

(2) about 50 mg of HMS5552 and about 2.5 mg of saxagliptin (or about 2.64 mg of saxagliptin monohydrate);

(3) about 75 mg of HMS5552 and about 2.5 mg of saxagliptin (or about 2.64 mg of saxagliptin monohydrate);

(4) about 100 mg of HMS5552 and about 2.5 mg of saxagliptin (or about 2.64 mg of saxagliptin monohydrate);

(5) about 25 mg of HMS5552 and about 5 mg of saxagliptin (or about 5.29 mg of saxagliptin monohydrate);

(6) about 50 mg of HMS5552 and about 5 mg of saxagliptin (or about 5.29 mg of saxagliptin monohydrate);

(7) about 75 mg of HMS5552 and about 5 mg of saxagliptin (or about 5.29 mg of saxagliptin monohydrate);

(8) about 100 mg of HMS5552 and about 5 mg of saxagliptin (or about 5.29 mg of saxagliptin monohydrate);

alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[0094]** In one embodiment, the alternative dosage form of the above-mentioned

pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is a tablet.

**[0095]** In one embodiment, the above-mentioned tablet is a fixed dose combination tablet of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and saxagliptin (or saxagliptin monohydrate).

**[0096]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/2.5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 25 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 2.5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0097]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/2.5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 50 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 2.5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier,

alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0098]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/2.5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 75 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 2.5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[0099]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/2.5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 100 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 2.5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00100]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a

pharmaceutically acceptable salt thereof)/5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 25 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00101]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 50 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00102]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 75 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of saxagliptin (or

an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00103]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin)) contains the following components by weight: about 100 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of saxagliptin (or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin); about 0-80% of filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, alternatively, the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00104]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the second active ingredient is linagliptin. The above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and linagliptin contains one or more of the substances with the following amounts (by weight): about 1-90% of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 1-20% of linagliptin; about 0-90% of filler(s); about 1-25% of binder(s); about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s), about 0-3% of glidant(s) and about 0-5% of coating agent(s).

**[00105]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the second active ingredient is linagliptin. The above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and linagliptin contains one or more of the substances with the following amounts (by weight): about 1-80% of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 1-20% of linagliptin; about 0-90% of filler(s); about 1-25% of binder(s); about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s), about 0-3% of glidant(s) and about 0-5% of coating agent(s). The pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is prepared by a wet granulation method or a dry granulation method, alternatively by a wet granulation method.

**[00106]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 1 mg to 200 mg. The alternative dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg to 100 mg. Alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg, about 10 mg, about 20 mg, about 25 mg, about 30 mg, about 40 mg, about 50 mg, about 60 mg, about 75 mg, about 80 mg, about 90 mg, about 100 mg, or any range therebetween. Yet alternatively, the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 25 mg, about 50 mg, about 75 mg, or about 100 mg. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[00107]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose

combination formulation), the second active ingredient is linagliptin, and the dose (alternatively, a unit dose) of linagliptin is about 1 mg to about 50 mg, alternatively about 2.5 mg, about 5 mg, about 7.5 mg or about 10 mg. The alternative dose (alternatively, a unit dose) of linagliptin is about 2.5 mg or about 5 mg. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[00108]** In the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the embodiments of the doses (alternatively, unit doses) of HMS5552 (or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and saxagliptin are as follows:

(1) about 25 mg of HMS5552 and about 2.5 mg of linagliptin;

(2) about 25 mg of HMS5552 and about 5 mg of linagliptin;

(3) about 50 mg of HMS5552 and about 2.5 mg of linagliptin;

(4) about 50 mg of HMS5552 and about 5 mg of linagliptin;

(5) about 75 mg of HMS5552 and about 2.5 mg of linagliptin;

(6) about 75 mg of HMS5552 and about 5 mg of linagliptin;

(7) about 100 mg of HMS5552 and about 2.5 mg of linagliptin; and

(8) about 100 mg of HMS5552 and about 5 mg of linagliptin;

alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[00109]** In one embodiment, the alternative dosage form of the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is a tablet.

**[00110]** In one embodiment, the above-mentioned tablet is a fixed dose combination tablet of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and linagliptin.

**[00111]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg

glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg linagliptin) contains the components with the following amounts (by weight): about 25 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of linagliptin; about 0-90% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00112]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg linagliptin) contains the components with the following amounts (by weight): about 50 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of linagliptin; about 0-90% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00113]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg linagliptin) contains the components with the following amounts (by weight): about 75 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of linagliptin; about 0-90% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of

coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00114]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/5 mg linagliptin) contains the components with the following amounts (by weight): about 100 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 5 mg of linagliptin; about 0-90% of optional filler(s); about 2-8% of binder(s); about 1-5% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00115]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the second active ingredient is vildagliptin. The above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and vildagliptin contains by weight about 1-80% of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 1-50% of vildagliptin; about 0-55% of filler(s); about 1-25 % of binder(s); about 0-15% of disintegrant(s); about 0.1-10% of lubricant(s); about 0-3% of glidant(s); about 0-5% of coating agent(s). The pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) is prepared by a wet granulation method or a dry granulation method, alternatively by a dry granulation method.

**[00116]** In one embodiment, in the above-mentioned pharmaceutical combination,

pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and vildagliptin, the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 1 mg to 200 mg. The alternative dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg to 100 mg. Alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 5 mg, about 10 mg, about 20 mg, about 25 mg, about 30 mg, about 40 mg, about 50 mg, about 60 mg, about 75 mg, about 80 mg, about 90 mg, about 100 mg, or any range therebetween. Yet alternatively, the dose (alternatively, a unit dose) of the glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) is about 25 mg, about 50 mg, about 75 mg, or about 100 mg. Alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[00117]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and vildagliptin, the dose (alternatively, a unit dose) of vildagliptin is about 10 mg to about 150 mg, alternatively about 50 mg or about 100 mg, and the alternative dose (alternatively, a unit dose) of vildagliptin is about 50 mg.

**[00118]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), the embodiments of the doses (alternatively, unit doses) of HMS5552 (or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and vildagliptin are as follows:

(1) about 25 mg of HMS5552 and about 50 mg of vildagliptin;

(2) about 50 mg of HMS5552 and about 50 mg of vildagliptin;

(3) about 75 mg of HMS5552 and about 50 mg of vildagliptin; and

(4) about 100 mg of HMS5552 and about 50 mg of vildagliptin;

alternatively, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), HMS5552 exists in the form of a solid dispersion.

**[00119]** In one embodiment, the alternative dosage form of the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) disclosed herein is a tablet.

**[00120]** In one embodiment, the above-mentioned fixed dose combination tablet is a tablet of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof) and vildagliptin.

**[00121]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 25 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg vildagliptin) contains the components with the following amounts (by weight): about 25 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of vildagliptin; about 0-80% of filler(s); about 2-8% of binder(s); about 1-8% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00122]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 50 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg vildagliptin) contains the components with the following amounts (by weight): about 50 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of vildagliptin; about 0-80% of filler(s); about 2-8% of binder(s); about 1-8% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of

coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00123]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 75 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg vildagliptin) contains the components with the following amounts (by weight): about 75 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of vildagliptin; about 0-80% of filler(s); about 2-8% of binder(s); about 1-8% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00124]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination tablet of 100 mg glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof)/50 mg vildagliptin) contains the components with the following amounts (by weight): about 100 mg of the glucokinase activator (HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof); about 50 mg of vildagliptin; about 0-80% of filler(s); about 2-8% of binder(s); about 1-8% of disintegrant(s); about 0.5-3% of lubricant(s); about 0-0.5% of glidant(s) and about 0-5% of coating agent(s); alternatively, the above-mentioned glucokinase activator is in the form of a solid dispersion as described above, and alternatively the solid dispersion contains a glucokinase activator and a polymer carrier, alternatively contains about 1:1 of the glucokinase activator and Eudragit L100.

**[00125]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose

combination formulation) further comprises an excipient, wherein the excipient includes, but is not limited to, one or more of diluents, binders, fillers, disintegrants, lubricants, glidants, flavoring agents (flavors), sweetening agents, coloring agents, and coating agents.

**[00126]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) disclosed herein contains optionally one or more fillers (diluents). Examples of fillers include, but are not limited to, cellulose derivatives such as microcrystalline cellulose or lignocellulose (including microcrystalline cellulose and silicified microcrystalline cellulose), lactose, anhydrous lactose or lactose monohydrate, sucrose, starch, pregelatinized starch, dextrose, mannitol (including mannitol Pearlitol SD 200), fructose, xylitol, sorbitol, corn starch, modified corn starch, inorganic salts such as calcium carbonate, calcium phosphate, dicalcium phosphate, calcium sulfate, dextrin/glucose binder, maltodextrin, compressible sugar and other known compatibilizers or fillers/or a mixture of two or more of them.

**[00127]** Examples of alternative fillers (diluents) include microcrystalline cellulose (MCC), silicified microcrystalline cellulose (SMCC), lactose, mannitol, sorbitol, calcium dihydrogen phosphate (dihydrate), corn starch, pregelatinized starch and powdered cellulose. Another alternative fillers (diluents) are microcrystalline cellulose and silicified microcrystalline cellulose. Microcrystalline cellulose can be obtained from several suppliers, including Avicel PH 101, Avicel PH 102, Avicel PH 103, Avicel PH 105, and Avicel PH 200 manufactured by FMC Corporation.

**[00128]** In one embodiment, the pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) disclosed herein contains optionally one or more binders. Examples include, but are not limited to, carboxymethylcellulose (including sodium carboxymethylcellulose), hydroxypropyl cellulose (including hydroxypropyl cellulose EXF), corn starch, pregelatinized starch, modified corn starch, polyvinyl pyrrolidone (PVP), hydroxypropylmethyl cellulose (HPMC) (including hydroxypropylmethyl cellulose 2208), lactose, sucrose, gum arabic, ethylcellulose, cellulose acetate and wax binders such as carnauba wax, paraffin wax, cetyl wax, polyethylene or microcrystalline wax and other conventional binder and/or a mixture of two or more of them. Further, in addition to the above binders, binders suitable for use in the present disclosure

include, but are not limited to, alginic acid, microcrystalline cellulose, dextrin, gelatin, amylopectin, liquid glucose, guar gum, methylcellulose, polyethylene oxide, povidone and syrup, and the combination of them.

**[00129]** Alternative embodiments of the binder include hydroxypropyl cellulose (HPC), hydroxypropyl methyl cellulose (HMPC), polyvinylpyrrolidone (Povidone), hydroxyethyl cellulose, starch 1500 and Polyvidon. Another alternative binders are hydroxypropyl cellulose, hydroxypropyl methyl cellulose and polyvinylpyrrolidone.

**[00130]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) contains optionally one or more disintegrants. Examples of disintegrants suitable for use in the present disclosure include, but are not limited to, croscarmellose sodium, crospovidone, lactose, sucrose, starch, potato starch, pregelatinized starch, corn starch, sodium carboxymethyl starch, sodium starch glycolate, microcrystalline cellulose, light silicic acid anhydride, low-substituted hydroxypropyl cellulose and other known disintegrants.

**[00131]** Alternatively, the disintegrant is selected from one or more of modified starch, modified cellulose polymer or polycarboxylic acid, specifically selected from the group consisting of croscarmellose sodium, crospovidone, sodium starch glycolate, polacrilin potassium and CMC Calcium. In one embodiment, the disintegrant is crospovidone. In another embodiment, the disintegrant is sodium starch glycolate. In another embodiment, the disintegrant is croscarmellose sodium. Croscarmellose sodium NF type A is available in the market under the trade name "Ac-di-sol".

**[00132]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) contains one or more lubricants. Examples of lubricants suitable for use in the present disclosure include, but are not limited to, magnesium stearate, zinc stearate, calcium stearate, talc, carnauba wax, stearic acid, palmitic acid, sodium stearyl fumarate, sodium lauryl sulphate, glyceryl palmitate stearate, palmitic acid, myristic acid and hydrogenated vegetable oils (including hydrogenated castor oil) and fats and other known lubricants and/or a mixture of two or more of them.

**[00133]** Alternatively, embodiments of the lubricant include magnesium stearate, calcium stearate, stearic acid, sodium stearyl fumarate, hydrogenated castor oil, and a mixture thereof. Another alternative lubricant is magnesium stearate, or sodium stearyl fumarate, or a mixture thereof.

**[00134]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) contains one or more glidants and/or anti-adherents. Examples of glidants and/or anti-adherents suitable for use in the present disclosure include, but are not limited to, silicon dioxide, colloidal silicon dioxide, magnesium silicate, calcium phosphate, magnesium trisilicate, talc and other forms of silicon dioxide such as aggregated silicate and hydrated silica gel.

**[00135]** Alternatively, embodiments of the glidant include colloidal silicon dioxide, calcium phosphate, magnesium silicate, and talc, or a mixture thereof. The alternative glidant is colloidal silicon dioxide.

**[00136]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) may also optionally contain one or more surfactants or wetting agents. The surfactant can be an anionic, cationic or neutral surfactant. The anionic surfactant includes sodium lauryl sulfate, sodium lauryl sulfonate, sodium oleyl sulfate, and sodium laurate mixed with stearate and talc. The cationic surfactant includes benzalkonium chloride and alkyl trimethyl ammonium bromide. The neutral surfactant includes glycerol monooleate, polyoxyethylene sorbitan fatty acid ester, polyvinyl alcohol and sorbitan ester. Embodiments of the wetting agent include poloxamer, polyoxyethylene alkyl ether, polyoxyethylene castor oil derivative, and polyoxyethylene stearate.

**[00137]** In one embodiment, the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation) may also optionally contain an antioxidant to render chemical stability. Examples of the antioxidant suitable for use in the present disclosure include, but are not limited to, tocopherol, ascorbic acid, gallic acid ester, ascorbyl palmitate, butylated hydroxyanisole, butylated hydroxytoluene, thioglycerol, potassium metabisulfite, propionic

acid, propyl gallate, sodium ascorbate, sodium bisulfite, sodium metabisulfite and sodium sulfite and a combination thereof.

**[00138]** Alternatively, the antioxidant is selected from the group consisting of α-tocopherol, γ-tocopherol, δ-tocopherol, extracts from natural sources enriched in tocopherol, L-ascorbic acid and sodium or calcium salt thereof, ascorbyl palmitate, propyl gallate, octyl gallate, lauryl gallate, butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA). In one embodiment, the antioxidant is BHT or BHA.

**[00139]** In one embodiment, the alternative formulation of the above-mentioned fixed dose combination formulation is a tablet prepared by a compression method. The tablet may be coated, and alternative examples of coating substrates include sugar coating substrates, water-soluble film coating substrates, enteric film coating substrates, and the like.

**[00140]** Sucrose is used as the sugar coating substrate. In addition, one or more selected from talc powder, precipitated calcium carbonate, gelatin, gum arabic, amylopectin, carnauba wax, and the like can also be used in combination.

