

Postbiotic and use thereof in regulation of lipid metabolism

Cross-Reference to Related Application

The present application claims priority to the Chinese application with application number CN 202311768062.2 (filed on December 21, 2023), and the disclosure of the Chinese application is incorporated into the present application in its entirety.

Technical Field

The present application relates to a postbiotic and use thereof in regulation of lipid metabolism. Specifically, the present application relates to the use of the postbiotic in the manufacture of a pharmaceutical or food product. The present application also relates to a method for regulating the weight of a subject, and a method for inhibiting or reducing lipid absorption in the gastrointestinal tract of a subject.

Background

In modern society, the improvement of people's living standards, combined with unhealthy lifestyle habits such as high-calorie diets and prolonged sedentary behavior, has led to a gradual increase in the prevalence of obesity, resulting in a series of metabolic abnormalities, such as excessive lipid deposition leading to conditions like hyperlipidemia and non-alcoholic fatty liver disease. Additionally, adipocyte dysfunction can cause systemic inflammation and vascular stiffness, contributing to hypertension and cardiovascular diseases. As the number of overweight and obese individuals continues to rise, the incidence of these diseases is escalating rapidly, becoming a major health concern for urban populations. Moreover, obesity and overweight are increasingly affecting younger age groups.

Currently, the primary treatment for obesity, overweight, or lipid metabolism disorders involves lifestyle interventions, including a low-saturated fatty acid diet and moderate-to-vigorous physical activity. In addition, pharmacological treatments may be used, such as the lipase inhibitor drug orlistat, or medications for treating hypertension or dyslipidemia, as well as cholesterol-lowering drugs. While these drugs can be effective in treating obesity or lipid metabolism disorders, long-term use may lead to significant side effects, particularly on liver and kidney function.

Research has found that probiotics can play an important role in human physiological metabolism by producing metabolites and regulating gut microbiota. According to the definition of probiotics given by British scientist Roy Fuller in 1989, probiotics are "a live microbial supplement that, when ingested, exerts beneficial effects on the host by improving the balance of

the intestinal microecology." The China Nutrition and Health Food Association has released a group standard, T/CNHFA 006-2022, "Guidelines for Classifying the Viable Count Rate of Probiotic Foods," which classifies the viable count rate of probiotic foods, emphasizes that ensuring a sufficient number of live probiotics reach the intestines is one of the fundamental conditions for probiotics to exert their efficacy.

Recent scientific research has shown that certain specific probiotics, even when inactivated, can still possess unique biological activities, referred to as "postbiotics." The International Scientific Association for Probiotics and Prebiotics defines postbiotics as "preparations of inanimate microorganisms and/or relevant components thereof that confer health benefits on the host." The efficacy of postbiotics stems from both the microbial cells themselves and their growth metabolites. Generally, postbiotic preparations are considered to comprise inactivated or dead microbial cells; macromolecular substances secreted by microorganisms or bound to their cell surfaces, such as proteins, lipids, and carbohydrates; microbial metabolites like short-chain fatty acids (SCFAs) and organic acids; and cell wall components such as lipoteichoic acid and peptidoglycan. With the advancement of scientific research, the definition and scope of postbiotics will continue to be refined. Compared to probiotics, inactivated probiotics offer distinct advantages for commercial production and product applications.

Therefore, developing an inactivated probiotic strain that can regulate or improve lipid metabolism abnormalities holds high market value and broad application prospects.

Contents of the Invention

The applicant of the present patent application has previously screened a probiotic strain, *Bifidobacterium breve* 207-1, with the microbial deposit number GDMCC No. 60962. During subsequent research, it was unexpectedly discovered that the postbiotic prepared by fermenting and inactivating this strain exhibits outstanding efficacy in promoting lipolysis and/or inhibiting fat absorption. Therefore, the postbiotic of the present application and the composition containing it hold great potential for use in the manufacture of a medicament or food product for a disease and/or symptom associated with fat increase.

Therefore, in a first aspect, the present application provides a use of a postbiotic, or a composition comprising the postbiotic, in the manufacture of a medicament or food product for preventing and/or ameliorating a disease and/or symptom associated with increased fat in a subject;

wherein, the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, wherein the *Bifidobacterium breve* strain is deposited at the Guangdong Microbial Culture Collection Center with the accession number GDMCC No. 60962.

Preparation of postbiotic

The postbiotic of the present invention can be prepared by various methods known in the art.

In some embodiments, the postbiotic is prepared by inactivating the *Bifidobacterium breve* strain. In some embodiments, the postbiotic comprises the *Bifidobacterium breve* strain in dead bacterial form.

In some embodiments, the postbiotic is prepared by fermentation and subsequent inactivation of the *Bifidobacterium breve* strain. In some embodiments, the postbiotic comprises the *Bifidobacterium breve* strain in dead bacterial form, as well as a primary and/or secondary metabolite generated during in vitro fermentation.

As used herein, the postbiotic may comprise many different components.

In some embodiments, the postbiotic comprises the cell components of the *Bifidobacterium breve* strain. In some embodiments, the postbiotic comprises a cell lysate of the *Bifidobacterium breve* strain. In some embodiments, the postbiotic comprises peptidoglycan, lipoteichoic acid, cell wall peptide, cell wall polysaccharide, pilus-type structure, etc.

In some embodiments, the postbiotic comprises a primary and/or secondary metabolite of the *Bifidobacterium breve* strain. In some embodiments, the postbiotic comprises short-chain fatty acid (SCFA, such as acetic acid, propionic acid, and butyric acid), extracellular polysaccharide, functional protein, vitamin (e.g., biotin, cobalamin, folic acid, niacin, pantothenic acid, pyridoxine, riboflavin, and thiamine), etc.

In such embodiments, those skilled in the art can choose a suitable method to prepare various dead bacterial formulations of the *Bifidobacterium breve* strain contained in the postbiotic. Therefore, the dosage form of the postbiotic includes, but is not limited to, pill, powder, capsule, tablet (e.g., effervescent tablet), film-coated tablet, orally soluble granule, and liquid.

In some embodiments, the postbiotic is a powder.

In some embodiments, the postbiotic is a bacterial powder.

In some embodiments, the bacterial powder is prepared by the following method: culturing and inactivating the *Bifidobacterium breve* strain, then collecting and drying the resulting precipitate.

In some embodiments, the bacterial powder is prepared by the following method: fermenting and inactivating the *Bifidobacterium breve* strain, then centrifuging to collect the resulting precipitate and freeze-drying it under vacuum.

In some embodiments, the *Bifidobacterium breve* strain is fermented using a MRS medium.

In some embodiments, the *Bifidobacterium breve* strain is subjected to heat inactivation treatment at 70 to 95 °C.

In some embodiments, the medicament or food product is used to prevent and/or ameliorate a disease and/or symptom caused by increased fat in a subject.

In some embodiments, the disease and/or symptom is selected from the group consisting of weight gain, obesity, fatty liver, fat accumulation (e.g., visceral fat accumulation, subcutaneous fat accumulation), lipid metabolism disorder, or any combination thereof.

