

DESCRIPTION

TITLE OF INVENTION: COMPOSITION FOR INCREASING LEUKOCYTES
AND/OR BASOPHILS

5

TECHNICAL FIELD

[0001]

The present invention relates to a composition for
increasing leukocytes and/or basophils. The present
10 invention also relates to a composition for inhibiting
epidermal growth factor receptor (EGFR) tyrosine kinase and
a composition for activating innate immunity. The present
invention further relates to a method of increasing
leukocytes and/or basophils, a method of inhibiting
15 epidermal growth factor receptor (EGFR) tyrosine kinase, a
method of activating innate immunity, and the like.

BACKGROUND ART

[0002]

20 Leukocytes are generally classified into five types:
monocytes (macrophages), lymphocytes, neutrophils,
basophils, and eosinophils, which are immunocompetent cells
involved in biological defense. These cells are
hematopoietic stem cell-derived cells that play a role in
25 eliminating foreign substances such as bacteria and viruses
that have entered the body from the outside and eliminating
tumor cells and cells that have completed their roles. The
immune function of these immunocompetent cells is known to
decline with aging. Presumably, the main cause is that the
30 thymus, which is responsible for the production of T cells,
and the spleen, which is rich in lymphocytes, atrophy
faster than other organs with aging.

[0003]

Epidermal growth factor receptor (hereinafter also
35 referred to as "EGFR") is a tyrosine kinase receptor that

performs signal transduction when a kinase in the cell membrane is activated upon binding of a ligand such as epidermal growth factor (hereinafter also referred to as "EGF") to the receptor. EGFR is mutated or amplified in cancer tissues and known to contribute to canceration of cells, cancer proliferation, invasion, metastasis, and the like. However, EGFR is also expressed in normal tissues and known to prevent virus entry into cells by inhibiting the function of existing EGFR.

10 [0004]

Ergothioneine is an amino acid found in mushrooms and the like. L-ergothioneine is present in nature. According to Patent Literature 1, the peritesticular fat weight and the triglyceride (neutral fat) level in plasma were lower in mice orally administered with ergothioneine than in mice not orally administered with ergothioneine.

[0005]

Patent Literature 2 discloses an agent for promoting the production of immune response activating cytokines, which contains, as active ingredients, ergothioneine and any one Toll-like receptor ligand selected from lipopolysaccharide (LPS), Pam2CSK4, synthetic triacylated lipoprotein, and imidazoquinolines. In the absence of the TLR ligand, none of IL-6, IL-12p40, IL-1 β , and IL-10 was detected in any sample with an ergothioneine concentration of either 0 or 10 mM. In other words, according to the disclosure, when TLR was not stimulated, none of IL-6, IL-12p40, IL-1 β , and IL-10 was detected regardless of the presence or absence of ergothioneine (claim 1 and elsewhere, and paragraph [0068]). Thus, an agent for promoting the production of immune response activating cytokines has been known which contains, as active ingredients, ergothioneine and a specific Toll-like receptor ligand.

35

CITATION LIST

- Patent Literature

[0006]

Patent Literature 1: JP 2011-102286 A

5 Patent Literature 2: JP 6121597 B

SUMMARY OF INVENTION

- Technical Problem

[0007]

10 However, it has not been known that L-ergothioneine
or a salt thereof has an action to increase leukocytes
and/or basophils and an action to inhibit epidermal growth
factor receptor (EGFR) tyrosine kinase.

[0008]

15 The present invention aims to provide a composition
for increasing leukocytes and/or basophils. The present
invention also aims to provide a composition for inhibiting
epidermal growth factor receptor (EGFR) tyrosine kinase.
The present invention also aims to provide a composition
20 for activating innate immunity. The present invention also
aims to provide a method of increasing leukocytes and/or
basophils, a method of inhibiting epidermal growth factor
receptor (EGFR) tyrosine kinase, and a method of activating
innate immunity.

25

- Solution to Problem

[0009]

 As a result of extensive studies to solve the problem
described above, the present inventors found that L-
30 ergothioneine has an action to increase leukocytes and/or
basophils and an action to inhibit epidermal growth factor
receptor (EGFR) tyrosine kinase.

[0010]

 Specifically, the present invention relates to, but
35 is not limited to, a composition for increasing leukocytes

and/or basophils and the like described below.

(1) A composition for increasing at least one of leukocytes or basophils, containing L-ergothioneine or a salt thereof as an active ingredient.

5 (2) A composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase, containing L-ergothioneine or a salt thereof as an active ingredient.

(3) A composition for activating innate immunity, containing the composition according to (1) or (2) above.

10 (4) The composition according to any one of (1) to (3) above, wherein the composition is an oral composition.

(5) The composition according to any one of (1) to (4) above, wherein the composition is a food or beverage.

(6) The composition according to any one of (1) to (5) above, wherein an amount of L-ergothioneine or a salt thereof in the composition per adult daily intake is 2 to 50 mg in terms of L-ergothioneine.

(7) A method of increasing at least one of leukocytes or basophils, including administering L-ergothioneine or a salt thereof.

(8) A method of inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase, including administering L-ergothioneine or a salt thereof.