**[00141]** Examples of the water-soluble film coating substrate include cellulosic polymers such as hydroxypropyl cellulose, hydroxypropyl methyl cellulose, hydroxyethyl cellulose, methyl hydroxyethyl cellulose, and the like; synthetic polymers such as polyvinyl acetal diethylaminoacetate, aminoalkyl methacrylate copolymer E [Eudragit E (trade name)], polyvinylpyrrolidone, and the like.

**[00142]** Examples of the enteric film coating substrate include cellulosic polymers such as hydroxypropyl methyl cellulose phthalate, hydroxypropyl methyl cellulose acetate succinate, carboxymethyl ethyl cellulose, cellulose acetate phthalate, and the like; acrylic polymer, such as methacrylic acid copolymer L [Eudragit L (trade name)], methacrylic acid copolymer LD [Eudragit L-30D55 (trade name)], methacrylic acid copolymer S [Eudragit S (trade name)], and the like.

**[00143]** Preferable examples of coating additives include: plasticizers such as polyvinyl alcohol (PVA), polyethylene glycol (PEG), propylene glycol, triethyl citrate, castor oil, polysorbate, and the like, or a mixture of two or more of them; opacifiers such as titanium dioxide and the like; coloring agents, dyes and lakes such as iron oxide red (ferric oxide), iron oxide yellow, and the like; and glidants such as talc and the like.

**[00144]** Alternatively, the tablet may be coated with, for example, a mixture of hydroxypropylcellulose and hydroxypropylmethylcellulose, wherein the mixture contains titanium dioxide and/or other coloring agents, such as iron oxide, dyes and lakes; a mixture of polyvinyl alcohol (PVA) and polyethylene glycol (PEG); or any other suitable immediate-release coating agent. The coating provides taste masking and additional stability to the final tablet. The commercially available coating material is Opadry® such as Opadry 03K12429 which is a pre-formulated powder mixture provided by Colorcon.

**[00145]** In one embodiment, in the above-mentioned pharmaceutical combination, pharmaceutical composition or pharmaceutical formulation (alternatively a fixed dose combination formulation), sweetening agents and/or flavoring agents may also be added as needed.

**[00146]** In one embodiment, the above-mentioned binder is polyvinylpyrrolidone, hydroxypropyl cellulose or hydroxypropyl methyl cellulose, the above-mentioned filler is microcrystalline cellulose, silicified microcrystalline cellulose, lactose, calcium dihydrogen phosphate, mannitol, corn starch or pregelatinized starch, the above-mentioned disintegrant is croscarmellose sodium, crospovidone or sodium starch glycolate, the above-mentioned lubricant is magnesium stearate or sodium stearyl fumarate, and the above-mentioned glidant is colloidal silicon dioxide.

**[00147]** In one embodiment, the above-mentioned binder is hydroxypropyl cellulose, the above-mentioned filler is microcrystalline cellulose, silicified microcrystalline cellulose or lactose, the above-mentioned disintegrant is croscarmellose sodium, crospovidone or sodium starch glycolate, the above-mentioned lubricant is magnesium stearate or sodium stearyl fumarate, and the above-mentioned glidant is colloidal silicon dioxide.

**[00148]** In one embodiment, the above-mentioned binder is polyvinylpyrrolidone, the above-mentioned filler is microcrystalline cellulose or silicified microcrystalline cellulose, the above-mentioned disintegrant is croscarmellose sodium or crospovidone, the above-mentioned lubricant is magnesium stearate or sodium stearyl fumarate, and the above-mentioned glidant is colloidal silicon dioxide.

**[00149]** In one embodiment, the above-mentioned binder is hydroxypropyl methyl cellulose, the above-mentioned filler is microcrystalline cellulose, silicified microcrystalline cellulose

or lactose, the above-mentioned disintegrant is croscarmellose sodium, crospovidone or sodium starch glycolate, the above-mentioned lubricant is magnesium stearate or sodium stearyl fumarate, and the above-mentioned glidant is colloidal silicon dioxide.

**[00150]** In one embodiment, the above-mentioned binder is hydroxypropyl cellulose, the above-mentioned filler is microcrystalline cellulose, silicified microcrystalline cellulose or lactose, the above-mentioned disintegrant is croscarmellose sodium, and the above-mentioned lubricant is magnesium stearate or sodium stearyl fumarate.

**[00151]** In one embodiment, the above-mentioned binder is polyvinylpyrrolidone, the above-mentioned lubricant is magnesium stearate, and the above-mentioned glidant is colloidal silicon dioxide.

**Preparation method**

**[00152]** In one embodiment, the pharmaceutical composition or fixed dose combination formulation disclosed herein is prepared by wet granulation (high shear and/or fluidized bed). The granulation is a method in which binder(s) is added into a solvent to prepare a binder solution, and then added or directly added into a granulator to prepare wet granules. The wet granulation method includes the steps of:

(1) adding an active pharmaceutical ingredient glucokinase activator (alternatively HMS5552) and a partner drug (alternatively sitagliptin, saxagliptin, vildagliptin and linagliptin) into a granulator;

(2) adding optional filler(s) (e.g., microcrystalline cellulose, silicified microcrystalline cellulose, or lactose) into the mixture obtained in step (1);

(3) adding optional disintegrant(s) (e.g., croscarmellose sodium, crospovidone, or sodium starch glycolate) into the mixture obtained in step (1) or (2);

(4) for high-shear granulation, adding binder(s) (e.g., hydroxypropyl cellulose, polyvinylpyrrolidone or hydroxypropyl methyl cellulose) into pure water to prepare a binder solution, and then adding it into a granulator for granulation with stirring. For fluidized bed granulation, two active pharmaceutical ingredients are added into a fluidized bed, and a binder solution that is an aqueous solution prepared from binder(s) and pure water is sprayed into the fluidized bed by compressed air;

(5) sizing the obtained wet granules in a suitable mill to obtain wet granules of suitable size;
(6) for granules prepared by high-shear granulation, drying with a tray in an oven or drying in a fluidized bed dryer; and for granules obtained by granulating in a fluidized bed, drying in a fluidized bed;
(7) sizing the granules on a suitable grinder to obtain dry granules of suitable size;
(8) in a suitable mixer, adding optional filler(s) (diluent(s), such as microcrystalline cellulose) and optional disintegrant(s) (e.g., croscarmellose sodium), and mixing with the dry granules;
(9) adding lubricant(s) (e.g., magnesium stearate and sodium stearyl fumarate) into the mixture in step (8);
(10) adding optional glidant(s) (e.g., colloidal silicon dioxide) into the mixture in step (9);
(11) filling the mixture of lubricated granules in step (9) or (10) into vials, pouches or capsules, or compressing it into a tablet with a desired shape; and
(12) optionally, film-coating the obtained tablets.

**[00153]** In another embodiment, the pharmaceutical composition disclosed herein is prepared by wet granulation (high shear and/or fluidized bed). The granulation is a method in which binder(s) and a second active ingredient are added into a solvent to prepare a binder solution (or suspension), and then added into a granulator to prepare wet granules. The wet granulation method includes the steps of:
(1) adding the active pharmaceutical ingredient glucokinase activator (alternatively HMS5552) into a granulator;
(2) adding optional filler(s) (e.g., microcrystalline cellulose, silicified microcrystalline cellulose, or lactose) into the mixture in step (1);
(3) adding optional disintegrant(s) (e.g., croscarmellose sodium, crospovidone, or sodium starch glycolate) into the mixture obtained in step (1) or (2);
(4) for high-shear granulation, adding binder(s) (e.g., hydroxypropyl cellulose, polyvinylpyrrolidone or hydroxypropyl methyl cellulose) into a solvent for uniform dispersion or dissolution, and then adding the second active ingredient (alternatively sitagliptin, saxagliptin, vildagliptin and linagliptin) in a formulated amount for dispersion or dissolution, so as to form a uniform binder system. The system is added into a granulator for

granulation with stirring. For fluidized bed granulation, an active pharmaceutical ingredient such as HMS5552 is added into a fluidized bed, and a binder system that is a solution or suspension prepared by binder(s) and pure water or an organic solvent (e.g., ethanol) is sprayed into the fluidized bed by compressed air;

(5) sizing the obtained wet granules in a suitable mill to obtain wet granules of suitable size;

(6) for granules prepared by high-shear granulation, drying with a tray in an oven or drying in a fluidized bed dryer; and for granules obtained by granulating in a fluidized bed, drying in a fluidized bed;

(7) sizing the granules on a suitable grinder to obtain dry granules of suitable size;

(8) in a suitable mixer, adding optional filler(s) (diluent, such as microcrystalline cellulose) and optional disintegrant(s) (e.g., croscarmellose sodium), and mixing with the dry granules;

(9) adding lubricant(s) (e.g., magnesium stearate and sodium stearyl fumarate) into the mixture in step (8);

(10) optionally, adding optional glidant(s) (e.g., colloidal silicon dioxide) into the mixture in step (9);

(11) filling the mixture of lubricated granules in (9) or (10) into vials, pouches or capsules, or compressing it into a tablet with a desired shape; and

(12) optionally, film-coating the obtained tablets.

**[00154]** The dry processing (direct compression or dry granulation) method includes the steps of:

(1) adding the active pharmaceutical ingredient glucokinase activator (alternatively HMS5552) and the partner drug (alternatively sitagliptin, saxagliptin, vildagliptin and linagliptin) into a mixing tank;

(2) adding optional filler(s) (e.g., microcrystalline cellulose, silicified microcrystalline cellulose, or lactose) into the mixture in step (1);

(3) adding optional binder(s) (e.g., hydroxypropyl cellulose, polyvinylpyrrolidone or hydroxypropyl methyl cellulose) into the mixture obtained in step (1) or (2);

(4) adding lubricant(s) or glidant(s) into the mixture in step (3), and mixing;

(5) filling the mixture in step (4) into vials, pouches or capsules, compressing the mixture in

step (4) into a tablet with a desired shape, or processing the mixture in step (4) by a roller compressor;

(6) mixing the mixture in step (3) in advance, and then rolled with a roller if processing the mixture in step (4) by a roller compressor; if necessary, sizing the granules on a suitable grinder to obtain granules of the required size;

(7) in a suitable mixer, adding optional diluent(s) to the granules obtained in step (6) to improve the compression performance;

(8) adding optional disintegrant(s) (e.g., croscarmellose sodium, crospovidone, or sodium starch glycolate) into the mixture in step (7);

(9) adding optional lubricant(s) or glidant(s) into the mixture in step (8);

(10) filling the mixture of lubricated granules in step (9) or (10) into vials, pouches or capsules, or compressing it into a tablet with a desired shape; and

(11) optionally, film-coating the tablets obtained in step (5) or step (10).

**[00155]** In one embodiment disclosed herein, the glucokinase activator in the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation disclosed herein is in the form of a solid dispersion, which can be prepared by a method selected from the group consisting of spray drying method, fluidized bed drying method, solvent method, melt extrusion method and the like.

**[00156]** One embodiment disclosed herein is a method of preparing a solid dispersion of a glucokinase activator by a spray drying method, which includes the steps of:

(1) formulating a spray drying solution, including dissolving a polymer carrier and a glucokinase activator (alternatively HMS5552) in a solvent;

(2) spray drying, including controlling the temperature of the inlet air, the amount of the inlet air, the flow rate and pressure of the atomized airflow, the spraying speed of the solution, and the like.

**[00157]** In the embodiment disclosed herein, the solvent used in the preparation of the solid dispersion of the glucokinase activator includes but is not limited to alkanols, esters, nitriles, cycloalkanes, aromatic hydrocarbons, ketones and the like. Specifically, the solvent is selected from the group consisting of anhydrous ethanol, methanol, isopropanol, ethyl acetate, acetone, acetonitrile, isobutanol, n-hexane, benzene and toluene. The solvent can be a single

solvent, a mixed solvent, or a mixture of an organic solvent and water.

**Methods and uses for treating and/or preventing diseases**

**[00158]** Another embodiment disclosed herein relates to a method or use of a composition or formulation (alternatively a fixed dose combination pharmaceutical composition or a fixed dose combination formulation) comprising a glucokinase activator disclosed herein for the treatment and/or prevention of the following diseases and medical disorders, especially one or more diseases selected from the group consisting of type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, and hyperglycemia, including administering to a subject a therapeutically effective amount of the composition or preparation (alternatively a fixed dose combination pharmaceutical composition or a fixed dose combination formulation) disclosed herein:

**[00159]** -preventing, slowing the progression of, delaying or treating a metabolic disorder selected from the group consisting of type 1 diabetes mellitus, type 2 diabetes mellitus, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity and metabolic syndrome; or

**[00160]** -improving glycemic control and/or for reducing of fasting plasma glucose, of postprandial plasma glucose and/or of glycosylated hemoglobin HbA1c; or

**[00161]** -preventing, slowing, delaying or reversing progression from impaired glucose tolerance, insulin resistance and/or from metabolic syndrome to type 2 diabetes mellitus; or

**[00162]** -preventing, slowing the progression of, delaying or treating of a condition or disorder selected from the group consisting of complications of diabetes mellitus such as cataracts and micro- and macrovascular diseases, such as nephropathy, retinopathy, neuropathy, learning and memory dysfunction, neurodegenerative or cognitive disorders, cardio- or cerebrovascular diseases, tissue ischaemia, diabetic foot or ulcus, arteriosclerosis, hypertension, endothelial dysfunction, myocardial infarction, accute coronary syndrome, unstable angina pectoris, stable angina pectoris, stroke, peripheral arterial occlusive disease, cardiomyopathy, heart failure, heart rhythm disorders and vascular restenosis; or

**[00163]** -reducing body weight and/or body fat or preventing an increase in body weight and/or body fat or facilitating a reduction in body weight and/or body fat; or

**[00164]** -preventing, slowing, delaying or treating the degeneration of pancreatic beta cells and/or the decline of the functionality of pancreatic beta cells and/or for improving and/or restoring or protecting the functionality of pancreatic beta cells and/or restoring the functionality of pancreatic insulin secretion; or

**[00165]** -for preventing, slowing, delaying or treating diseases or conditions attributed to an abnormal accumulation of liver or ectopic fat; or

**[00166]** -maintaining and/or improving the insulin sensitivity and/or for treating or preventing hyperinsulinemia and/or insulin resistance; or

**[00167]** -for preventing, slowing progression of, delaying, or treating new onset diabetes after transplantation (NODAT) and/or post-transplant metabolic syndrome (PTMS); or

**[00168]** -for preventing, delaying, or reducing NODAT and/or PTMS associated complications including micro- and macrovascular diseases and events, graft rejection, infection, and death; or

**[00169]** -for treating hyperuricemia and hyperuricemia associated conditions; or

**[00170]** -diabetic cognitive dysfunction, memory dysfunction, senile dementia.

**[00171]** The present disclosure also provides a method for the treatment of type II diabetes by orally administering a therapeutically effective amount of a pharmaceutical composition or formulation (alternatively a fixed dose combination pharmaceutical composition or a fixed dose combination formulation) comprising a glucokinase activator and a partner drug disclosed herein to a subject in need of the treatment. In one embodiment, the subject in need of the treatment is a human. In another embodiment, the pharmaceutical composition is in the form of a tablet. The composition or formulation (alternatively a fixed dose combination pharmaceutical composition or a fixed dose combination formulation) comprising a glucokinase activator disclosed herein can be administered once a day (QD), twice a day (BID) or three times a day (TID).