In some embodiments, the subcutaneous fat accumulation is selected from the group consisting of abdominal fat accumulation, arm fat accumulation, leg fat accumulation, or any combination thereof.

In some embodiments, the visceral fat accumulation is selected from the group consisting of perienteric fat accumulation, perirenal fat accumulation, perigonadal fat accumulation, or any combination thereof.

In some embodiments, the disease caused by the lipid metabolism disorder is selected from the group consisting of hyperlipidemia, non-alcoholic fatty liver disease, hypertension, cardiovascular disease, or any combination thereof.

In some embodiments, the subject with obesity has a BMI greater than 23.9 kg/m² (e.g., a BMI greater than 25 kg/m², greater than 26 kg/m², greater than 27 kg/m², greater than 28 kg/m², greater than 29 kg/m², greater than 30 kg/m²).

In some embodiments, the medicament or food product is capable of promoting lipolysis and/or inhibiting fat absorption.

In some embodiments, the medicament or food product is capable of maintaining the subject's weight and/or BMI.

In some embodiments, the medicament or food product is capable of reducing the subject's weight and/or BMI.

In some embodiments, the medicament or food product is capable of giving the subject a healthy BMI (e.g., 18.5 to 23.9 kg/m²).

In some embodiments, the medicament or food product is given to a subject with a healthy BMI to maintain the subject's weight and/or BMI. In some embodiments, the medicament or food product is given to a subject with overweight BMI to reduce the subject's weight and/or BMI, or to bring the subject's weight and/or BMI toward a healthy weight and/or BMI (e.g., 18.5 to 23.9 kg/m²).

In some embodiments, after the medicament or food product is administered to the subject, it is capable of increasing the subject's feeling of satiety.

In some embodiments, after the medicament or food product is administered to the subject, it is capable of reducing the subject's food intake.

In some embodiments, the medicament or food product further comprises an additional active ingredient (e.g., a compound).

In some embodiments, the additional active ingredient is capable of promoting lipolysis and/or inhibiting fat absorption; for example, L-carnitine.

In some embodiments, the additional active ingredient is capable of accelerating metabolism; for example, tea polyphenol, caffeine.

In some embodiments, the additional active ingredient is a lipase inhibitor; for example, orlistat.

As used herein, the term "medicament" encompasses both medicaments for human use and medicaments for animal use (i.e., veterinary applications). In some embodiments, the medicament is for human use.

In some embodiments, the pharmaceutical composition comprises a formulation of the postbiotic.

In some embodiments, the pharmaceutical composition comprises a pharmaceutically acceptable carrier.

In some embodiments, the pharmaceutical composition is formulated for oral administration.

In some embodiments, the medicament or food product is one that is targeted for release in gastrointestinal tract, or one that is released in a controlled manner in the gastrointestinal tract.

In some embodiments, the medicament is in the form of pill, powder, capsule, tablet (e.g., effervescent tablet), film-coated tablet, orally soluble granule, liquid, suppository, or enema.

As used herein, the term "food product" is used broadly to include human food and drink, as well as to encompass animal food and drink (i.e., feed). In some embodiments, the food is suitable for and designed for human consumption.

It is understood that the food product of the present application may be in the form of liquid, solid, suspension, or powder, depending on its method of use, method of application, or method of administration.

In some embodiments, the food product is selected from the group consisting of solid beverage, candy, or fruit juice, or the food product is a dairy product (e.g., yogurt, flavored fermented milk, lactic acid bacteria beverage, cheese).

In some embodiments, the food product is a dietary supplement.

As used herein, the term "dietary supplement" refers to an edible product capable of providing a beneficial effect (e.g., nutritional effect, preventive effect, therapeutic effect, or other beneficial effect) to a consumer. As used herein, the dietary supplement encompasses products such as health foods, medical foods, nutritional products, and supplements.

In some embodiments, the dietary supplement is formulated for oral administration.

In some embodiments, the food product may further comprise (but is not limited to) one or any combination of the following substances: probiotics (e.g., probiotic bacteria), carbohydrates (e.g., dietary fiber), proteins (e.g., enzymes), lipids (e.g., fats), vitamins, and minerals.

In some embodiments, the food product may further comprise an immunomodulator.

In some embodiments, the food product may further comprises plant component (e.g., flavonoid, polyphenolic plant extract, etc.), milk substitute, or metabolite or extract of the *Bifidobacterium breve* strain or progeny thereof.

In some embodiments, the postbiotic of the present invention may further be combined with various sweeteners or flavorings, colorants, stabilizers, flow aids, fillers, and other food-acceptable excipients.

In some embodiments, the food product further comprises a prebiotic.

In some embodiments, the prebiotic is selected from the group consisting of fructooligosaccharide, galactooligosaccharide, xylooligosaccharide, isomaltooligosaccharide, soybean oligosaccharide, inulin, spirulina, arthrospira, *Trametes (Coriolus) versicolor* polysaccharide, carrot nitrogenous polysaccharide, casein hydrolysate, α -lactalbumin, lactoferrin, or any combination thereof.

In some embodiments, the food product is in the form of a pill, powder, capsule, tablet (e.g., effervescent tablet), film-coated tablet, orally soluble granule, or liquid.

In some embodiments, the subject is a mammal. In some embodiments, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

In some embodiments, the prebiotic is added to the medicament or food product in an amount of 0.001 g to 0.1 g.

In some embodiments, the prebiotic is added to the medicament or food product in an amount of 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, or 0.05 to 0.1 g.

It is understood that those skilled in the art are capable of administering an effective amount of the postbiotic to a subject based on the specific circumstances of the subject.

In some embodiments, since the postbiotic comprises the inactivated *Bifidobacterium breve* strain, the number of *Bifidobacterium breve* cells is used as the unit of measurement for the *Bifidobacterium breve* strain. In some embodiments, the number of *Bifidobacterium breve* cells in the postbiotic is 10^8 to 10^{14} /g (e.g., 10^8 to 10^{10} /g, 10^{10} to 10^{12} /g, 10^{12} to 10^{14} /g).

Therefore, when the postbiotic is added to the medicament or food product in an amount of 0.001g, the number of bacterial cells in the postbiotic is 10^5 to 10^{11} . When the postbiotic is added to the medicament or food product in an amount of 0.1g, the number of bacterial cells in the postbiotic is 10^7 to 10^{13} .

In some embodiments, the composition comprises the postbiotic and a microorganism selected from the group consisting of bacterium, fungus, or any combination thereof.

In some embodiments, the microorganism is a probiotic.

In some embodiments, the microorganism is yeast.

In some embodiments, the yeast is selected from the group consisting of *Saccharomyces cerevisiae*, *Saccharomyces boulardii*, *Kluyveromyces marxianus*, or any combination thereof.