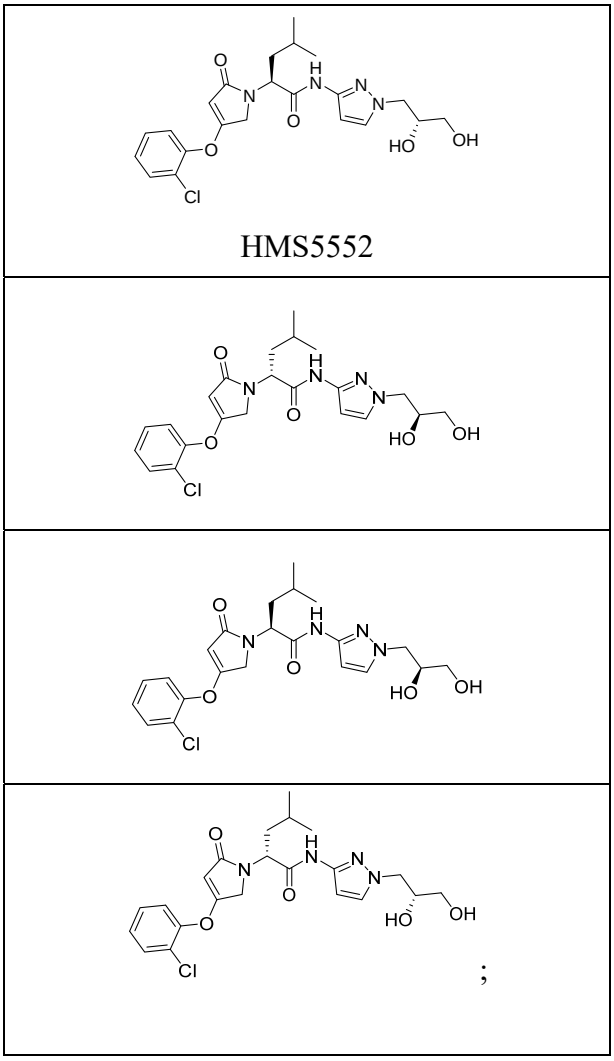
**[00172] Specifically, the present disclosure relates to the following specific embodiments.**

**[00173] Embodiment I-glucokinase activator + DPP-IV inhibitor (e.g., sitagliptin)**

**[00174]** Solution 1. A pharmaceutical combination, a pharmaceutical composition or a fixed

dose combination formulation, comprising:

(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




(b) a DPP-IV inhibitor; and

(c) one or more excipients;

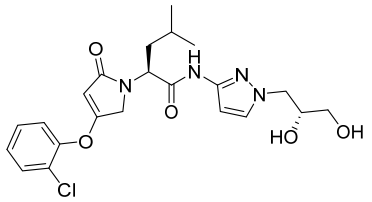
wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

**[00175]** Solution 2. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 100:1, alternatively about 1:4 to 40:1, and yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1,

about 10:1, about 15:1, about 20:1, or about 40:1.

**[00176]** Solution 3. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1 or 2, wherein the glucokinase activator is about 1-98% by weight; and the DPP-IV inhibitor is about 0.2-80% by weight.

**[00177]** Solution 4. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-3, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552 .

**[00178]** Solution 5. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-4, wherein the glucokinase activator is in the form of a solid dispersion.

**[00179]** Solution 6. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 5, wherein the glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, wherein the polymer carrier is a methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

**[00180]** Solution 7. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 6, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5 or about 5:6 or any range therebetween.

**[00181]** Solution 8. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-7, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate),

saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin and a pharmaceutically acceptable salt thereof, and alternatively sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt thereof.

**[00182]** Solution 9. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-8, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively from about 25 mg to about 100 mg, and alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg, or about 100 mg.

**[00183]** Solution 10. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-9, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively from about 2.5 mg to about 100 mg, alternatively, the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg, or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

**[00184]** Solution 11. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-10, wherein the one or more

excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

**[00185]** Solution 12. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-11, which is a tablet.

**[00186]** Solution 13. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 12, which is a coated tablet.

**[00187]** Solution 14. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 13, wherein the coated tablet is a film-coated tablet comprising:

a film-coating substrate, such as hypromellose, hydroxypropyl methyl cellulose or a mixture thereof;

an optional plasticizer, such as polyvinyl alcohol, polyethylene glycol, propylene glycol, polysorbate or a mixture thereof;

an optional coloring agent, such as iron oxide red, iron oxide yellow or a mixture thereof;

an optional opacifier, such as titanium dioxide, and

an optional glidant.

**[00188]** Solution 15. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 14, wherein the coated tablet is a film-coated tablet, and the film-coating agent is Opadry.

**[00189]** Solution 16. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-15, comprising (by weight):

about 1 to 80% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof), alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

about 1-80% of sitagliptin or sitagliptin phosphate monohydrate;

about 0-55% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00190]** Solution 17. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 16, comprising (by weight):

about 5-70% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof), alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

about 5-75% of sitagliptin or sitagliptin phosphate monohydrate;

about 0-50% of filler(s) (diluent(s));

about 1-10% of binder(s);

about 1-10% of disintegrant(s);

about 0.1-5% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00191]** Solution 18. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 16, wherein the doses (alternatively, unit doses) of the ingredients are (by weight):

about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;

about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg of sitagliptin or an amount of sitagliptin phosphate monohydrate that can obtain said amount of sitagliptin;

about 0-55% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00192]** Solution 19. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 50 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00193]** Solution 20. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 75 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s); and

- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00194]** Solution 21. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 50 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00195]** Solution 22. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 75 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);

- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00196]** Solution 23. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 25 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00197]** Solution 24. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18 (the fixed dose combination formulation is alternatively a tablet of 100 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate), comprising the components with the following amounts (by weight):

- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);

- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00198]** Solution 25. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 100 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 40.30 mg of microcrystalline cellulose, about 6.60 mg of hydroxypropyl cellulose, about 6.60 mg of croscarmellose sodium, about 2.20 mg of magnesium stearate, and about 6.60 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

**[00199]** Solution 26. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 150 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 27.55 mg of microcrystalline cellulose, about 7.80 mg of hydroxypropyl cellulose, about 7.80 mg of croscarmellose sodium, about 2.60 mg of magnesium stearate, and about 7.80 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

**[00200]** Solution 27. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 100 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 41.20 mg of microcrystalline cellulose, about 8.70 mg of hydroxypropyl cellulose, about 8.70 mg of croscarmellose sodium, about 2.90 mg of magnesium stearate, and about 8.70 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

**[00201]** Solution 28. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 150 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 47.00 mg of microcrystalline cellulose, about 10.50 mg of hydroxypropyl cellulose, about 10.50 mg of croscarmellose

sodium, about 3.50 mg of magnesium stearate, and about 10.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

**[00202]** Solution 29. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 50 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 100.50 mg of microcrystalline cellulose, about 9.00 mg of hydroxypropyl cellulose, about 9.00 mg of croscarmellose sodium, about 3.00 mg of magnesium stearate, and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

**[00203]** Solution 30. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 18, comprising about 200 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 61.26 mg of microcrystalline cellulose, about 10.50 mg of hydroxypropyl cellulose, about 10.50 mg of croscarmellose sodium, about 3.50 mg of magnesium stearate, and about 10.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

**[00204]** Solution 31. A method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-30, comprising incorporating the active ingredients into one or more excipients for granulation, alternatively further filling the obtained granule mixture into a vial, a sachet or a capsule, or compressing it into a tablet with a desired shape; and yet alternatively, further coating the obtained tablet.

**[00205]** Solution 32. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to solution 31, wherein the preparation is carried out by wet granulation (high shear and/or fluidized bed), or by dry processing (direct compression or dry granulation).

**[00206]** Solution 33. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to any one of solutions 31-32, wherein the glucokinase activator is prepared in the form of a solid

dispersion.

**[00207]** Solution 34. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to any one of solutions 31-33, wherein the glucokinase activator and the second or more active ingredients can also be prepared together in the form of a combination solid dispersion (that is, a solid dispersion comprising two or more active ingredients).

**[00208]** Solution 35. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-30, which is used to treat or prevent, slow the progression of, delay, or treat one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improve blood glucose control and/or reduce fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or prevent, slow, delay, or reverse complications of diabetes mellitus.

**[00209]** Solution 36. A method for treating or preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or preventing, slowing, delaying, or reversing complications of diabetes mellitus, comprising administering to a subject a therapeutically effective amount of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-30.

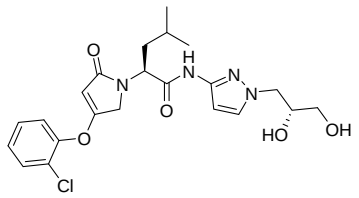
**[00210]** Solution 37. Use of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-30 in the manufacture of a medicament for treating or preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II

diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c.

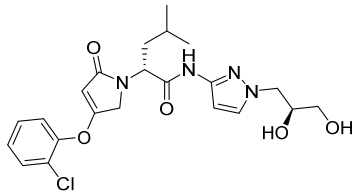
**Embodiment II-glucokinase activator + DPP-IV inhibitor (e.g. vildagliptin)**

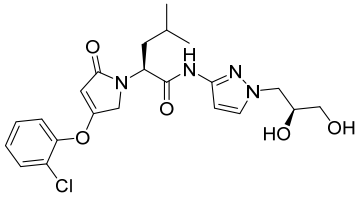
**[00211]** Solution 1. A pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation, comprising:

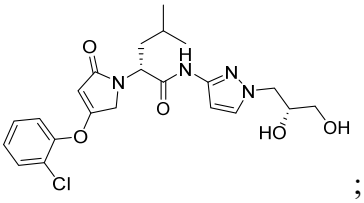
(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,



HMS5552







;

(b) a DPP-IV inhibitor; and

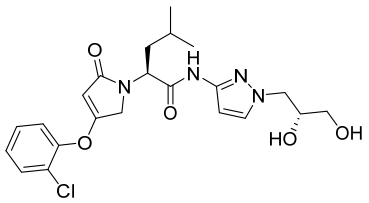
(c) one or more excipients;

wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

**[00212]** Solution 2. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 50:1, alternatively about 1:4 to 40:1, yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1, or about 40:1.

**[00213]** Solution 3. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1 or 2, wherein the glucokinase activator is about 1 to 80% by weight; and the DPP-IV inhibitor is about 1-50% by weight.

**[00214]** Solution 4. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-3, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552 .

**[00215]** Solution 5. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-4, wherein the glucokinase activator is in the form of a solid dispersion.

**[00216]** Solution 6. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 5, wherein the glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, and the polymer carrier is a methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

**[00217]** Solution 7. The pharmaceutical combination, pharmaceutical composition or fixed

dose combination formulation of solution 6, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5 or about 5:6 or any range therebetween.

**[00218]** Solution 8. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-7, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin and a pharmaceutically acceptable salt thereof, and alternatively sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt thereof.

**[00219]** Solution 9. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-8, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively from about 25 mg to about 100 mg, and alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg or about 100 mg.

**[00220]** Solution 10. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-7, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, alternatively, the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively

about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

**[00221]** Solution 11. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-10, wherein the one or more excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

**[00222]** Solution 12. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-11, which is a tablet.

**[00223]** Solution 13. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 12, which is a coated tablet.

**[00224]** Solution 14. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 13, wherein the coated tablet is a film-coated tablet comprising:

a film-coating substrate, such as hypromellose, hydroxypropyl methyl cellulose or a mixture thereof;

an optional plasticizer, such as polyvinyl alcohol, polyethylene glycol, propylene glycol, polysorbate or a mixture thereof;

an optional coloring agent, such as iron oxide red, iron oxide yellow or a mixture thereof;

an optional opacifier, such as titanium dioxide, and

an optional glidant.

**[00225]** Solution 15. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 14, wherein the coated tablet is a film-coated tablet, and the film-coating agent is Opadry.

**[00226]** Solution 16. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-15, comprising (by weight):

about 1 to 80% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof), alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

about 1-50% of vildagliptin;

about 0-55% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00227]** Solution 17. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 16, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):

about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;

about 50 mg or about 100 mg of vildagliptin;

about 0-55% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00228]** Solution 18. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 25 mg HMS5552/50 mg vildagliptin), comprising the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid

dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 50 mg of vildagliptin;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00229]** Solution 19. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 50 mg HMS5552/50 mg vildagliptin), comprising the components with the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of vildagliptin;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00230]** Solution 20. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 75 mg HMS5552/50 mg vildagliptin), comprising the components with the following amounts (by weight):

- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of vildagliptin;

- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00231]** Solution 21. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 50 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 464.00 mg of microcrystalline cellulose, about 24.00 mg of croscarmellose sodium, about 6.00 mg of micronized silica gel, about 6.00 mg of magnesium stearate, and about 18.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

**[00232]** Solution 22. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 100 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 414.00 mg of microcrystalline cellulose, about 24.00 mg of croscarmellose sodium, about 6.00 mg of micronized silica gel, about 6.00 mg of magnesium stearate, and about 18.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

**[00233]** Solution 23. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 150 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 512.50 mg of silicified microcrystalline cellulose, about 30.00 mg of croscarmellose sodium, about 7.50 mg of magnesium stearate, and about 21.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

**[00234]** Solution 24. A method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-23, comprising incorporating the active ingredients into one or more excipients for granulation, alternatively further filling the obtained granule mixture into a vial, a sachet or a capsule, or compressing it into a tablet with a desired shape; yet alternatively, further coating the obtained tablet.

**[00235]** Solution 25. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to solution 24, wherein the preparation is carried out by wet granulation (high shear and/or fluidized bed), or by dry processing (direct compression or dry granulation).

**[00236]** Solution 26. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according toany one of solutions 24-25, wherein the glucokinase activator is prepared in the form of a solid dispersion.

**[00237]** Solution 27. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according toany one of solutions 24-26, wherein the glucokinase activator and the second or more active ingredients can also be prepared together in the form of a combination solid dispersion (that is, a solid dispersion comprising two or more active ingredients).

**[00238]** Solution 28. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-23, which is used to prevent, slow the progression of, delay, or treat one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improve blood glucose control and/or reduce fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or prevent, slow, delay, or reverse complications of diabetes mellitus.

**[00239]** Solution 29. A method for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or preventing, slowing, delaying, or reversing complications of diabetes mellitus, including administering to

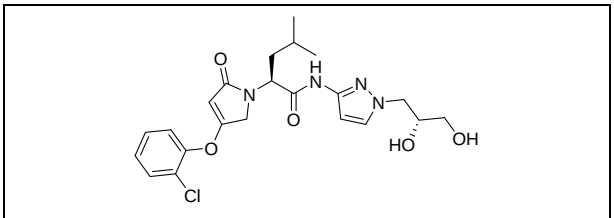
a subject a therapeutically effective amount of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-23.

**[00240]** Solution 30. Use of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-23 in the manufacture of a medicament for treating or preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c.

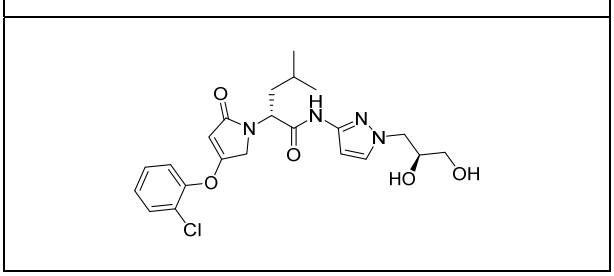
**Embodiment III-glucokinase activator + DPP-IV inhibitor (e.g. saxagliptin)**

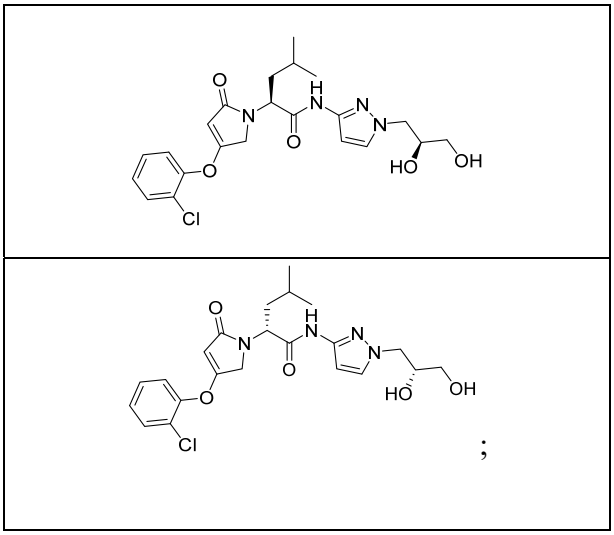
**[00241]** Solution 1. A pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation, comprising:

(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552





(b) a DPP-IV inhibitor; and

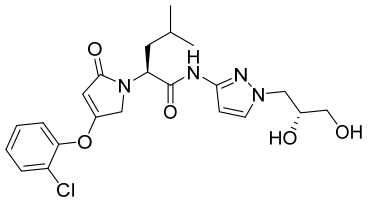
(c) one or more excipients;

wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

**[00242]** Solution 2. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 100:1, alternatively about 1:4 to 40:1, and yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1, or about 40:1.

**[00243]** Solution 3. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1 or 2, wherein the glucokinase activator is about 1-80% by weight; and the DPP-IV inhibitor is about 1-20% by weight.

**[00244]** Solution 4. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-3, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552 .

**[00245]** Solution 5. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-4, wherein the glucokinase activator is in the form of a solid dispersion.

**[00246]** Solution 6. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 5, wherein the glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, and the polymer carrier is a methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

**[00247]** Solution 7. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 6, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5 or about 5:6 or any range therebetween.

**[00248]** Solution 8. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-7, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin and a pharmaceutically acceptable salt thereof, and alternatively sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt thereof.

**[00249]** Solution 9. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-8, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively from about 25 mg to about 100 mg, and alternatively, the dose (alternatively, a

unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg, or about 100 mg.

**[00250]** Solution 10. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-9, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, alternatively, the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

**[00251]** Solution 11. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-10, wherein the one or more excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

**[00252]** Solution 12. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-11, which is a tablet.

**[00253]** Solution 13. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 12, which is a coated tablet.

**[00254]** Solution 14. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 13, wherein the coated tablet is a film-coated tablet

comprising:

a film-coating substrate, such as hypromellose, hydroxypropyl methyl cellulose or a mixture thereof;

an optional plasticizer, such as polyvinyl alcohol, polyethylene glycol, propylene glycol, polysorbate or a mixture thereof;

an optional coloring agent, such as iron oxide red, iron oxide yellow or a mixture thereof;

an optional opacifier, such as titanium dioxide, and

an optional glidant.

**[00255]** Solution 15. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 14, wherein the coated tablet is a film-coated tablet, and the film-coating agent is Opadry.

**[00256]** Solution 16. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-15, comprising (by weight):

about 1 to 80% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof), alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

about 1-20% of saxagliptin or saxagliptin monohydrate;

about 0-90% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00257]** Solution 17. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 16, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):

about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically

acceptable salt thereof);

about 2.5 mg, about 5 mg, about 7.5 mg, and about 10 mg of saxagliptin or an amount of saxagliptin monohydrate that can obtain said amount of saxagliptin;

about 0-90% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00258]** Solution 18. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 25 mg HMS5552/5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate), comprising the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00259]** Solution 19. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 50 mg HMS5552/2.5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate), comprising the components with the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a

solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 2.5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00260]** Solution 20. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 75 mg HMS5552/5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate), comprising the components with the following amounts (by weight):

- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00261]** Solution 21. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 100 mg HMS5552/2.5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate), comprising the components with the following amounts (by weight):

- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a

solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 2.5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00262]** Solution 22. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 150 mg of a solid dispersion, about 5.29 mg of saxagliptin monohydrate, about 7.50 mg of hydroxypropyl cellulose, about 79.71 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

**[00263]** Solution 23. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 100 mg of a solid dispersion, about 2.64 mg of saxagliptin monohydrate, about 7.50 mg of hydroxypropyl cellulose, about 132.36 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

**[00264]** Solution 24. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 200 mg of a solid dispersion, about 2.64 mg of saxagliptin monohydrate, about 9.00 mg of povidone, about 79.36 mg of microcrystalline cellulose, about 3.00 mg of magnesium stearate, about 6.00 mg of croscarmellose sodium and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

**[00265]** Solution 25. The pharmaceutical combination, pharmaceutical composition or fixed

dose combination formulation of solution 17, comprising about 50 mg of a solid dispersion, about 5.29 mg of saxagliptin monohydrate, about 7.50 mg of povidone, about 179.71 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

**[00266]** Solution 26. A method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-25, comprising incorporating the active ingredients into one or more excipients for granulation, alternatively further filling the obtained granule mixture into a vial, a sachet or a capsule, or compressing it into a tablet with a desired shape; yet alternatively, further coating the obtained tablet.

**[00267]** Solution 27. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to solution 26, wherein the preparation is carried out by wet granulation (high shear and/or fluidized bed), or by dry processing (direct compression or dry granulation).

**[00268]** Solution 28. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to any one of solutions 26-27, wherein the glucokinase activator is prepared in the form of a solid dispersion.

**[00269]** Solution 29. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to any one of solutions 26-28, wherein the glucokinase activator and the second or more active ingredients can also be prepared together in the form of a combination solid dispersion (that is, a solid dispersion comprising two or more active ingredients).

**[00270]** Solution 30. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-25, which is used to prevent, slow the progression of, delay, or treat one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile

dementia and/or metabolic syndrome; or improve blood glucose control and/or reduce fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or prevent, slow, delay, or reverse complications of diabetes mellitus.

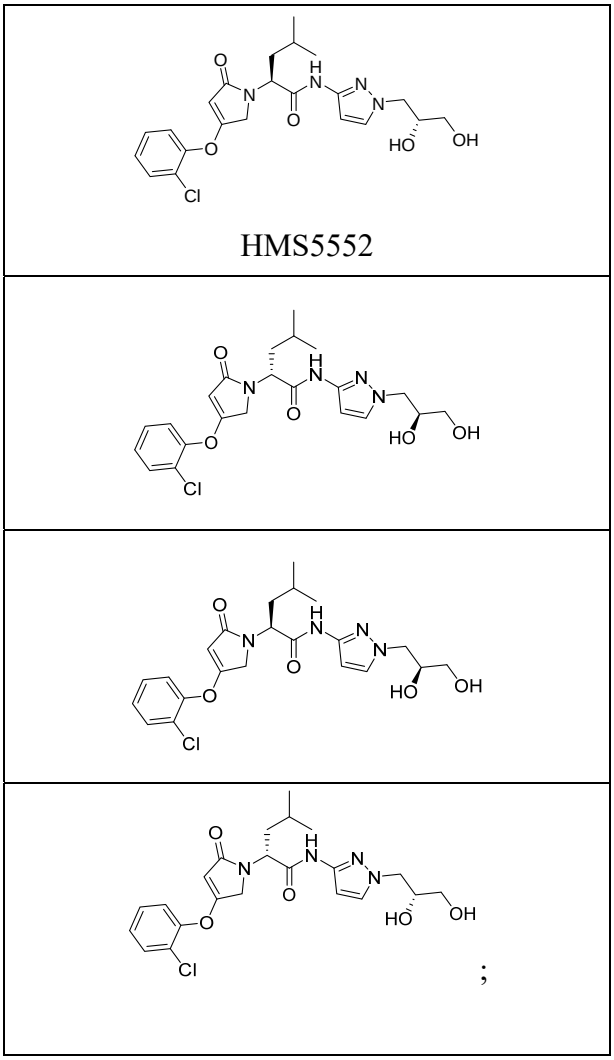
**[00271]** Solution 31. A method for preventing, slowing the progression of, delaying or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or preventing, slowing, delaying, or reversing complications of diabetes mellitus, including administering to a subject a therapeutically effective amount of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-25.

**[00272]** Solution 32. Use of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-25 in the manufacture of a medicament for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c.

**Embodiment IV-glucokinase activator + DPP-IV inhibitor (e.g. linagliptin)**

**[00273]** Solution 1. A pharmaceutical combination, a pharmaceutical composition or a fixed dose combination formulation, comprising:

(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




(b) a DPP-IV inhibitor; and

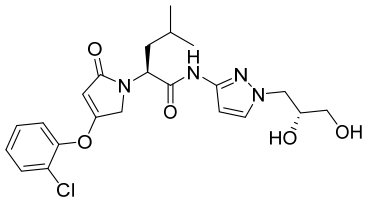
(c) one or more excipients;

wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

**[00274]** Solution 2. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 50:1, alternatively about 1:4 to 40:1, and yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1, or about 40:1.

**[00275]** Solution 3. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 1 or 2, wherein the glucokinase activator is about 1-90% by weight; and the DPP-IV inhibitor is about 1-20% by weight.

**[00276]** Solution 4. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-3, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552

.

**[00277]** Solution 5. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-4, wherein the glucokinase activator is in the form of a solid dispersion.

**[00278]** Solution 6. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 5, wherein the glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, and the polymer carrier is a methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

**[00279]** Solution 7. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 6, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5 or about 5:6 or any range therebetween.

**[00280]** Solution 8. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-7, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin and a pharmaceutically acceptable salt thereof, and alternatively sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt

thereof.

**[00281]** Solution 9. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-8, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively about 25 mg to about 100 mg, and alternatively, the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg, or about 100 mg.

**[00282]** Solution 10. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-9, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, and alternatively, the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

**[00283]** Solution 11. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-10, wherein the one or more excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

**[00284]** Solution 12. The pharmaceutical combination, pharmaceutical composition or fixed

dose combination formulation of any one of solutions 1-11, which is a tablet.

**[00285]** Solution 13. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 12, which is a coated tablet.

**[00286]** Solution 14. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 13, wherein the coated tablet is a film-coated tablet comprising:

a film-coating substrate, such as hypromellose, hydroxypropyl methyl cellulose or a mixture thereof;

an optional plasticizer, such as polyvinyl alcohol, polyethylene glycol, propylene glycol, polysorbate or a mixture thereof;

an optional coloring agent, such as iron oxide red, iron oxide yellow or a mixture thereof;

an optional opacifier, such as titanium dioxide, and

an optional glidant.

**[00287]** Solution 15. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 14, wherein the coated tablet is a film-coated tablet, and the film-coating agent is Opadry.

**[00288]** Solution 16. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-15, comprising (by weight):

about 1 to 80% of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof), alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

about 1-20% of linagliptin;

about 0-90% of filler(s);

about 1-25% binder(s);

about 0-15% of disintegrant(s);

about 0.1-10% of lubricant(s);

about 0-3% of glidant(s); and

about 0-5% of coating agent(s).

**[00289]** Solution 17. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 16, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):

- about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator (alternatively HMS5552 or an isotope labeled analogue thereof or a pharmaceutically acceptable salt thereof);
- about 2.5 mg, about 5 mg, about 7.5 mg or about 10 mg of linagliptin;
- about 0-90% of filler(s);
- about 1-25% binder(s);
- about 0-15% of disintegrant(s);
- about 0.1-10% of lubricant(s);
- about 0-3% of glidant(s); and
- about 0-5% of coating agent(s).

**[00290]** Solution 18. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 25 mg HMS5552/5 mg linagliptin), comprising the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00291]** Solution 19. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 50 mg HMS5552/5 mg linagliptin), comprising the components with

the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00292]** Solution 20. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 75 mg HMS5552/5 mg linagliptin), comprising the components with the following amounts (by weight):

- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00293]** Solution 21. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17 (the fixed dose combination formulation is alternatively a tablet of 100 mg HMS5552/5 mg linagliptin), comprising the components with the following amounts (by weight):

- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a

solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

**[00294]** Solution 22. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 50 mg of a solid dispersion, about 5.00 mg of linagliptin, about 151.80 mg of microcrystalline cellulose, about 6.60 mg of hydroxypropyl cellulose, about 4.40 mg of croscarmellose sodium, about 2.20 mg of magnesium stearate and about 6.60 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

**[00295]** Solution 23. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 100 mg of a solid dispersion, about 5.00 mg of linagliptin, about 120.60 mg of microcrystalline cellulose, about 7.20 mg of hydroxypropyl cellulose, about 4.80 mg of croscarmellose sodium, about 2.40 mg of magnesium stearate, and about 7.20 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

**[00296]** Solution 24. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 150 mg of a solid dispersion, about 5.00 mg of linagliptin, about 27.50 mg of microcrystalline cellulose, about 50.00 mg of mannitol, about 7.50 mg of hydroxypropyl cellulose, about 7.50 mg of croscarmellose sodium, about 2.50 mg of magnesium stearate, and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

**[00297]** Solution 25 The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 50 mg of a solid dispersion,

about 5.00 mg of linagliptin, about 137.00 mg of microcrystalline cellulose, about 4.00 mg of croscarmellose sodium, about 2.00 mg of magnesium stearate, about 2.00 mg of micronized silica gel and about 6.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

**[00298]** Solution 26. The pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of solution 17, comprising about 200 mg of a solid dispersion, about 5.00 mg of linagliptin, about 77.0 mg of microcrystalline cellulose, about 9.00 mg of hydroxypropyl cellulose, about 6.00 mg of croscarmellose sodium, about 3.00 mg of magnesium stearate and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

**[00299]** Solution 27. A method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-26, comprising incorporating the active ingredients into one or more excipients for granulation, alternatively further filling the obtained granule mixture into a vial, a sachet or a capsule, or compressing it into a tablet with a desired shape; yet alternatively, further coating the obtained tablet.