In some embodiments, the bacterium is selected from the group consisting of *Lactobacillus* spp., *Bifidobacterium* spp., *Bacillus* spp., *Propionibacterium* spp., *Streptococcus* spp., *Lactococcus* spp., *Pediococcus* spp., *Enterococcus* spp., and *Staphylococcus* spp., or any combination thereof.

In some embodiments, the bacterium of the *Lactobacillus* spp. is selected from the group consisting of: *Lactobacillus paracasei*, *Lactobacillus acidophilus*, *Lactobacillus brevis*, *Lactobacillus jensenii*, *Lactobacillus iners*, *Lactobacillus casei*, *Lactobacillus crispatus*, *Lactobacillus curvatus*, *Lactobacillus delbrueckii*, *Lactobacillus fermentum*, *Lactobacillus*

gasseri, *Lactobacillus helveticus*, *Lactobacillus johnsonii*, *Lactobacillus plantarum*, *Lactobacillus reuteri*, *Lactobacillus rhamnosus*, *Lactobacillus sakei*, *Lactobacillus salivarius*, or any combination thereof.

In some embodiments, the bacterium of the *Bifidobacterium* spp. is selected from the group consisting of: *Bifidobacterium animalis*, *Bifidobacterium bifidum*, *Bifidobacterium breve*, *Bifidobacterium infantis*, *Bifidobacterium longum*, *Bifidobacterium adolescentis*, or any combination thereof.

In some embodiments, the bacterium of the *Bacillus* spp. is selected from the group consisting of: *Bacillus subtilis*, *Bacillus coagulans*, or any combination thereof.

In some embodiments, the bacterium of the *Propionibacterium* spp. is selected from the group consisting of: *Propionibacterium shermanii*, *Propionibacterium freudenreichii*, *Propionibacterium acidipropionici*, or any combination thereof.

In some embodiments, the bacterium of the *Streptococcus* spp. is selected from the group consisting of: *Streptococcus thermophilus*, *Streptococcus salivarius*, or any combination thereof.

In some embodiments, the bacterium of the *Lactococcus* spp. is *Lactococcus lactis*.

In some embodiments, the bacterium of the *Enterococcus* spp. is selected from the group consisting of: *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus mundtii*, or any combination thereof.

In a second aspect, the present application provides a method for regulating the weight of a subject, the method comprising: administering an effective amount of a postbiotic to the subject, wherein the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with the accession number GDMCC No. 60962.

In some embodiments, the effective amount of the postbiotic is 0.001 g to 0.1 g; for example, 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, or 0.05 to 0.1 g.

In some embodiments, the subject with obesity has a BMI greater than 23.9 kg/m².

In some embodiments, the method is capable of maintaining the subject's weight.

In some embodiments, the method is capable of reducing the subject's weight.

In some embodiments, the method is capable of giving the subject a healthy BMI (e.g., 18.5 to 23.9 kg/m²).

In some embodiments, the subject is a mammal. In some embodiments, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

In some embodiments, the method is a method for regulating the subject's weight for non-therapeutic purposes.

In such embodiments, the subject does not have or is diagnosed with a disease (e.g., obesity).

In such embodiments, the subject has a healthy BMI.

In such embodiments, the subject has gained weight due to an unhealthy diet (e.g., a high-fat diet, a high-sugar diet, a high-cholesterol diet) or environmental factor.

In such embodiments, an effective amount of the postbiotic or a composition containing the postbiotic is administered to the subject to maintain or reduce the subject's weight and/or BMI.

In such embodiments, the frequency and manner of administering the postbiotic or the composition containing the postbiotic to the subject can be adjusted based on the subject's characteristics (e.g., age, sex, race, weight, height, BMI, body fat percentage, and/or medical history).

On the other hand, the present application provides a use of a postbiotic or a composition containing the postbiotic in the manufacture of a medicament or food product for regulating the weight of a subject; wherein the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with the accession number GDMCC No. 60962.

In some embodiments, the postbiotic is added in an amount of 0.001 g to 0.1 g; for example, 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, or 0.05 to 0.1 g.

In some embodiments, the subject is a mammal. In some embodiments, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

In some embodiments, the *Bifidobacterium breve* strain is present in the postbiotic in a dead bacterial form.

In such embodiments, those skilled in the art can choose a suitable method to prepare various dead bacterial forms of the *Bifidobacterium breve* strain. The dead bacterial forms include, but are not limited to, pills, powders, capsules, tablets (e.g., effervescent tablets), film-coated tablets, orally soluble granules, and liquids.

In some embodiments, the *Bifidobacterium breve* strain is a powder.

In some embodiments, the *Bifidobacterium breve* strain is a bacterial powder.

In some embodiments, the bacterial powder is prepared by the following method: culturing and inactivating the *Bifidobacterium breve* strain, then collecting and drying the resulting precipitate.

In some embodiments, the bacterial powder is prepared by the following method: fermenting and inactivating the *Bifidobacterium breve* strain, then centrifuging to collect the resulting precipitate and freeze-drying it under vacuum.

In some embodiments, the *Bifidobacterium breve* strain is fermented using a MRS medium.

In some embodiments, the *Bifidobacterium breve* strain is subjected to heat inactivation treatment at 70 to 95 °C.

In a third aspect, the present application provides a method for inhibiting or reducing lipid absorption in the gastrointestinal tract of a subject, the method comprising: administering an effective amount of a postbiotic to the subject, wherein the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with accession number GDMCC No. 60962.

In some embodiments, the effective amount of the postbiotic is 0.001 g to 0.1 g; for example, 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, or 0.05 to 0.1 g.

In some embodiments, the method is capable of maintaining the subject's body weight.

In some embodiments, the method is capable of reducing the subject's body weight.

In some embodiments, the method is capable of maintaining the subject's BMI (e.g., 18.5 to 23.9 kg/m²).

In some embodiments, the subject is a mammal. In some embodiments, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

In some embodiments, the method is a method for inhibiting or reducing lipid absorption in the gastrointestinal tract of a subject for non-therapeutic purposes.

In such embodiments, the subject does not have or is diagnosed with a disease (e.g., obesity).

In such embodiments, the subject has a healthy BMI.

In such embodiments, the subject has gained weight due to an unhealthy diet (e.g., a high-fat diet, a high-sugar diet, a high-cholesterol diet) or environmental factor.

In such embodiments, an effective amount of the postbiotic or a composition containing the postbiotic is administered to the subject to maintain or reduce the subject's weight and/or BMI.

In such embodiments, the frequency and manner of administering the postbiotic or the composition containing the postbiotic to the subject can be adjusted based on the subject's characteristics (e.g., age, sex, race, weight, height, BMI, body fat percentage, and/or medical history).

On the other hand, the present application provides a use of the postbiotic or the composition containing the postbiotic in the manufacture of a pharmaceutical composition for inhibiting or reducing lipid absorption in the gastrointestinal tract of a subject; wherein the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with accession number GDMCC No. 60962.

In some embodiments, the postbiotic is added to the medicament or food product in an amount of 0.001 g to 0.1 g; for example, 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, 0.05 to 0.1 g.

In some embodiments, the subject is a mammal. In some embodiments, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

In some embodiments, the *Bifidobacterium breve* strain is present in the postbiotic in a dead bacterial form.

In such embodiments, those skilled in the art can choose suitable methods to prepare various dead bacterial forms of the *Bifidobacterium breve* strain. The dead bacterial forms include, but are not limited to, pills, powders, capsules, tablets (e.g., effervescent tablets), film-coated tablets, orally soluble granules, and liquids.

In some embodiments, the *Bifidobacterium breve* strain is a powder.

In some embodiments, the *Bifidobacterium breve* strain is a bacterial powder.

In some embodiments, the bacterial powder is prepared by the following method: culturing and inactivating the *Bifidobacterium breve* strain, then collecting and drying the resulting precipitate.

In some embodiments, the bacterial powder is prepared by the following method: fermenting and inactivating the *Bifidobacterium breve* strain, then centrifuging to collect the precipitate and freeze-drying it under vacuum.

In some embodiments, the *Bifidobacterium breve* strain is fermented using a MRS medium.

In some embodiments, the *Bifidobacterium breve* strain is subjected to heat inactivation treatment at 70 to 95 °C.

Definition of terms

In the present invention, unless otherwise stated, the scientific and technical terms used herein have the meanings commonly understood by those skilled in the art. Meanwhile, to better understand this invention, definitions and explanations of relevant terms are provided below.

As used herein, the term "lipid metabolism" is a biochemical reaction, specifically referring to the process by which lipids in an organism are synthesized, broken down, digested, absorbed, and transported under the action of various related enzymes. The main lipids in the blood include cholesterol, triacylglycerol (TAG), phospholipid (PL), and free fatty acids. In some embodiments, lipid metabolism processes fats into substances needed by the body to ensure normal physiological functions.

As used herein, the term "abnormal lipid metabolism" refers to abnormalities in the synthesis, breakdown, digestion, absorption, and transport of lipids in the body, resulting in an excess or deficiency of lipids in tissues. Long-term high-cholesterol, high-saturated-fat, and high-calorie diets, genetic factors, apolipoprotein abnormalities, mental exertion, lack of exercise, and mental stress can all lead to abnormal lipid metabolism. Abnormal lipid metabolism may result in hyperlipidemia, non-alcoholic fatty liver disease, hypertension, and cardiovascular disease.

As used herein, the term "pharmaceutically acceptable carrier" refers to a carrier that is pharmacologically and/or physiologically compatible with the subject and the active ingredient, which is well known in the art (see, for example, Remington's Pharmaceutical Sciences. Edited by Gennaro AR, 19th ed. Pennsylvania: Mack Publishing Company, 1995), and includes, but is not limited to: pH adjusters, surfactants, adjuvants, and ionic strength enhancers. For example, pH adjusters include, but are not limited to, phosphate buffers; surfactants include, but are not limited to, cationic, anionic, or nonionic surfactants, such as Tween-80; and ionic strength enhancers include, but are not limited to, sodium chloride.

As used herein, the term "dietary supplement" refers to an edible product that can provide a beneficial effect (e.g., nutritional effect, preventative effect, therapeutic effect, or other beneficial effect) to a consumer. As used herein, the dietary supplement encompasses products such as health products, nutritional supplements, and tonics.

As used herein, the term "medicament" encompasses medicaments intended for use in both humans and animals in human medicine and veterinary medicine, and also includes medicaments intended for inclusion in animal feed (e.g., livestock feed and/or pet food). Furthermore, the term "medicament" as used herein refers to any substance that provides therapeutic, preventative, and/or beneficial effects. The term "medicament" as used herein is not necessarily limited to substances requiring marketing approval, but includes substances that can be used in cosmetics, health products, foods (including, for example, animal feed and beverages), probiotic cultures, and dietary supplements.

Beneficial effects of the invention

The applicant of the present patent application previously screened and identified a probiotic strain, *Bifidobacterium breve* 207-1, which has been deposited under the accession number GDMCC No. 60962. During subsequent research, it was unexpectedly discovered that the inactivated form of this strain exhibits outstanding efficacy in promoting lipolysis and/or inhibiting fat absorption. Therefore, the strain and the composition comprising it as described in the present application hold great potential for use in the manufacture of a medicament or food product for a disease and/or symptom associated with fat increase. For example, it has the potential to be applied in conditions and/or symptoms such as weight gain, obesity, fatty liver, and fat accumulation.

The embodiments of the present invention will be described in detail below with reference to the accompanying drawings and examples. However, those skilled in the art will understand that the following drawings and examples are for illustrative purposes only and are not intended to limit the scope of the present invention. Various objects and advantages of the present invention will become apparent to those skilled in the art from the following detailed description of the accompanying drawings and preferred embodiments.

Brief Description of the Drawings

Fig. 1 shows the fluorescence intensity diagrams of zebrafish treated with different samples to promote lipolysis.

Fig. 2 shows the fat staining in the intestines and tail blood vessels of zebrafish after treatment with different samples.

Fig. 3 shows the change curves of body weight in mice from different treatment groups at various time points, wherein $\#p < 0.05$ compared with the model group.

Fig. 4 shows the total body weight gain in mice from different treatment groups before and after the treatment, wherein #p < 0.05 compared with the model group.

Fig. 5 shows the HE staining results of liver tissue in mice from different treatment groups.

Explanation regarding the deposit of biological material

Bifidobacterium breve 207-1 has been deposited at the Guangdong Microbial Culture Collection Center (GDMCC), located at the 5th Floor of Building 59, No. 100, Xianlie Middle Road, Guangzhou, with the accession number GDMCC No. 60962, and the deposit date is January 15, 2020.

Specific Models for Carrying Out the present invention

The present invention will now be described with reference to the following examples, which are intended to illustrate the present invention (but not limit the present invention).

Unless otherwise specified, the experiments and methods described in the examples were generally performed in accordance with conventional methods well known in the art and described in various references. For example, conventional techniques such as immunology, biochemistry, chemistry, molecular biology, microbiology, cell biology, genomics, and recombinant DNA used in the present invention can be found in Sambrook, Fritsch, and Maniatis, *Molecular Cloning: A Laboratory Manual*, 2nd edition (1989); *Current Protocols in Molecular Biology* (edited by F.M. Ausubel et al., (1987)); *Methods in Enzymology*, series (Academic Publishing Company); *PCR 2: A Practical Approach* (edited by M.J. MacPherson, B.D. Hames, and G.R. Taylor (1995)); and *Animal Cell Culture* (edited by R.I. Freshney (1987)).

Furthermore, unless specific conditions are specified in the examples, conventional conditions or conditions recommended by the manufacturer were followed. Reagents or instruments which manufacturers are not specified are all commercially available conventional products. Those skilled in the art will understand that the examples describe the present invention by way of illustration and are not intended to limit the scope of the present invention. All disclosures and other references mentioned herein are incorporated herein by reference in their entirety.