**[00300]** Solution 28. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according to solution 27, wherein the preparation is carried out by wet granulation (high shear and/or fluidized bed), or by dry processing (direct compression or dry granulation).

**[00301]** Solution 29. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according toany one of solutions 27-28, wherein the glucokinase activator is prepared in the form of a solid dispersion.

**[00302]** Solution 30. The method for preparing the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation according toany one of solutions 27-29, wherein the glucokinase activator and the second or more active ingredients can also be prepared together in the form of a combination solid dispersion (that is, a solid dispersion comprising two or more active ingredients).

**[00303]** Solution 31. The pharmaceutical combination, pharmaceutical composition or fixed

dose combination formulation of any one of solutions 1-26, which is used to prevent, slow the progression of, delay, or treat one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improve blood glucose control and/or reduce fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or prevent, slow, delay, or reverse complications of diabetes mellitus.

**[00304]** Solution 32. A method for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or preventing, slowing, delaying, or reversing complications of diabetes mellitus, including administering to a subject a therapeutically effective amount of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-26.

**[00305]** Solution 33. Use of the pharmaceutical combination, pharmaceutical composition or fixed dose combination formulation of any one of solutions 1-26 in the manufacture of a medicament for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c.

**[00306]** The following examples further describe and illustrate embodiments within the

scope of the present disclosure. However, the present invention is not limited to the examples, and various modifications and substitutions made on the basis of the technology disclosed herein are within the protection scope of the present invention.

**Examples**

**Preparation of the combination tablet of the glucokinase activator**

**[00307]** The chemicals used in the present disclosure can be purchased from companies such as Shin-Etsu Japan, Evonik Germany, J.T. Baker US, SCR China, Ashland US, FMC US, JRS Germany, Colorcon US, Capsugel, BASF, Zhenxing China, and the like. A producing equipment, analytical testing instrument and the like can be purchased from companies such as Sartorius, Nikon, Sympatec, Bruker, Gea Niro, Korsch, Erweka, Agilent, Quadro Engineering, Canada; Warters, US; TA, US; SOTAX, Switzerland; Mettler Toledo Instrument Newark, DE.

**I. Preparation of the solid dispersion of the glucokinase activator**

**1.1 Preparation of the solution of the solid dispersion used for spray drying**

**Example 1A (weight ratio of active ingredients to polymer carriers is 1:9)**

**[00308]** 6.75g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 0.75g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 2A (weight ratio of active ingredients to polymer carriers is 3:7)**

**[00309]** 5.25g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 2.25g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 3A (weight ratio of active ingredients to polymer carriers is 5:5)**

**[00310]** 3.75g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 3.75g of the compound

HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 4A (weight ratio of active ingredients to polymer carriers is 7:3)**

**[00311]** 2.25g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 5.25g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 5A (weight ratio of active ingredients to polymer carriers is 8:2)**

**[00312]** 1.5g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 6g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 6A (weight ratio of active ingredients to polymer carriers is 9:1)**

**[00313]** 0.75g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 6.75 g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 7A (weight ratio of active ingredients to polymer carriers is 6:4)**

**[00314]** 3.0 g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 4.5 g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 8A (weight ratio of active ingredients to polymer carriers is 4:6)**

**[00315]** 4.5g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (J.T.Baker) under stirring. After it was completely dissolved, 3.0 g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 50 ml solution.

**Example 9A (weight ratio of active ingredients to polymer carriers is 5:5)**

**[00316]** 187.5 g Eudragit L100 (Evonik Germany) was weighed, and added to anhydrous ethanol (Zhenxing China). After it was completely dissolved, 187.5 g of the compound HMS5552 was added. Stirring was continued after adding sufficient amount of anhydrous ethanol to obtain 2500ml solution.

### 1.2 Preparation of the solid dispersion of the glucokinase activator

**[00317]** The solid dispersion of the glucokinase activator was prepared by spray drying the solution prepared above. The numbering of the obtained solid dispersion corresponds to the numbering of the above examples. The spray drying devices that are suitable for the present disclosure include, but are not limited to, the spray drying devices produced by Niro GEA Process Engineering Inc., Buchi Labortechnik AG, ProCept and SPX ANHYDROUS companies. The spray drying can be performed by selecting an appropriate inlet air temperature of dry gas, inlet amount, feed rate, and atomization pressure, so that the droplets are sufficiently dried as they reach the device wall. This can make sure that the dried droplets are essentially solid and in a form of a fine powder, which will not stick to the wall, and is not difficult to collect in the cyclone. The resulting powder is subjected to a secondary drying to make sure the product meets quality requirement.

Description of the production process for the preparation of the solid dispersion of the glucokinase activator by spray drying

**[00318]** The solid dispersions were prepared by the spray drying the solution prepared in the above Examples **1A-8A**, wherein the inlet air temperature of the spray dryer was 90-150 °C, the flow rate of the inlet air was 0.3-0.5 $m^3$/min, the flow rate of the air flow was 15-30 L/min, and the spray rate of above solutions were 5-7 mL/min. Solid dispersions **1-8** were obtained by spray drying.

**[00319]** The solid dispersion was prepared by spray drying the solution prepared in the above Example **9A**, wherein the inlet air temperature of the spray dryer was 90-150 °C, the flow rate of the inlet air was 20-30 kg/h, the flow rate of the air flow was 3-30 kg/h, and the spray rate of above solutions were 5-200 mL/min. Solid dispersion **9** was obtained by spray drying.

**[00320]** Solid dispersions **1-9** were prepared according to the process described above, wherein:

mass percent of the compound HMS5552 in solid dispersion **1** was 10%; mass percent of the compound HMS5552 in solid dispersion **2** was 30%; mass percent of the compound HMS5552 in solid dispersion **3** was 50%; mass percent of the compound HMS5552 in solid dispersion **4** was 70%; mass percent of the compound HMS5552 in solid dispersion **5** was 80%; mass percent of the compound HMS5552 in solid dispersion **6** was 90%; mass percent of the compound HMS5552 in solid dispersion **7** was 60%; mass percent of the compound HMS5552 in solid dispersion **8** was 40%; and mass percent of the compound HMS5552 in solid dispersion **9** was 50%.

## II. Preparation of the combination tablet

### 2.1 Preparation of the combination tablet by high-shear wet granulation

**[00321]** The HMS5552 solid dispersion prepared according to the above preparation examples of the solid dispersion of the glucokinase activator and the partner drug were added into a high-shear wet granulator. The filler (e.g., microcrystalline cellulose, silicified microcrystalline cellulose, or lactose) and disintegrant (e.g., croscarmellose sodium, crospovidone, or sodium starch glycolate) were added. A part of the binder powder was added and mixed for 5 minutes with high-shear stirring. A prepared solution of the binder (e.g., hydroxypropyl cellulose, polyvinylpyrrolidone or hydroxypropyl methyl cellulose) was added to the above dry mixture under high-shear stirring for 1 to 6 minutes for granulation. Wet granules are sized on a Comil mill to obtain wet granules of suitable size. The wet granules were dried with a tray in an oven at about 60°C or in a fluidized bed dryer (with the inlet air temperature of 40-60°C) for 20-40 minutes. Then, the dried material was ground using a grinder to obtain granules of suitable size. After grinding, the microcrystalline cellulose or silicified microcrystalline cellulose (for the filler comprising an extragranular part) and the disintegrant (e.g., croscarmellose sodium, crospovidone, or sodium starch glycolate) were added to the granules and the mixture was mixed in a barrel mixer. Then, the lubricant (magnesium stearate or sodium stearyl fumarate) and/or optional glidant (micronized silica gel) were added to the mixture and mixed well additionally. The lubricated mixture was compressed with a rotary tablet press to obtain tablets (plain tablets, uncoated tablet cores) of different tablet weights and tablet shapes corresponding to different strengths.

Optionally, the obtained tablets were film-coated with Opadry® II, and the weight increased by about 3%, thereby obtaining film-coated tablets.

**[00322] Example 1B a combination tablet of HMS5552 + sitagliptin (dose strength: 50 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| sitagliptin phosphate monohydrate* | 64.25 | 29.20 |
| HMS5552 solid dispersion | 100.00 | 45.46 |
| microcrystalline cellulose | 40.35 | 18.34 |
| hydroxypropyl cellulose | 6.60 | 3.00 |
| croscarmellose sodium | 6.60 | 3.00 |
| magnesium stearate | 2.20 | 1.00 |
| Total weight of tablet cores | 220.00 | 100.00 |
| Opadry | 6.60 | 3.00 |
| Total weight of coated tablets | 226.60 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552;

**64.25 mg of sitagliptin phosphate monohydrate was equivalent to 50.0 mg of sitagliptin free base anhydrate.

**[00323] Example 2B a combination tablet of HMS5552 + sitagliptin (dose strength: 75 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| sitagliptin phosphate monohydrate** | 64.25 | 24.71 |
| HMS5552 solid dispersion* | 150.00 | 57.69 |
| microcrystalline cellulose | 27.55 | 10.60 |
| hydroxypropyl cellulose | 7.80 | 3.00 |

| | | |
|---|---|---|
| croscarmellose sodium | 7.80 | 3.00 |
| magnesium stearate | 2.60 | 1.00 |
| Total weight of tablet cores | 260.00 | 100.00 |
| Opadry | 7.80 | 3.00 |
| Total weight of coated tablets | 267.80 | - |

*150.00 mg of the HMS5552 solid dispersion contained 75 mg of HMS5552;

**64.25 mg of sitagliptin phosphate monohydrate was equivalent to 50.0 mg of sitagliptin free base anhydrate.

**[00324] Example 3B a combination tablet of HMS5552+ sitagliptin (dose strength: 50 mg/100 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| sitagliptin phosphate monohydrate** | 128.50 | 44.31 |
| HMS5552 solid dispersion* | 100.00 | 34.48 |
| microcrystalline cellulose | 41.20 | 14.21 |
| hydroxypropyl cellulose | 8.70 | 3.00 |
| croscarmellose sodium | 8.70 | 3.00 |
| magnesium stearate | 2.90 | 1.00 |
| Total weight of tablet cores | 290.0 | 100.00 |
| Opadry | 8.70 | 3.00 |
| Total weight of coated tablets | 298.70 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552;

**128.5 mg of sitagliptin phosphate monohydrate was equivalent to 100.0 mg of sitagliptin free base anhydrate.

**[00325] Example 4B a combination tablet of HMS5552 + sitagliptin (dose strength: 75 mg/100 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|

| | | |
|---|---|---|
| sitagliptin phosphate monohydrate** | 128.50 | 36.71 |
| HMS5552 solid dispersion* | 150.00 | 42.86 |
| microcrystalline cellulose | 47.00 | 13.43 |
| hydroxypropyl cellulose | 10.50 | 3.00 |
| croscarmellose sodium | 10.50 | 3.00 |
| magnesium stearate | 3.50 | 1.00 |
| Total weight of tablet cores | 350.00 | 100.00 |
| Opadry | 10.50 | 3.00 |
| Total weight of coated tablets | 360.50 | - |

*150.00 mg of the HMS5552 solid dispersion contained 75 mg of HMS5552;

**128.50 mg of sitagliptin phosphate monohydrate was equivalent to 100.0 mg of sitagliptin free base anhydrate.

**[00326] Example 5B a combination tablet of HMS5552 + sitagliptin (dose strength: 25 mg/100 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| sitagliptin phosphate monohydrate** | 128.50 | 42.83 |
| HMS5552 solid dispersion* | 50.00 | 16.67 |
| microcrystalline cellulose | 100.50 | 33.50 |
| hydroxypropyl cellulose | 9.00 | 3.00 |
| croscarmellose sodium | 9.00 | 3.00 |
| magnesium stearate | 3.00 | 1.00 |
| Total weight of tablet cores | 300.00 | 100.00 |
| Opadry | 9.00 | 3.00 |
| Total weight of coated tablets | 309.00 | |

*50.00 mg of the HMS5552 solid dispersion contained 25 mg of HMS5552;

**128.50 mg of sitagliptin phosphate monohydrate was equivalent to 100.0 mg of sitagliptin

free base anhydrate.

**[00327] Example 6B a combination tablet of HMS5552 + sitagliptin (dose strength: 100 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| sitagliptin phosphate monohydrate* | 64.25 | 18.36 |
| HMS5552 solid dispersion | 200.00 | 57.14 |
| microcrystalline cellulose | 61.26 | 17.50 |
| hydroxypropyl cellulose | 10.50 | 3.00 |
| croscarmellose sodium | 10.50 | 3.00 |
| magnesium stearate | 3.50 | 1.00 |
| Total weight of tablet cores | 350.00 | 100.00 |
| Opadry | 10.50 | 3.00 |
| Total weight of coated tablets | 360.50 | |

*200.00 mg of the HMS5552 solid dispersion contained 100 mg of HMS5552;

**64.25 mg of sitagliptin phosphate monohydrate was equivalent to 50.0 mg of sitagliptin free base anhydrate.

**[00328] Example 7B a combination tablet of HMS5552 + linagliptin (dose strength: 25 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 50.00 | 22.73 |
| linagliptin | 5.00 | 2.27 |
| microcrystalline cellulose | 151.80 | 69.00 |
| hydroxypropyl cellulose | 6.60 | 3.00 |
| croscarmellose sodium | 4.40 | 2.00 |
| magnesium stearate | 2.20 | 1.00 |
| Total weight of tablet cores | 220.00 | 100.00 |

| | | |
|---|---|---|
| Opadry | 6.60 | 3.00 |
| Total weight of coated tablets | 226.60 | - |

*50.00 mg of the HMS5552 solid dispersion contained 25 mg of HMS5552.

**[00329] Example 8B a combination tablet of HMS5552 + linagliptin (dose strength: 50 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 100.00 | 41.67 |
| linagliptin | 5.00 | 2.08 |
| microcrystalline cellulose | 120.60 | 50.25 |
| hydroxypropyl cellulose | 7.20 | 3.00 |
| croscarmellose sodium | 4.80 | 2.00 |
| magnesium stearate | 2.40 | 1.00 |
| Total weight of tablet cores | 240.00 | 100.0 |
| Opadry | 7.20 | 3.00 |
| Total weight of coated tablets | 247.20 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552.

**[00330] Example 9B a combination tablet of HMS5552 + linagliptin (dose strength: 75 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 150.00 | 60.00 |
| linagliptin | 5.00 | 2.00 |
| microcrystalline cellulose | 27.50 | 11.00 |
| mannitol | 50.00 | 20.00 |
| hydroxypropyl cellulose | 7.50 | 3.00 |
| croscarmellose sodium | 7.50 | 3.00 |
| magnesium stearate | 2.50 | 1.00 |
| Total weight of tablet cores | 250.00 | 100.00 |

| | | |
|---|---|---|
| Opadry | 7.50 | 3.00 |
| Total weight of coated tablets | 257.50 | - |

*150.00 mg of the HMS5552 solid dispersion contained 75 mg of HMS5552.