Example 1. Test strains

Preparation method of postbiotic:

Live cells of *Bifidobacterium breve* 207-1 were fermented in MRS medium at 35 to 37 °C for 24 to 72 hours, followed by heat inactivation treatment at 70 to 95 °C. The inactivated bacterial cells were collected by centrifugation, and the resulting precipitate was subjected to vacuum freeze-drying. The resulting dried bacterial powder was sieved to obtain the final postbiotic. The postbiotic was tested for various quality indicators, including sensory characteristics, net content, total lactic acid bacteria count, bacterial cell count, and coliform bacteria, all of which met the requirements of the "Administrative Provisions on the Metrological Supervision of Prepackaged Products with Quantitative Content" (Order No. 75 of the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China). Test results showed that the bacterial cell count of *Bifidobacterium breve* 207-1 in the postbiotic was 3×10^{11} CFU/g.

Source of experimental strains:

The *Bifidobacterium breve* strains involved in this experiment were all derived from By-health's proprietary strain bank. These strains were isolated from fecal samples of healthy full-term newborns delivered at the West China Women's and Children's Hospital of Sichuan University. Specifically, fresh feces from infants aged 1 to 4 months were collected using sterile collection tubes. The samples were temporarily stored at 4°C immediately after collection and transported to the laboratory at low temperature by the sampling personnel. The fecal samples were immediately diluted and cultivated. If immediate processing was not possible, the samples were stored anaerobically at 4°C and cultured on the same day. Following this, the strains were isolated and purified using the plate streaking method to obtain single colonies. The specific species of the isolated strains were identified using bioMérieux's API 50 CH system and 16S rDNA sequencing. After identification, the strains were numbered and preserved in By-health's proprietary strain bank. Among these, *Bifidobacterium breve* 207-1 was deposited in the early stages of research due to its acid tolerance and bile salt tolerance, and a patent application was subsequently filed for it.

Example 2. Evaluation of efficacy of postbiotic in promoting lipolysis in zebrafish

2.1 Experimental animal

The mutant strain of zebrafish with the melanin allele mutation, known as the semi-transparent Albino line, was raised in fish-rearing water maintained at 28°C (water quality: 200 mg of instant sea salt was added per 1 L of reverse osmosis water, with an electrical conductivity of 450 to 550 μ S/cm, a pH of 6.5 to 8.5, and a hardness of 50 to 100 mg/L CaCO₃). The zebrafish were bred and provided by our company's fish breeding center. The license

number for the use of experimental animals was SYXK (Zhejiang) 2022-0004, and the breeding and management complied with the requirements of the international AAALAC accreditation (accreditation number: 001458).

Zebrafish were bred using a natural pair-mating method, and zebrafish at the age of 2 days post-fertilization (2 dpf) were used to determine the maximum test concentration (MTC) of the sample for promoting lipolysis and to evaluate its efficacy.

2.2 Determination of MTC

Randomly selected 2 dpf Albino strain zebrafish with mutant melanin alleles were placed into 6-well plates, with 30 zebrafish per well (experimental group) treated. Samples were administered via waterborne exposure, while a normal control group was simultaneously established, with a volume of 3 mL per well. After treatment at 28°C for 2 days, the MTC of the samples on normal zebrafish was determined. Under the conditions of this experiment, the MTC for promoting lipolysis efficacy of the postbiotic was 2000 µg/mL.

2.3 Evaluation of lipolysis-promoting efficacy (phenotype)

Randomly selected 2 dpf zebrafish of the Albino strain with melanin allele mutation were placed in 6-well plates, with 30 zebrafish per well (experimental group) treated. Samples were administered via water exposure, along with the positive control resveratrol at 11.4 µg/mL (Shanghai Aladdin Biochemical Technology Co., Ltd.), while a normal control group was also established, with a volume of 3 mL per well. After treatment at 28°C for one day, Nile red dye was administered via water exposure to each experimental group. Following an additional day of treatment at 28°C, 10 zebrafish were randomly selected from each experimental group and photographed under a fluorescence microscope. Datas were collected and analyzed using NIS-Elements D 3.20 advanced image processing software to assess the fluorescence intensity of fat in the zebrafish yolk sac. The statistical analysis results of this indicator were used to evaluate the sample's efficacy in promoting lipolysis. Statistical results were expressed as mean ± SE. Statistical analysis was performed using SPSS 26.0 software, with $p < 0.05$ indicating statistically significant differences. The experimental results are shown in Table 1 and Fig. 1.

Table 1. Evaluation results of lipolysis-promoting efficacy of samples (n = 10)

Group	Concentration (µg/mL)	Yolk sac fat fluorescence intensity (pixels, mean ± SE)
Normal control group	-	610304 ± 47330
Resveratrol	11.4	307329 ± 41002***
Postbiotic	1000	462516 ± 51322
	2000	348507 ± 36482***

Note: Compared with the normal control group, $*p < 0.05$, $***p < 0.001$.

2.4 Evaluation of lipolysis-promoting efficacy (gene)

Uncoupling protein 1 (*UCP1*) (Gene ID: 83908) is a specific protein located on the inner mitochondrial membrane. When *ucp1* was activated, it uncouples oxidative phosphorylation in the mitochondrial respiratory chain, thereby inhibiting the synthesis of ATP in the body. This process allows energy to be released in the form of heat and increases the body's energy expenditure. Studies have shown that the overexpression of *ucp1* in white adipose tissue reduces body weight in obese mice, and the activation of *ucp1* increases energy output and decreases fatty acid synthesis.

Total RNA was extracted from the zebrafish in each group from step 1.3 using the Universal RNA Extraction TL Kit C (Foshan Aowei Biotechnology Co., Ltd.). The concentration and purity of the total RNA were measured using an ultraviolet-visible spectrophotometer, and all samples met the quality standards. 2.00 µg of total RNA was taken from the zebrafish sample, and used to synthesize 20.0 µL of cDNA following the instructions of cDNA first-strand synthesis kit. The primer information for *ucp1* is shown in Table 2.

Table 2. Information of primer sequences for *β-actin* and *ucp1* gene

Gene	Primer sequence		SEQ NO ID:
<i>β-actin</i>	Forward	TCGAGCAGGAGATGGGAACC	1
	Reverse	CTCGTGGATACCGCAAGATTC	2
<i>ucp1</i>	Forward	GGTGTGGGCAGACGATACAA	3
	Reverse	ACGGGAGATTGTCTGACAGG	4

The expression of the *β-actin* and *ucp1* genes was detected by q-PCR. The *β-actin* gene was used as an internal reference for gene expression to calculate the relative RNA expression level of the *ucp1* gene. The statistical results were presented as mean ± SE. Statistical analysis was performed using SPSS 26.0 software, and a p-value of less than 0.05 indicated a statistically significant difference. The results are shown in Table 3.