**[00331] Example 10B a combination tablet of HMS5552 + linagliptin (dose strength: 100 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 200.0 | 66.67 |
| linagliptin | 5.0 | 1.67 |
| microcrystalline cellulose | 77.0 | 25.67 |
| hydroxypropyl cellulose | 9.00 | 3.00 |
| croscarmellose sodium | 6.00 | 2.00 |
| magnesium stearate | 3.00 | 1.00 |
| Total weight of tablet cores | 300.00 | 100.0 |
| Opadry | 9.00 | 3.00 |
| Total weight of coated tablets | 309.00 | - |

*200.00 mg of the HMS5552 solid dispersion contained 100 mg of HMS5552.

**[00332] Example 11B a combination tablet of HMS5552 + saxagliptin (dose strength: 75 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 150.00 | 60.00 |
| saxagliptin monohydrate** | 5.29 | 2.12 |
| hydroxypropyl cellulose | 7.50 | 3.00 |
| microcrystalline cellulose | 79.71 | 31.88 |
| magnesium stearate | 2.50 | 1.00 |
| croscarmellose sodium | 5.00 | 2.00 |
| Total weight of tablet cores | 250.00 | 100.00 |
| Opadry | 7.50 | 3.00 |

| | | |
|---|---|---|
| Total weight of coated tablets | 257.50 | - |

*150.00 mg of the HMS5552 solid dispersion contained 75 mg of HMS5552;

** 5.29 mg of saxagliptin monohydrate was equivalent to 5.0 mg of saxagliptin free base anhydrate.

**[00333] Example 12B a combination tablet of HMS5552 + saxagliptin (dose strength: 50 mg/2.5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 100.00 | 40.00 |
| saxagliptin monohydrate** | 2.64 | 1.06 |
| hydroxypropyl cellulose | 7.50 | 3.00 |
| microcrystalline cellulose | 132.36 | 52.94 |
| magnesium stearate | 2.50 | 1.00 |
| croscarmellose sodium | 5.00 | 2.00 |
| Total weight of tablet cores | 250.00 | 100.00 |
| Opadry | 7.50 | 3.00 |
| Total weight of coated tablets | 257.50 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552;

** 2.64mg of saxagliptin monohydrate was equivalent to 2.5 mg of saxagliptin free base anhydrate.

**[00334] Example 13B a combination tablet of HMS5552 + saxagliptin (dose strength: 100 mg/2.5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 200.00 | 66.67 |
| saxagliptin monohydrate** | 2.64 | 0.88 |
| povidone | 9.00 | 3.00 |
| microcrystalline cellulose | 79.36 | 26.45 |
| magnesium stearate | 3.00 | 1.00 |

| | | |
|---|---|---|
| croscarmellose sodium | 6.00 | 2.00 |
| Total weight of tablet cores | 300.00 | 100.00 |
| Opadry | 9.00 | 3.00 |
| Total weight of coated tablets | 309.00 | - |

*200.00 mg of the HMS5552 solid dispersion contained 100 mg of HMS5552;

** 2.64mg of saxagliptin monohydrate was equivalent to 2.5 mg of saxagliptin free base anhydrate.

**2.2 Preparation of the combination tablet by fluidized bed wet granulation**

**[00335]** The HMS5552 solid dispersion prepared according to the above preparation examples of the solid dispersion of the glucokinase activator and the partner drug were added into a fluidized bed granulator. The optional filler (e.g., microcrystalline cellulose) was added. The prepared solution of the binder (e.g., polyvinylpyrrolidone) was sprayed into the mixture in the fluidized bed during 20 to 60 minutes for granulation, and then drying was continued in a fluidized bed dryer (with the inlet air temperature of 40-60°C). Then, the dried material was ground using a grinder to obtain granules of suitable size. After grinding, the microcrystalline cellulose or silicified microcrystalline cellulose (for the formulation comprising an extragranular filler) was added to the granules, and the mixture was mixed in a barrel mixer. Then, the lubricant (magnesium stearate) and/or optional glidant (micronized silica gel) were added to the mixture and mixed well additionally. The lubricated mixture was compressed with a rotary tablet press to obtain tablets (plain tablets, uncoated tablet cores) of different tablet weights and tablet shapes corresponding to different strengths. Optionally, the obtained tablets were film-coated with prepared according to the above preparation examples of the solid dispersion of the glucokinase activator, and the weight increased by about 3%, thereby obtaining film-coated tablets.

**[00336] Example 14B a combination tablet of HMS5552 + saxagliptin (dose strength: 25 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|

| | | |
|---|---|---|
| HMS5552 solid dispersion* | 50.0 | 20.0 |
| saxagliptin monohydrate** | 5.29 | 2.12 |
| povidone | 7.50 | 3.00 |
| microcrystalline cellulose | 179.71 | 71.88 |
| magnesium stearate | 2.50 | 1.00 |
| croscarmellose sodium | 5.00 | 2.00 |
| Total weight of tablet cores | 250.0 | 100.0 |
| Opadry | 7.50 | 3.00 |
| Total weight of coated tablets | 257.50 | - |

*50.00 mg of the HMS5552 solid dispersion contained 25 mg of HMS5552;

** 5.29 mg of saxagliptin monohydrate was equivalent to 5.0 mg of free saxagliptin anhydrate.

**2.3 Preparation of the combination tablet by dry rolling granulation**

**[00337]** The HMS5552 solid dispersion prepared according to the above preparation examples of the solid dispersion of the glucokinase activator and the partner drug were added into a mixing tank. The filler (e.g., microcrystalline cellulose) and the binder (e.g., hydroxypropyl cellulose) were added and mixed well. Then, the mixture was rolled by a roller compaction granulator, and the obtained bar was crushed and sized by a crusher to obtain granules of suitable size. After grinding, the optional microcrystalline cellulose or silicified microcrystalline cellulose (for the filler comprising an extragranular part) and the disintegrant (e.g., croscarmellose sodium) were added to the granules, and the mixture was mixed in a barrel mixer. Then, the lubricant (magnesium stearate or sodium stearyl fumarate) and/or optional glidant (micronized silica gel) were added to the mixture and mixed well additionally. The lubricated mixture was compressed with a rotary tablet press to obtain tablets (plain tablets, uncoated tablet cores) of different tablet weights and tablet shapes corresponding to different strengths. Optionally, the obtained tablets were film-coated with Opadry® II, and the weight increased by about 3%, thereby obtaining film-coated tablets.

**[00338] Example 15B a combination tablet of HMS5552+vildagliptin (dose strength: 25 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 50.00 | 8.33 |
| vildagliptin | 50.00 | 8.33 |
| microcrystalline cellulose | 464.00 | 77.33 |
| croscarmellose sodium | 24.00 | 4.00 |
| micronized silica gel | 6.00 | 1.00 |
| magnesium stearate | 6.00 | 1.00 |
| Total weight of tablet cores | 600 | 100.00 |
| Opadry | 18.00 | 3.00 |
| Total weight of coated tablets | 618.00 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552.

**[00339] Example 16B a combination tablet of HMS5552 + vildagliptin (dose strength: 50 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 100.00 | 16.67 |
| vildagliptin | 50.00 | 8.33 |
| microcrystalline cellulose | 414.00 | 69.00 |
| croscarmellose sodium | 24.00 | 4.00 |
| micronized silica gel | 6.00 | 1.00 |
| magnesium stearate | 6.00 | 1.00 |
| Total weight of tablet cores | 600.00 | 100.00 |
| Opadry | 18.00 | 3.00 |
| Total weight of coated tablets | 618.00 | - |

*100.00 mg of the HMS5552 solid dispersion contained 50 mg of HMS5552.

**[00340] Example 17B a combination tablet of HMS5552 + vildagliptin (dose strength:**

**75 mg/50 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 150.00 | 20.00 |
| vildagliptin | 50.00 | 6.67 |
| silicified microcrystalline cellulose | 512.50 | 68.33 |
| croscarmellose sodium | 30.00 | 4.00 |
| magnesium stearate | 7.50 | 1.00 |
| Total weight of tablet cores | 750.00 | 100.00 |
| Opadry | 21.50 | 3.00 |
| Total weight of coated tablets | 771.50 | - |

*150.00 mg of the HMS5552 solid dispersion was equivalent to 75 mg of HMS5552.

**2.4 Preparation of the combination tablet by direct compression of the powder mixture**

**[00341]** The HMS5552 solid dispersion prepared according to the above preparation examples of the solid dispersion of the glucokinase activator and the partner drug were premixed uniformly according to the principle of geometric progression, and then added to a mixing tank. The filler (e.g., microcrystalline cellulose), the disintegrant (e.g., croscarmellose sodium) and optional glidant (micronized silica gel) were added to the granules and mixed in a barrel mixer. Then, the lubricant (magnesium stearate or sodium stearyl fumarate) was added to the mixture and mixed well additionally. The lubricated mixture was compressed with a rotary tablet press to obtain tablets (plain tablets, uncoated tablet cores) of different tablet weights and tablet shapes corresponding to different strengths. Optionally, the obtained tablets were film-coated with Opadry® II, and the weight increased by about 3%, thereby obtaining film-coated tablets.

**[00342]** The formula composition of the combination tablet described in the above preparation process was:

**[00343] Example 18B a combination tablet of HMS5552 + linagliptin (dose strength: 25 mg/5 mg)**

| Formula composition | Unit formula amount/mg | % (w/w) |
|---|---|---|
| HMS5552 solid dispersion* | 50.00 | 25.00 |
| linagliptin | 5.00 | 2.50 |
| microcrystalline cellulose | 137.00 | 68.50 |
| croscarmellose sodium | 4.00 | 2.00 |
| magnesium stearate | 2.00 | 1.00 |
| micronized silica gel | 2.00 | 1.00 |
| Total weight of tablet cores | 200.00 | 100.00 |
| Opadry | 6.00 | 3.00 |
| Total weight of coated tablets | 206.00 | - |

*50.00 mg of the HMS5552 solid dispersion contained 25 mg of HMS5552

**III. Dissolution test in vitro of the combination formulation comprising the glucokinase activator**

**[00344]** The dissolution rate of the tablet was tested by the paddle method of the Chinese Pharmacopoeia (2015 edition). The dissolution of HMS5552 and another partner drug in the medium of pH 6.8 was tested, respectively. At 5 minutes, 15 minutes, 30 minutes, 45 minutes, and 60 minutes, respectively, 5 ml of samples were taken for HPLC analysis.

**[00345]** According to the above test method, several tablets of above-mentioned fixed dose strengths and their corresponding single tablets were tested for their dissolution, and the results were shown below.

**[00346] Table 1 The dissolution results of fixed dose combination tablets prepared in Example 1B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 1B-HMS5552, 50 mg | 97.5 | 98.5 | 98.5 | 98.5 | 98.5 |
| Example 1B-sitagliptin, 50 mg | 86.9 | 96.9 | 97.3 | 97.3 | 97.3 |

**[00347] Table 2 The dissolution results of fixed dose combination tablets prepared in Example 4B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 4B-HMS5552, 75 mg | 83.2 | 98.9 | 99.5 | 99.5 | 99.4 |
| Example 4B-sitagliptin, 100 mg | 93.7 | 98.5 | 98.8 | 98.8 | 98.9 |

**[00348] Table 3 The dissolution results of fixed dose combination tablets prepared in Example 7B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 7B-HMS5552, 25 mg | 50.4 | 77.0 | 86.4 | 91.7 | 95.7 |
| Example 7B-linagliptin, 5 mg | 38.0 | 60.4 | 72.3 | 79.35 | 85.2 |

**[00349] Table 4 The dissolution results of fixed dose combination tablets prepared in Example 9B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 9B-HMS5552, 75 mg | 53.5 | 90.0 | 98.3 | 100.2 | 100.8 |
| Example 9B-linagliptin, 5 mg | 44.4 | 69.5 | 82.2 | 88.5 | 92.6 |

**[00350] Table 5 The dissolution results of fixed dose combination tablets prepared in Example 11B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 11B-HMS5552, | 61.5 | 89.9 | 97.1 | 99.4 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| 75 mg | | | | | |
| Example 11B-saxagliptin, 5 mg | 54.4 | 78.2 | 84.6 | 85.8 | 86.9 |

**[00351] Table 6 The dissolution results of fixed dose combination tablets prepared in Example 14B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 14B-HMS5552, 25 mg | 63.0 | 86.5 | 92.7 | 94.7 | 95.7 |
| Example 14B-saxagliptin, 5 mg | 58.4 | 74.1 | 78.6 | 79.6 | 80.5 |

**[00352] Table 7 The dissolution results of fixed dose combination tablets prepared in Example 17B**

| Time point | Dissolution rate (%) | | | | |
|---|---|---|---|---|---|
| | 5 min | 15 min | 30 min | 45 min | 60 min |
| Example 17B-HMS5552, 75 mg | 50.2 | 71.6 | 76.4 | 78.9 | 87.0 |
| Example 17B-vildagliptin, 50 mg | 54.0 | 74.0 | 79.0 | 81.7 | 90.0 |

**[00353]** It can be seen from the above dissolution results of the fixed dose combination formulations that the dissolution of the fixed dose combination formulations disclosed herein meets the requirements of a fast-release formulation.

## IV. Physical properties of combination formulations containing the glucokinase activator

**[00354]** According to the relevant instruments and methods described in the Pharmacopoeia, the physical properties of several tablets of above-mentioned fixed-dose strengths were tested. The results were described below.