Table 3. Evaluation of lipolysis-promoting efficacy of samples (*ucp1* gene) (n = 3)

Group	Concentration (µg/mL)	Relative expression level of <i>ucp1</i> gene (mean ± SE)
Normal control group	-	1.00 ± 0.035
Resveratrol	11.4	1.44 ± 0.050**
Postbiotic	1000	1.41 ± 0.041***
	2000	1.48 ± 0.052***

Note: Compared with the normal control group, $**p < 0.01$, $***p < 0.001$

The results indicate that the postbiotic had the effect of promoting lipolysis in zebrafish. Specifically, at the phenotypic level, compared with the control group, the fluorescence intensity of yolk sac fat was significantly reduced, and the most effective lipolysis was observed at a concentration of 2000 µg/mL.

At the gene level, compared with the control group, treatment with the inactivated postbiotic at concentrations of 1000 µg/mL and 2000 µg/mL significantly upregulated the relative expression level of the *ucp1* gene. This finding suggests that the postbiotic might reduce body weight in obese mice by upregulating the expression of *ucp1*.

Example 3. Evaluation of effect of postbiotic on inhibiting fat absorption in zebrafish

3.1 Experimental animal

Wild-type AB strain zebrafish were raised at 28°C in fish-rearing water (water quality: 200 mg of instant sea salt was added per 1 L of reverse osmosis water, with an electrical conductivity of 450 to 550 µS/cm, a pH of 6.5 to 8.5, and a hardness of 50 to 100 mg/L CaCO₃). The zebrafish were bred and provided by our company's fish breeding center. The license number for the use of experimental animals was SYXK (Zhejiang) 2022-0004, and the breeding and management complied with the requirements of the international AAALAC accreditation (accreditation number: 001458).

The zebrafish were bred using a natural pair-mating method. Zebrafish at the age of 5 dpf were used to determine the maximum tested concentration (MTC) of the samples for inhibiting fat absorption and to evaluate its efficacy.

3.2 Determination of MTC

Wild-type AB strain zebrafish aged 5 dpf were randomly selected and placed in beakers, with 30 zebrafish treated in each beaker (experimental group). Samples were administered via water exposure, while a normal control group and a model control group were also established, with each beaker having a volume of 20 mL. After treatment at 28°C for 1 hour, except for the normal control group, all other concentration groups were administered pure egg yolk powder via water exposure to establish a food fat absorption model in zebrafish. Following continued treatment at 28°C for another day, the MTC of the samples on the model zebrafish was determined. Under the conditions of this experiment, the MTC for the inhibitory effect of postbiotics on fat absorption was 2000 µg/mL.

3.3 Evaluation of fat absorption inhibition efficacy (phenotype)

Wild-type AB strain zebrafish aged 5 dpf were randomly selected and placed in beakers, with 30 zebrafish treated in each beaker (experimental group). The samples were administered via water exposure, and the positive control orlistat (Shandong New Era Pharmaceutical Co., Ltd.) was given at a concentration of 15.0 µg/mL. A normal control group and a model control group were also established, with a volume of 20 mL per beaker. After treatment at 28°C for 1 hour, except for the normal control group, all other concentration groups were administered pure egg yolk powder via water exposure to establish a dietary fat absorption model. After an additional day of treatment at 28°C, whole-body fat was stained using Oil Red O. After decolorization and bleaching, 10 zebrafish from each experimental group were randomly selected and photographed under a dissecting microscope. Data were collected using NIS-Elements D 3.20 advanced image processing software, and the staining intensity of fat in intestinal tracts and tail blood vessels was analyzed. The statistical analysis results of this index were used to evaluate the efficacy of the samples in inhibiting fat absorption. Statistical results are expressed as mean ± SE. Statistical analysis was performed using SPSS 26.0 software, with $p < 0.05$ indicating statistical significance. The results are shown in Table 4. The fat staining in intestinal tracts and tail blood vessels of zebrafish is shown in Fig. 2.

Table 4. Experimental results for evaluation of efficacy of samples in inhibiting fat absorption (phenotype) (n = 10)

Group	Concentration (µg/mL)	Staining intensity of fat in intestinal tract and tail vessel (pixels, mean ± SE)
Normal control group	-	4374 ± 174***
Model control group	-	34550 ± 1037
Orlistat	15.0	25118 ± 992***
Postbiotic	500	23045 ± 980***
	1000	21945 ± 892***
	2000	20806 ± 775***

Compared with the control group, *** $p < 0.001$

3.4 Evaluation of fat absorption inhibition effect (gene)

The *adipor2* gene (Gene ID: 560140) encodes the adiponectin receptor AdipoR2. Adiponectin is a hormone secreted by adipocytes that increases fatty acid combustion and energy expenditure. Adiponectin activates the AMPK and PPARα pathways, thereby stimulating fatty acid oxidation, enhancing fatty acid combustion, and reducing tissue cholesterol levels in the liver. AdipoR2 serves as a receptor for full-length adiponectin, mediating the increase in AMPK and PPARα ligand activity, as well as adiponectin-induced fatty acid oxidation and glucose uptake. Obesity reduces adiponectin levels and also decreases *adipor2* expression level, leading

to reduced adiponectin sensitivity and diminished fatty acid combustion capacity, thereby creating a vicious cycle. The *lepa* gene (Gene ID: 100150233) encodes the protein hormone leptin, which is secreted by adipocytes. Leptin plays a primary role in the regulation of energy homeostasis. Circulating leptin binds to leptin receptors in the brain, activating downstream signaling pathways that inhibit food intake and promote energy expenditure. In obese conditions, leptin levels increase, thereby suppressing food intake, while weight loss leads to a decrease in leptin levels, resulting in increased food intake.

Total RNA was extracted from the zebrafish in each group from step 2.3 using the Universal RNA Extraction TL Kit C. The concentration and purity of the total RNA were determined using a UV-visible spectrophotometer. 2.00 µg of zebrafish total RNA was taken and used to synthesize 20.0 µL of cDNA following the instructions of the cDNA first-strand synthesis kit. The information of primers is shown in Table 5.

Table 5. Information of primer sequences for *β-actin*, *adipor2*, and *lepa* genes

Gene	Primer sequence		SEQ NO ID:
<i>β-actin</i>	Forward	TCGAGCAGGAGATGGGAACC	5
	Reverse	CTCGTGGATACCGCAAGATTC	6
<i>adipor2</i>	Forward	GCAAGTGTGACATCTGGTTTC	7
	Reverse	TGAGAGGAACTTTGTCTCCCT	8
<i>lepa</i>	Forward	TTTCCAGCTCTCCGCTCAAC	9
	Reverse	CGTTGGAAGTAAATTTGCCCG	10

The expression of *β-actin*, *adipor2*, and *lepa* genes was detected by q-PCR. *β-actin* was used as an internal reference for gene expression, and the relative RNA expression levels of *adipor2* and *lepa* genes were calculated. Statistical results are expressed as mean ± SE. Statistical analysis was performed using SPSS 26.0 software, and $p < 0.05$ indicated statistical significance. Results are shown in Table 6.