**[00355] Table 8 Physical properties of fixed dose combination tablets prepared in different examples**

| Ingredient | Dose strength (HMS5552/sitagliptin), mg | | | | | |
|---|---|---|---|---|---|---|
| | 75/50 | 75/100 | 50/50 | 50/100 | 25/100 | 100/50 |
| Corresponding Example | Example 2B | Example 4B | Example 1B | Example 3B | Example 5B | Example 6B |
| Tablet shape | Round biconvex | Round biconvex | Round biconvex | Round biconvex | Round biconvex | Round biconvex |
| Tablet core size/mm | 8.73 | 10 | 8.73 | 10 | 8.73 | 10 |
| Colour | white | white | white | white | white | white |
| Weight/mg | 260 | 350 | 220 | 290 | 300 | 350 |
| Hardness/KP (average value) | ≥ 7 | ≥ 10 | ≥ 7 | ≥ 7 | ≥10 | ≥10 |
| Disintegration time/minute | ≤ 15 | ≤ 15 | ≤ 15 | ≤ 15 | ≤5 | ≤5 |
| Fragility/% | ≤ 0.5 | ≤ 0.5 | ≤ 0.5 | ≤ 0.5 | ≤0.5 | ≤0.5 |

**[00356] Table 9 Physical properties of fixed dose combination tablet cores prepared in different examples**

| Ingredient | Dose strength (HMS5552/linagliptin), mg | | | | |
|---|---|---|---|---|---|
| | 25/5 | 50/5 | 75/5 | 100/5 | 25/5 |
| Corresponding Example | Example 7B | Example 8B | Example 9B | Example 10B | Example 18B |
| Tablet shapes | Round biconvex | Round biconvex | Round biconvex | Round biconvex | Round biconvex |
| Tablet core size/mm | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 |
| Colour | white | white | white | white | white |

| | | | | | |
|---|---|---|---|---|---|
| Weight/mg | 220 | 240 | 250 | 300 | 200 |
| Hardness/kp (average value) | ≥10 | ≥10 | ≥10 | ≥10 | ≥10 |
| Disintegration time/minute | ≤5 | ≤5 | ≤5 | ≤5 | ≤5 |
| Fragility/% | ≤0.5 | ≤0.5 | ≤0.5 | ≤0.5 | ≤0.5 |

**[00357] Table 10 Physical properties of fixed dose combination tablet cores prepared in different examples**

| Ingredient | Dose strength (HMS5552/saxagliptin), mg | | | |
|---|---|---|---|---|
| | 75/5 | 50/2.5 | 25/5 | 100/2.5 |
| Corresponding Example | Example 11B | Example 12B | Example 14B | Example 13B |
| Tablet shape | Round biconvex | Round biconvex | Round biconvex | Round biconvex |
| Tablet core size/mm | 9.00 | 9.00 | 9.00 | 9.00 |
| Colour | white | white | white | white |
| Weight/mg | 250 | 250 | 250 | 300 |
| Hardness/kp (average value) | ≥7 | ≥7 | ≥7 | ≥7 |
| Disintegration time/minute | ≤10 | ≤10 | ≤10 | ≤10 |
| Fragility/% | ≤0.5 | ≤0.5 | ≤0.5 | ≤0.5 |

**[00358] Table 11 Physical properties of fixed dose combination tablet cores prepared in different examples**

| Ingredient | Dose strength (HMS5552/vildagliptin), mg | | |
|---|---|---|---|
| | 25/50 | 50/50 | 75/50 |

| Corresponding Example | Example 15B | Example 16B | Example 17B |
|---|---|---|---|
| Tablet shape | Oval biconcave | Oval biconcave | Oval biconcave |
| Tablet core size/mm | 16.60*8.45 | 16.60*8.45 | 19*9.7 |
| Colour | white | white | white |
| Weight/mg | 600 | 600 | 750 |
| Hardness/kp (average value) | ≥15 | ≥15 | ≥15 |
| Disintegration time/minute | ≤10 | ≤10 | ≤10 |
| Fragility/% | ≤0.5 | ≤0.5 | ≤0.5 |

**[00359] V. Study of pharmacodynamics of combination formulations comprising the glucokinase activator**

**Example 1C**

**Animal study of pharmacodynamics of HMS5552 combined with sitagliptin in rat model of type 2 diabetes**

**[00360]** Obese SD rats were induced by STZ to form rat model of type 2 diabetes. They were orally administered lysozyme, 10 mg/kg of HMS5552, 30 mg/kg of HMS5552, 10 mg/kg of sitagliptin, 30 mg/kg of sitagliptin, 10 mg/kg of HMS5552 combined with 10 mg/kg of sitagliptin, or 10 mg/kg of HMS5552 combined with 30 mg/kg of sitagliptin once daily, respectively. After 30 days of treatment, using an oral glucose tolerance test (OGTT), the change in the area under the curve for blood glucose between 0-4 hours (AUEC0-4hr, hr*mg/dL) from the baseline before administration (AUEC) was analyzed. The results showed that 10 mg/kg of HMS5552 combined with 30 mg/kg of sitagliptin has the best hypoglycemic effect, which is better than those of high-dose monotherapies of HMS5552 and sitagliptin (30 mg/kg) with statistically significant differences.

**[00361]** Sitagliptin, a dipeptidyl peptidase-4 (DPP-IV) inhibitor, improves blood glucose control by inhibiting the degradation of incretin GLP-1 and increasing the level of active incretin, thereby reducing postprandial blood glucose and treating type 2 diabetes. HMS5552, a novel glucokinase activator, can improve pancreatic islet function in patients with type 2 diabetes, promote the secretion of incretin, reduce insulin resistance, and has dual therapeutic effects of reducing fasting and postprandial blood glucose. For patients whose blood glucose control fails with a DPP-IV inhibitor, obesity patients and diabetes patients with a cardiovascular disease, the combination of a DPP-IV inhibitor and HMS5552 has better efficacy of blood glucose control and reduces the risk of diabetes complications.

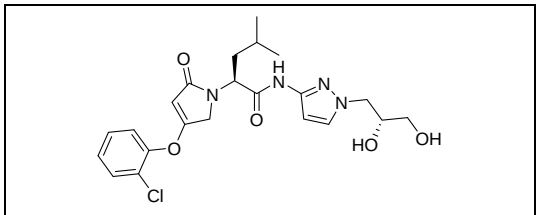
**[00362]** The above study on the effectiveness of HMS5552 combined with existing oral diabetes drugs shows that the combined use can improve the efficacy of HMS5552 or existing hypoglycemic drugs, reduce safety risks, and improve medical effects. Oral fixed dose combination formulations developed with HMS5552 and existing oral diabetes drugs are currently the most promising combination drugs for diabetes treatment to solve the above clinical needs.

CLAIMS

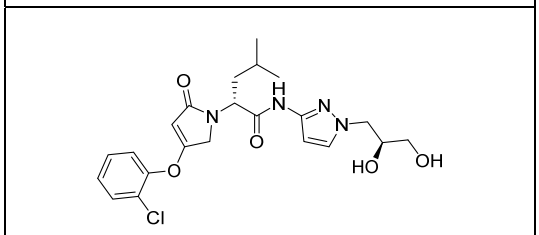
WHAT IS CLAIMED IS:

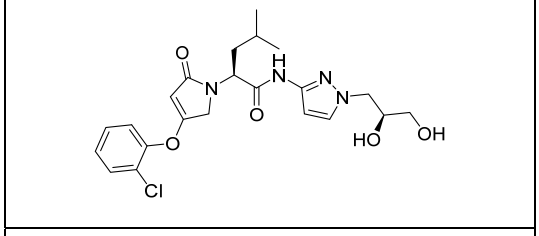
1. A pharmaceutical combination, comprising:

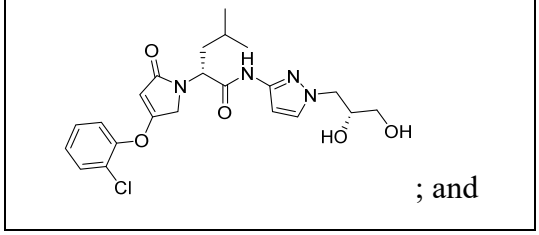
(a) a glucokinase activator, wherein the glucokinase activator is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,



HMS5552







; and

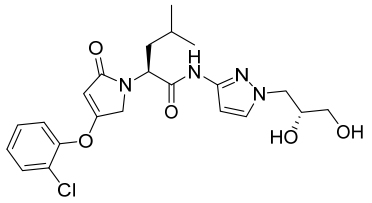
(b) a DPP-IV inhibitor;

wherein the above-mentioned drugs (a) and (b) are used simultaneously, separately or sequentially.

2. The pharmaceutical combination of claim 1, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 100:1, alternatively about 1:4 to 40:1, and

yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1 or about 40:1.

3. The pharmaceutical combination of claim 1 or 2, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or an isotope labeled analogue or a pharmaceutically acceptable salt thereof,




HMS5552 .

4. The pharmaceutical combination of any one of claims 1-3, wherein the glucokinase activator is in the form of a solid dispersion; alternatively, the glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, wherein the polymer carrier is methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

5. The pharmaceutical combination of claim 4, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5, or about 5:6.

6. The pharmaceutical combination of any one of claims 1-5, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin, and a pharmaceutically acceptable salt thereof, alternatively sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt thereof.

7. The pharmaceutical combination of any one of claims 1-6, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively from about 25 mg to about 100 mg, alternatively, wherein the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg or about 100 mg.

8. The pharmaceutical combination of any one of claims 1-7, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, alternatively, wherein the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

9. The pharmaceutical combination of any one of claims 1-8, which is in the form of a pharmaceutical composition.

10. The pharmaceutical composition of claim 9, comprising a solid dispersion of the glucokinase activator and the DPP-IV inhibitor, alternatively, wherein the weight ratio of the solid dispersion of the glucokinase activator to the DPP-IV inhibitor is about 1:5 to 100:1, alternatively about 1:2 to 80:1, and yet alternatively about 1:2, about 1:1, about 2:1, about 3:1,

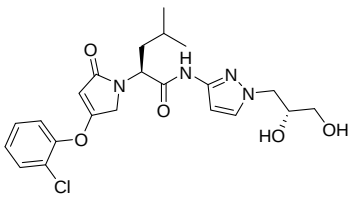
about 3:2, about 4:1, about 10:1, about 20:1, about 30:1, about 40:1, or about 80:1.

11. The pharmaceutical composition of claim 9 or 10, wherein the solid dispersion of the glucokinase activator is about 1-98% by weight; and the DPP-IV inhibitor is about 0.2-80% by weight.

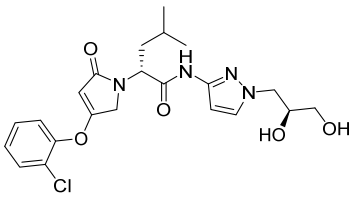
12. The pharmaceutical composition of any one of claims 9-11, further comprising one or more excipients, alternatively, the excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

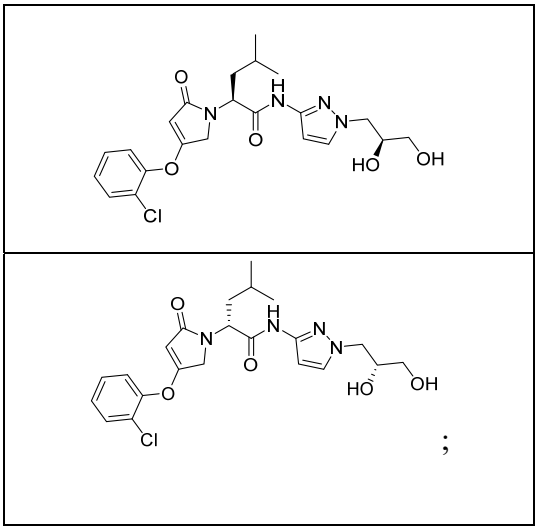
13. The pharmaceutical composition of any one of claims 9-12, which is in a form selected from the group consisting of a tablet, a capsule, a pill and a lozenge, alternatively a tablet, and yet alternatively a coated tablet.

14. A fixed dose combination formulation, comprising:
(a) a glucokinase activator, which is a compound represented by the following formulae, or a pharmaceutically acceptable salt, an isotope labeled analogue, a crystalline form, a hydrate, a solvate, a diastereomeric or enantiomeric form thereof,




HMS5552





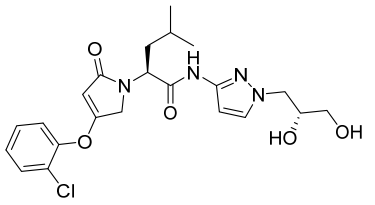
(b) a DPP-IV inhibitor; and

(c) one or more excipients.

15. The fixed dose combination formulation of claim 14, wherein the weight ratio of the glucokinase activator to the DPP-IV inhibitor is about 1:10 to 100:1, alternatively about 1:4 to 40:1, and yet alternatively about 1:4, about 1:2, about 1:1, about 1.5:1, about 1.5:2, about 2:1, about 5:1, about 10:1, about 15:1, about 20:1 or about 40:1.

16. The fixed dose combination formulation of claim 14 or 15, wherein the glucokinase activator is about 1-98% by weight; and the DPP-IV inhibitor is about 0.2-80% by weight.

17. The fixed dose combination formulation of any one of claims 14-16, wherein the glucokinase activator is the compound HMS5552 represented by the following formula, or an isotope labeled analogue or a pharmaceutically acceptable salt thereof,



HMS5552 .

18. The fixed dose combination formulation of any one of claims 14-17, wherein the glucokinase activator is in the form of a solid dispersion, alternatively, wherein the

glucokinase activator is in the form of a solid dispersion comprising a polymer carrier, wherein the polymer carrier is methacrylic acid copolymer of type A (an anionic copolymer of methacrylic acid and methyl methacrylate (1:1)), alternatively Eudragit, and yet alternatively Eudragit L100.

19. The fixed dose combination formulation of any one of claims 14-18, wherein the weight ratio of the glucokinase activator to the polymer carrier is about 1:10 to 10:1, alternatively about 1:9 to 9:1, about 1:4 to 4:1, about 3:7 to 7:3, about 2:3 to 3:2, about 3:4 to 4:3, about 4:5 to 5:4 or about 5:6 to 6:5, and yet alternatively about 1:1, about 2:3, about 3:4, about 4:5 or about 5:6.

20. The fixed dose combination formulation of any one of claims 14-19, wherein the DPP-IV inhibitor is selected from the group consisting of sitagliptin (or sitagliptin phosphate monohydrate), saxagliptin (or saxagliptin monohydrate), vildagliptin, linagliptin, alogliptin, denagliptin, melogliptin, gosogliptin, teneligliptin, dutogliptin, and a pharmaceutically acceptable salt thereof, alternatively sitagliptin (or ), saxagliptin (or saxagliptin monohydrate), vildagliptin and linagliptin, and a pharmaceutically acceptable salt thereof.

21. The fixed dose combination formulation of any one of claims 14-20, wherein the glucokinase activator is present in a dose (alternatively, a unit dose) ranging from about 1 mg to about 200 mg, alternatively about 25 mg to about 100 mg, alternatively, wherein the dose (alternatively, a unit dose) of the glucokinase activator is about 25 mg, about 50 mg, about 75 mg or about 100 mg.

22. The fixed dose combination formulation of any one of claims 14-21, wherein the DPP-IV inhibitor is present in a dose (alternatively, a unit dose) ranging from about 1 mg to 200 mg, alternatively about 2.5 mg to about 100 mg, alternatively, wherein the dose (alternatively, a unit dose) of the DPP-IV inhibitor is about 2.5 mg, about 5 mg, about 10 mg, about 20 mg, about 50 mg or about 100 mg, and still alternatively about 2.5 mg, about 5 mg, about 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is sitagliptin, with a dose (alternatively, a

unit dose) of about 25 mg to about 200 mg, alternatively about 50 mg to about 100 mg, alternatively about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg or about 200 mg, and yet alternatively about 25 mg, 50 mg or about 100 mg; alternatively, the DPP-IV inhibitor is linagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 5 mg or about 10 mg, and yet alternatively about 5 mg; alternatively, the DPP-IV inhibitor is saxagliptin, with a dose (alternatively, a unit dose) of about 1 mg to about 20 mg, alternatively about 1 mg, about 2.5 mg, about 5 mg or about 10 mg, and yet alternatively about 2.5 mg or about 5 mg; alternatively, the DPP-IV inhibitor is vildagliptin, with a dose (alternatively, a unit dose) of about 10 mg to about 150 mg, alternatively about 50 mg and about 100 mg, and still alternatively about 50 mg.