Table 6. Experimental results for evaluation of fat absorption inhibition efficacy of samples (gene) (n = 3)

Group	Concentration (µg/mL)	Relative expression level of <i>adipor2</i> (mean ± SE)	Relative expression level of <i>lepa</i> (mean ± SE)
Normal control group	-	1.62 ± 0.135*	0.530 ± 0.079**
Model control group	-	1.00 ± 0.091	1.00 ± 0.063
Orlistat	15.0	1.59 ± 0.108*	0.331 ± 0.019***
Postbiotic	1000	1.73 ± 0.064**	0.362 ± 0.026***
	2000	2.19 ± 0.136***	0.395 ± 0.047***

Compared with the model control group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results indicate that the postbiotic exhibited an inhibitory effect on fat absorption in zebrafish. Specifically, at the phenotypic level, compared to the model control group, the staining intensity of fat in the intestinal tracts and tail blood vessels was significantly reduced. Compared with the positive control drug, the fluorescence intensity at different concentrations of the postbiotic was lower than that of orlistat, demonstrating a superior effect in inhibiting fat absorption.

At the gene level, compared with the model control group, treatment with the postbiotic significantly upregulated the relative expression of the *adipor2* gene and downregulated the relative expression of the *lepa* gene. These findings suggest that the postbiotic may inhibit fat absorption by regulating the relative expression of these two genes.

Example 4. Study on the effect of postbiotics in ameliorating obesity in mice.

Male C57BL/6J mice aged 8 weeks were housed at an ambient temperature of $21 \pm 2^{\circ}\text{C}$, a humidity of 30 to 70 %, with 12-hour light/dark cycle and free access to water and feed. After 7 days of acclimatization, the mice were randomly divided into 3 groups, with 16 mice in each group. The control group (CON) was fed a normal diet and administered normal saline via gavage. The model group (HFD) was fed a high-fat, high-cholesterol, and high-fructose diet (HFHCD) and administered normal saline via gavage. The inactivated bacteria group (HK207-1) was fed a high-fat, high-cholesterol, and high-fructose diet and administered the postbiotic (0.01 g of the inactivated bacterial powder dissolved in 200 μl of normal saline) via gavage. Food intake and body weight were recorded weekly for each mouse. At week 5, the mice were euthanized, and blood samples and organs were collected.

After eyeball blood collection, the blood was allowed to stand for more than 2 hours, and then centrifuged at $2000\times g$ and 4°C for 20 minutes to obtain the supernatant. The supernatant was centrifuged again at $2000\times g$ and 4°C for 5 minutes to separate the serum. The liver fat, visceral fat (including perienteric, perirenal, and perigonadal fat), and inguinal subcutaneous fat were collected and weighed. Liver tissue was subjected to H&E staining. Transcriptomic analysis was performed to detect the mRNA expression levels of the adipogenic gene SCD1 (Gene ID: 20249), the lipolytic gene HSL (Gene ID: 16890), and the gene ACOX3 (Gene ID: 80911) involved in fatty acid β -oxidation.

The body weight of mice in the model group was significantly higher than that in the blank group two weeks after modeling (Fig. 3). The total weight gain in the model group was significantly greater than that in the blank group, indicating the successful establishment of the model. In contrast, the body weight of mice fed with the postbiotic was significantly lower than

that of the model group after five weeks (Fig. 4), and the total weight gain was also significantly lower than that of the model group. These results suggested that the postbiotic could ameliorate obesity.

The mice fed a high-fat diet exhibited significantly higher accumulation of liver fat, subcutaneous fat, and visceral fat compared to those in the control group. The intervention with the postbiotic significantly reduced the accumulation of liver fat, perienteric fat and perirenal fat, and showed potential in ameliorating subcutaneous fat accumulation. These findings suggest that the postbiotic could improve visceral fat accumulation and address issues such as abdominal obesity. Liver transcriptomic data revealed that, compared to the model group, the postbiotic intervention significantly downregulated the fat synthesis gene *SCD1* and upregulated the fat oxidation gene *ACOX3*. These results indicate that the postbiotic played a role in regulating lipid metabolism by promoting lipolysis and oxidation.

The liver staining results (Fig. 5) demonstrated that the high-fat diet feeding in the model group induced ballooning lesions in hepatocytes, resulting in a certain degree of fatty liver. However, the postbiotic intervention alleviated these lesions, suggesting that the postbiotic had a beneficial effect in improving fatty liver conditions.

Table 7. Visceral fat weight of mouse

	Control group, CON	Model group, HFD	Probiotic 207-1
Liver fat/g	0.916	1.127*	1.013#
Subcutaneous fat/g	0.330	0.636*	0.530
Perienteric fat/g	0.155	0.312*	0.218#
Perirenal fat/g	0.068	0.282*	0.195#
Perigonadal fat/g	0.386	0.732*	0.669

Compared with the blank group, * $p < 0.05$; compared with the model group, # $p < 0.05$

Table 8. Expression levels of genes involved in lipid metabolism in liver

	Control group, CON	Model group, HFD	Probiotic 207-1
<i>SCD1</i>	1676.1	3999.6*	2932.2#
<i>HSL</i>	8.4	13.4*	12.6
<i>ACOX3</i>	11.2	13.9*	16.3#

Compared with the blank group, * $p < 0.05$; compared with the model group, # $p < 0.05$

Although specific embodiments of the present invention have been described in detail, those skilled in the art will understand that various modifications and variations can be made to the details based on all the disclosed teachings, and all such changes are within the scope of protection of the present invention. The entire scope of the present invention is given by the appended claims and any equivalents thereof.

What is claimed is:

1. Use of a postbiotic or a composition containing the postbiotic in the manufacture of a medicament or food product for preventing and/or ameliorating a disease and/or symptom associated with increased fat in a subject;

wherein, the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Microbial Culture Collection Center with the accession number GDMCC No. 60962.

2. The use according to claim 1, wherein the medicament or food product is used to prevent and/or ameliorate a disease and/or symptom caused by increased fat in a subject;

the disease and/or symptom is selected from the group consisting of weight gain, obesity, fatty liver, fat accumulation (e.g., visceral fat accumulation, subcutaneous fat accumulation), abnormal lipid metabolism, or any combination thereof;

preferably, the subcutaneous fat accumulation is selected from the group consisting of abdominal fat accumulation, arm fat accumulation, leg fat accumulation, or any combination thereof;

preferably, the visceral fat accumulation is selected from the group consisting of perienteric fat accumulation, perirenal fat accumulation, perigonadal fat accumulation, or any combination thereof;

preferably, the subject with obesity has a BMI greater than 23.9 kg/m² (e.g., a BMI greater than 25 kg/m², greater than 26 kg/m², greater than 27 kg/m², greater than 28 kg/m², greater than 29 kg/m², greater than 30 kg/m²);

preferably, the medicament or food product is capable of promoting lipolysis and/or inhibiting fat absorption;

preferably, the medicament or food product is capable of maintaining the subject's weight and/or BMI;

preferably, the medicament or food product is capable of reducing the subject's weight and/or BMI;

preferably, the medicament or food product is capable of giving the subject a healthy BMI (e.g., 18.5 to 23.9 kg/m²).

3. The use according to claim 1 or 2, wherein the *Bifidobacterium breve* strain is present in the medicament or food product in the form of dead bacteria;

preferably, administering the medicament or food product to the subject increases the subject's feeling of satiety;

preferably, administering the medicament or food product to the subject reduces the subject's food intake;

preferably, the medicament or food product further comprises an additional active ingredient (e.g., a compound);

preferably, the additional active ingredient is capable of promoting lipolysis and/or inhibiting fat absorption; for example, L-carnitine;

preferably, the additional active ingredient is capable of accelerating metabolism; for example, tea polyphenols, caffeine;

preferably, the additional active ingredient is a lipase inhibitor (e.g., orlistat).

4. The use according to any one of claims 1 to 3, wherein the medicament has one or more of the following characteristics:

(1) the medicament is a medicament targeted for gastrointestinal release, or a medicament released in a controlled manner in gastrointestinal tract;

(2) the medicament further comprises a pharmaceutically acceptable carrier;

(3) the medicament is in the form of a pill, powder, capsule, tablet (e.g., effervescent tablet), film-coated tablet, orally soluble granule, liquid, suppository, or enema.

5. The use according to any one of claims 1 to 3, wherein the food product has one or more of the following characteristics:

(1) the food product is a dietary supplement;

(2) the food product further comprises a prebiotic;

preferably, the prebiotic is selected from the group consisting of fructooligosaccharide, galactooligosaccharide, xylooligosaccharide, isomaltooligosaccharide, soybean oligosaccharide, inulin, spirulina, arthrospira, *Trametes versicolor* polysaccharide, carrot nitrogenous polysaccharide, casein hydrolysate, α -lactalbumin, lactoferrin, or any combination thereof;

(3) the food product is selected from solid beverage, candy, or fruit juice, or the food product is a dairy product (e.g., yogurt, flavored fermented milk, lactic acid bacteria beverage, cheese);

(4) the food product is in the form of pill, powder, capsule, tablet (e.g., effervescent tablet), film-coated tablet, orally soluble granule, or liquid.

6. The use according to any one of claims 1 to 5, which has one or more of the following characteristics:

(1) the subject is a mammal; preferably, the mammal is selected from the group consisting of rat, pig, rabbit, monkey, sheep, or human;

(2) the postbiotic is added to the medicament or food product in an amount of 0.001g to 0.1g;

(3) the postbiotic is added to the medicament or food product in an amount of 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, or 0.05 to 0.1g.

7. The use according to any one of claims 1 to 6, wherein the composition comprises the postbiotic and a microorganism selected from the group consisting of bacterium, fungus, or any combination thereof;

preferably, the microorganism is a probiotic;

preferably, the microorganism is a yeast;

preferably, the yeast is selected from the group consisting of *Saccharomyces cerevisiae*, *Saccharomyces boulardii*, *Kluyveromyces marxianus*, or any combination thereof;

preferably, the bacterium is selected from the group consisting of *Lactobacillus* spp., *Bifidobacterium* spp., *Bacillus* spp., *Propionibacterium* spp., *Streptococcus* spp., *Lactococcus* spp., *Pediococcus* spp., *Enterococcus* spp., *Staphylococcus* spp., or any combination thereof.

8. The use according to claim 7, wherein the use has one or more characteristics selected from the following:

(1) the bacterium of the *Lactobacillus* spp. is selected from the group consisting of: *Lactobacillus paracasei*, *Lactobacillus acidophilus*, *Lactobacillus brevis*, *Lactobacillus jensenii*, *Lactobacillus iners*, *Lactobacillus casei*, *Lactobacillus crispatus*, *Lactobacillus curvatus*,

Lactobacillus delbrueckii, *Lactobacillus fermentum*, *Lactobacillus gasseri*, *Lactobacillus helveticus*, *Lactobacillus johnsonii*, *Lactobacillus plantarum*, *Lactobacillus reuteri*, *Lactobacillus rhamnosus*, *Lactobacillus sakei*, *Lactobacillus salivarius*, or any combination thereof;

(2) the bacterium of the *Bifidobacterium* spp. is selected from the group consisting of: *Bifidobacterium animalis*, *Bifidobacterium bifidum*, *Bifidobacterium breve*, *Bifidobacterium infantis*, *Bifidobacterium longum*, *Bifidobacterium adolescentis*, or any combination thereof;

(3) the bacterium of the *Bacillus* spp. is selected from the group consisting of: *Bacillus subtilis*, *Bacillus coagulans*, or any combination thereof;

(4) the bacterium of the *Propionibacterium* spp. is selected from the group consisting of: *Propionibacterium shermanii*, *Propionibacterium freudenreichii*, *Propionibacterium acidipropionici*, or any combination thereof;

(5) the bacterium of the *Streptococcus* spp. is selected from the group consisting of: *Streptococcus thermophilus*, *Streptococcus salivarius*, or any combination thereof;

(6) the bacterium of the *Lactococcus* spp. is *Lactococcus lactis*;

(7) the bacterium of the *Enterococcus* spp. is selected from the group consisting of: *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus mundtii*, or any combination thereof.

9. A method for regulating the weight of a subject, the method comprising: administering an effective amount of a postbiotic to the subject, wherein the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with the accession number GDMCC No. 60962;

preferably, the effective amount of the postbiotic is 0.001 g to 0.1 g; for example, 0.001 to 0.005 g, 0.005 to 0.01 g, 0.01 to 0.05 g, 0.05 to 0.1 g;

preferably, the method is capable of maintaining the subject's weight;

preferably, the method is capable of reducing the subject's weight;

preferably, the method is capable of maintaining the subject's BMI (e.g., 18.5 to 23.9 kg/m²);

preferably, the subject is a mammal;

preferably, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.

10. Use of a postbiotic or a composition containing the postbiotic in the manufacture of a pharmaceutical composition, wherein the pharmaceutical composition is used for inhibiting or reducing lipid absorption in the gastrointestinal tract of a subject, the postbiotic is prepared by fermentation and subsequent inactivation of a *Bifidobacterium breve* strain, and the *Bifidobacterium breve* strain is deposited at the Guangdong Provincial Microbial Culture Collection Center with the accession number GDMCC No. 60962;

preferably, the pharmaceutical composition is capable of maintaining the weight of the subject;

preferably, the pharmaceutical composition is capable of reducing the weight of the subject;

preferably, the pharmaceutical composition is capable of giving the subject a healthy BMI (e.g., 18.5 to 23.9 kg/m²);

preferably, the subject is a mammal;

preferably, the mammal is selected from the group consisting of mouse, pig, rabbit, monkey, sheep, and human.