23. The fixed dose combination formulation of any one of claims 14-22, wherein the weight ratio of the solid dispersion of the glucokinase activator to the DPP-IV inhibitor is about 1:5 to 100:1, alternatively about 1:2 to 80:1, and yet alternatively about 1:2, about 1:1, about 2:1, about 3:1, about 3:2, about 4:1, about 10:1, about 20:1, about 30:1, about 40:1 or about 80:1.

24. The fixed dose combination formulation of claim 23, wherein the solid dispersion of the glucokinase activator is about 1-98% by weight; and the DPP-IV inhibitor is about 0.2-80% by weight.

25. The fixed dose combination formulation of any one of claims 14-24, wherein the one or more excipients are selected from the group consisting of binders, fillers, disintegrants, lubricants, glidants, surfactants, wetting agents, antioxidants, flavoring agents, sweetening agents, coloring agents and coating agents.

26. The fixed dose combination formulation of claim 25, wherein the binder is selected from the group consisting of polyvinylpyrrolidone, hydroxypropyl cellulose and hydroxypropyl methyl cellulose; the filler is selected from the group consisting of microcrystalline cellulose, silicified microcrystalline cellulose, lactose, calcium dihydrogen phosphate, mannitol, corn starch and pregelatinized starch; the disintegrant is selected from the group consisting of

croscarmellose sodium, crospovidone and sodium starch glycolate; the lubricant is selected from the group consisting of magnesium stearate and sodium stearyl fumarate; and the glidant is selected from the group consisting of colloidal silicon dioxide and talc.

27. The fixed dose combination formulation of any one of claims 14-26, which is a tablet.

28. The fixed dose combination formulation of claim 27, which is a coated tablet.

29. The fixed dose combination formulation of claim 28, wherein the coated tablet is a film-coated tablet, wherein the film-coating agent comprises:
a film-coating substrate, such as hypromellose, hydroxypropyl methyl cellulose or a mixture thereof;
an optional plasticizer, such as polyvinyl alcohol, polyethylene glycol, propylene glycol, polysorbate or a mixture thereof;
an optional coloring agent, such as iron oxide red, iron oxide yellow or a mixture thereof;
an optional opacifier, such as titanium dioxide, and
an optional glidant.

30. The fixed dose combination formulation of claim 29, wherein the coated tablet is a film-coated tablet, and the film-coating agent is Opadry.

31. The fixed dose combination formulation of any one of claims 14-30, comprising (by weight):
- about 1-80%, alternatively about 5-75% of a glucokinase activator, alternatively HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 0.2-80%, alternatively about 0.5-75% of a DPP-IV inhibitor;
- about 0-55% of filler(s);
- about 1-25% of binder(s);

- about 0-15% of disintegrant(s);
- about 0.1-10% of lubricant(s);
- about 0-3% of glidant(s); and
- about 0-5% of coating agent(s).

32. The fixed dose combination formulation of claim 31, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):
about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;
about 25 mg, about 50 mg, about 75 mg, about 100 mg, about 150 mg, or about 200 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate.

33. The fixed dose combination formulation of claim 32, which is a tablet of 50 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):
- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

34. The fixed dose combination formulation of claim 32, which is a tablet of 75 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):
- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a

solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s); and
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

35. The fixed dose combination formulation of claim 32, which is a tablet of 50 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):
- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

36. The fixed dose combination formulation of claim 32, which is a tablet of 75 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):
- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid

dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

37. The fixed dose combination formulation of claim 32, which is a tablet of 25 mg HMS5552/100 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 100 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

38. The fixed dose combination formulation of claim 32, which is a tablet of 100 mg HMS5552/50 mg sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate, and comprises the components with the following amounts (by weight):

- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid

dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 50 mg of sitagliptin or a corresponding amount of sitagliptin phosphate monohydrate;
- about 0-50% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

39. The fixed dose combination formulation of claim 32, comprising about 100 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 40.35 mg of microcrystalline cellulose, about 6.60 mg of hydroxypropyl cellulose, about 6.60 mg of croscarmellose sodium, about 2.20 mg of magnesium stearate and about 6.60 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

40. The fixed dose combination formulation of claim 32, comprising about 150 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 27.55 mg of microcrystalline cellulose, about 7.80 mg of hydroxypropyl cellulose, about 7.80 mg of croscarmellose sodium, about 2.60 mg of magnesium stearate and about 7.80 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

41. The fixed dose combination formulation of claim 32, comprising about 100 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 41.20 mg of microcrystalline cellulose, about 8.70 mg of hydroxypropyl cellulose, about 8.70 mg of croscarmellose sodium, about 2.90 mg of magnesium stearate, and about 8.70 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

42. The fixed dose combination formulation of claim 32, comprising about 150 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 47.00 mg of microcrystalline cellulose, about 10.50 mg of hydroxypropyl cellulose, about 10.50 mg of croscarmellose sodium, about 3.50 mg of magnesium stearate and about 10.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75mg of HMS5552.

43. The fixed dose combination formulation of claim 32, comprising about 50 mg of a solid dispersion, about 128.50 mg of sitagliptin phosphate monohydrate, about 100.50 mg of microcrystalline cellulose, about 9.00 mg of hydroxypropyl cellulose, about 9.00 mg of croscarmellose sodium, about 3.00 mg of magnesium stearate and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

44. The fixed dose combination formulation of claim 32, comprising about 200 mg of a solid dispersion, about 64.25 mg of sitagliptin phosphate monohydrate, about 61.26 mg of microcrystalline cellulose, about 10.50 mg of hydroxypropyl cellulose, about 10.50 mg of croscarmellose sodium, about 3.50 mg of magnesium stearate and about 10.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

45. The fixed dose combination formulation of claim 31, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):
about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;
about 50 mg or about 100 mg of vildagliptin.

46. The fixed dose combination formulation of claim 45, which is a tablet of 25 mg HMS5552/50 mg vildagliptin, and comprises the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of vildagliptin;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

47. The fixed dose combination formulation of claim 45, which is a tablet of 50 mg HMS5552/50 mg vildagliptin, and comprises the components with the following amounts (by weight):
- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 50 mg of vildagliptin;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

48. The fixed dose combination formulation of claim 45, which is a tablet of 75 mg HMS5552/50 mg vildagliptin, and comprises the components with the following amounts (by weight):
- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid

dispersion comprising about 1:1 of HMS5552 and Eudragit L100;

- about 50 mg of vildagliptin;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-8% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

49. The fixed dose combination formulation of claim 45, comprising about 50 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 464.00 mg of microcrystalline cellulose, about 24.00 mg of croscarmellose sodium, about 6.00 mg of micronized silica gel, about 6.00 mg of magnesium stearate and about 18.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

50. The fixed dose combination formulation of claim 45, comprising about 100 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 414.00 mg of microcrystalline cellulose, about 24.00 mg of croscarmellose sodium, about 6.00 mg of micronized silica gel, about 6.00 mg of magnesium stearate, and about 18.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

51. The fixed dose combination formulation of claim 45, comprising about 150 mg of a solid dispersion, about 50.00 mg of vildagliptin, about 512.50 mg of silicified microcrystalline cellulose, about 30.00 mg of croscarmellose sodium, about 7.50 mg of magnesium stearate and about 21.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

52. The fixed dose combination formulation of claim 31, wherein the doses (alternatively,

unit doses) of the active ingredients are (by weight):

about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;

about 2.5 mg, about 5 mg, about 7.5 mg, and about 10 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate.

53. The fixed dose combination formulation of claim 52, which is a tablet of 25 mg HMS5552/5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate, and comprises the components with the following amounts (by weight):

- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

54. The fixed dose combination formulation of claim 52, which is a tablet of 50 mg HMS5552/2.5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate, and comprises the components with the following amounts (by weight):

- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 2.5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);

- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

55. The fixed dose combination formulation of claim 52, which is a tablet of 75 mg HMS5552/5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate, and comprises the components with the following amounts (by weight):
- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

56. The fixed dose combination formulation of claim 52, which is a tablet of 100 mg HMS5552/2.5 mg saxagliptin or a corresponding amount of saxagliptin monohydrate, and comprises the components with the following amounts (by weight):
- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 2.5 mg of saxagliptin or a corresponding amount of saxagliptin monohydrate;
- about 0-80% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and

- about 0-5% of coating agent(s).

57. The fixed dose combination formulation of claim 52, comprising about 150 mg of a solid dispersion, about 5.29 mg of saxagliptin monohydrate, about 7.50 mg of hydroxypropyl cellulose, about 79.71 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium, and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

58. The fixed dose combination formulation of claim 52, comprising about 100 mg of a solid dispersion, about 2.64 mg of saxagliptin monohydrate, about 7.50 mg of hydroxypropyl cellulose, about 132.36 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium, and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

59. The fixed dose combination formulation of claim 52, comprising about 200 mg of a solid dispersion, about 2.64 mg of saxagliptin monohydrate, about 9.00 mg of povidone, about 79.36 mg of microcrystalline cellulose, about 3.00 mg of magnesium stearate, about 6.00 mg of croscarmellose sodium and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

60. The fixed dose combination formulation of claim 52, comprising about 50 mg of a solid dispersion, about 5.29 mg of saxagliptin monohydrate, about 7.50 mg of povidone, about 179.71 mg of microcrystalline cellulose, about 2.50 mg of magnesium stearate, about 5.00 mg of croscarmellose sodium and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

61. The fixed dose combination formulation of claim 31, wherein the doses (alternatively, unit doses) of the active ingredients are (by weight):
about 25 mg, about 50 mg, about 75 mg or about 100 mg of a glucokinase activator, alternatively HMS5552;
about 2.5 mg, about 5 mg, about 7.5 mg, or about 10 mg of linagliptin.

62. The fixed dose combination formulation of claim 61, which is a tablet of 25 mg HMS5552/5 mg linagliptin, and comprises the components with the following amounts (by weight):
- about 25 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

63. The fixed dose combination formulation of claim 61, which is a tablet of 50 mg HMS5552/5 mg linagliptin, and comprises the components with the following amounts (by weight):
- about 50 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);

- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

64. The fixed dose combination formulation of claim 61, which is a tablet of 75 mg HMS5552/5 mg linagliptin, and comprises the components with the following amounts (by weight):
- about 75 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and
- about 0-5% of coating agent(s).

65. The fixed dose combination formulation of claim 61, which is a tablet of 100 mg HMS5552/5 mg linagliptin, and comprises the components with the following amounts (by weight):
- about 100 mg of HMS5552, alternatively a solid dispersion of HMS5552, alternatively a solid dispersion comprising HMS5552 and a polymer carrier, and alternatively a solid dispersion comprising about 1:1 of HMS5552 and Eudragit L100;
- about 5 mg of linagliptin;
- about 0-90% of filler(s);
- about 2-8% of binder(s);
- about 1-5% of disintegrant(s);
- about 0.5-3% of lubricant(s);
- about 0-0.5% of glidant(s); and

- about 0-5% of coating agent(s).

66. The fixed dose combination formulation of claim 61, comprising about 50 mg of a solid dispersion, about 5.00 mg of linagliptin, about 151.80 mg of microcrystalline cellulose, about 6.60 mg of hydroxypropyl cellulose, about 4.40 mg of croscarmellose sodium, about 2.20 mg of magnesium stearate, and about 6.60 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

67. The fixed dose combination formulation of claim 61, comprising about 100 mg of a solid dispersion, about 5.00 mg of linagliptin, about 120.60 mg of microcrystalline cellulose, about 7.20 mg of hydroxypropyl cellulose, about 4.80 mg of croscarmellose sodium, about 2.40 mg of magnesium stearate and about 7.20 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 50 mg of HMS5552.

68. The fixed dose combination formulation of claim 61, comprising about 150 mg of a solid dispersion, about 5.00 mg of linagliptin, about 27.50 mg of microcrystalline cellulose, about 50.00 mg of mannitol, about 7.50 mg of hydroxypropyl cellulose, about 7.50 mg of croscarmellose sodium, about 2.50 mg of magnesium stearate and about 7.50 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 75 mg of HMS5552.

69. The fixed dose combination formulation of claim 61, comprising about 50 mg of a solid dispersion, about 5.00 mg of linagliptin, about 137.00 mg of microcrystalline cellulose, about 4.00 mg of croscarmellose sodium, about 2.00 mg of magnesium stearate, about 2.00 mg of micronized silica gel, and about 6.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 25 mg of HMS5552.

70. The fixed dose combination formulation of claim 61, comprising about 200 mg of a solid dispersion, about 5.00 mg of linagliptin, about 77.0 mg of microcrystalline cellulose, about 9.00 mg of hydroxypropyl cellulose, about 6.00 mg of croscarmellose sodium, about 3.00 mg

of magnesium stearate, and about 9.00 mg of Opadry, wherein the solid dispersion comprises about 1:1 of HMS5552 and Eudragit L100, and comprises about 100 mg of HMS5552.

71. A method for preparing the fixed dose combination formulation of any one of the preceding claims, comprising incorporating the active ingredients into one or more excipients for granulation, alternatively further filling the obtained granule mixture into a vial, a sachet or a capsule, or compressing it into a tablet with a desired shape; yet alternatively, further coating the obtained tablet.

72. The method for preparing the fixed dose combination formulation according to claim 71, wherein the preparation is carried out by wet granulation (high shear and/or fluidized bed), or by dry processing (direct compression or dry granulation).

73. The method for preparing the fixed dose combination formulation according to any one of claims 71-72, wherein the glucokinase activator is prepared in the form of a solid dispersion.

74. The method for preparing the fixed dose combination formulation according to any one of claims 71-73, wherein the glucokinase activator and the second or more active ingredients are prepared together in the form of a combination solid dispersion.

75. The pharmaceutical combination or pharmaceutical composition of any one of claims 1-13 or the fixed dose combination formulation of any one of claims 14-70, which is used to prevent, slow the progression of, delay, or treat one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improve blood glucose control and/or reduce fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or prevent, slow, delay, or reverse complications of diabetes mellitus.

76. A method for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c; or preventing, slowing, delaying, or reversing complications of diabetes mellitus, comprising administering to a subject a therapeutically effective amount of the pharmaceutical combination or pharmaceutical composition of any one of claims 1-13 or the fixed dose combination formulation of any one of claims 14-70.

77. Use of the pharmaceutical combination or pharmaceutical composition of any one of claims 1-13 or the fixed dose combination formulation of any one of claims 14-70 in the manufacture of a medicament for preventing, slowing the progression of, delaying, or treating one or more metabolic disorders selected from the group consisting of: type I diabetes, type II diabetes, impaired glucose tolerance, impaired fasting blood glucose, hyperglycemia, postprandial hyperglycemia, overweight, obesity, hypertension, insulin resistance, diabetic cognitive dysfunction, memory dysfunction, senile dementia and/or metabolic syndrome; or improving blood glucose control and/or reducing fasting plasma glucose, postprandial plasma glucose and/or glycosylated hemoglobin HbA1c.