(9) A method of activating innate immunity, including administering L-ergothioneine or a salt thereof.

(10) Use of L-ergothioneine or a salt thereof for increasing at least one of leukocytes or basophils.

(11) Use of L-ergothioneine or a salt thereof for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase.

(12) Use of L-ergothioneine or a salt thereof for activating innate immunity.

- Advantageous Effects of Invention

35 [0011]

The present invention can provide a composition for increasing leukocytes and/or basophils. The present invention can also provide a composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase.

5 The present invention can provide a composition for activating innate immunity, a method of increasing leukocytes and/or basophils, a method of inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase, and a method of activating innate immunity.

10

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a graph showing the amount of change in blood leukocyte count between at the time of pre-testing and at the time of testing on week 4 in a test food group and a control food group.

FIG. 2 is a graph showing the amount of change in blood basophil count between at the time of pre-testing and at the time of testing on week 4 in the test food group and the control food group.

FIG. 3 is a graph showing an activity of L-ergothioneine to inhibit substrate binding of epidermal growth factor receptor (EGFR) tyrosine kinase.

DESCRIPTION OF EMBODIMENTS

[0013]

The composition for increasing leukocytes and/or basophils of the present invention contains L-ergothioneine or a salt thereof as an active ingredient. Hereinafter, the composition for increasing leukocytes and/or basophils of the present invention is sometimes referred to as "the composition according to the first embodiment of the present invention".

[0014]

35 The composition for inhibiting epidermal growth

factor receptor (EGFR) tyrosine kinase of the present invention contains L-ergothioneine or a salt thereof as an active ingredient. Hereinafter, the composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase of the present invention is sometimes referred to as "the composition according to the second embodiment of the present invention".

[0015]

L-ergothioneine is one of the amino acids.

10 The salt of L-ergothioneine is not limited as long as it is a pharmacologically acceptable salt or a dietary acceptable salt, and it may be either an acid salt or a basic salt. Examples of the acid salt include inorganic acid salts such as hydrochloride, sulfate, nitrate, and phosphate, and organic acid salts such as acetate, citrate, maleate, malate, oxalate, lactate, succinate, fumarate, and propionate. Examples of the basic salt include alkali metal salts such as sodium salt and potassium salt, and alkaline earth metal salts such as calcium salt and magnesium salt.

[0016]

L-ergothioneine or a salt thereof that can be used may be a chemically synthesized product or a purified extract of a natural product. L-ergothioneine is abundantly present in golden/yellow oyster mushrooms (binomial name: *Pleurotus cornucopiae* var. *citrinopileatus*) belonging to the genus *Pleurotus* of the family Pleurotaceae. L-ergothioneine is also present in mushrooms such as common mushrooms (binomial name: *Agaricus bisporus*) including white mushroom, cremini mushroom, and portabella mushroom; grey oyster mushroom (binomial name: *Pleurotus ostreatus*), shiitake (binomial name: *Lentinula edodes*), hen-of-the-wood (binomial name: *Grifola Frondosa*), reishi mushroom (binomial name: *Ganoderma lucidum*), lion's mane mushroom (binomial name: *Hericium erinaceus*), Yanagi-

matsutake (binomial name: *Agrocybe aegerita*), girolle (binomial name: *Cantharellus cibarius*), porcini (binomial name: *Boletus edulis*), and common morel (binomial name: *Morchella esculenta*). When L-ergothioneine is obtained
5 from a natural product, preferably, it is extracted from a golden/yellow oyster mushroom, for example. L-ergothioneine or a salt thereof can also be produced by microbial fermentation. An extract containing L-ergothioneine or a salt thereof produced by microbial
10 fermentation or a purified product thereof may be used. L-ergothioneine can be extracted and purified from natural products by known methods. L-ergothioneine or a salt thereof may be in an isolated form.

[0017]

15 L-ergothioneine or a salt thereof is present in natural products and food and beverages, and it is a compound that has been consumed. Thus, continuous ingestion of L-ergothioneine or a salt thereof, for example, is less likely to cause problems in terms of
20 safety.

[0018]

As shown in Examples (described later), ingestion of L-ergothioneine significantly increased the blood leukocyte count and basophil count, compared to no ingestion.

25 Thus, L-ergothioneine can be used as an active ingredient for promoting an increase in blood leukocytes and/or basophils. The blood leukocyte count and basophil count can be measured by known methods. Herein, the blood leukocytes include the following five types: monocytes
30 (macrophages), lymphocytes, neutrophils, basophils, and eosinophils. The blood leukocyte count is the total number of these.

[0019]

Having an action to increase blood leukocytes and
35 basophils, L-ergothioneine or a salt thereof has an action

to activate innate immunity.

The action to increase blood leukocytes may be achieved by any means such as moderating or reducing a decline in leukocyte count or promoting the recovery of leukocyte count. The action refers to an achievement of an effect of increasing blood leukocytes by ingestion of L-ergothioneine or a salt thereof.

The action to increase blood basophils may be achieved by any means such as moderating or reducing a decline in basophil count or promoting the recovery of basophil count. The action refers to an achievement of an effect of increasing blood basophils by ingestion of L-ergothioneine or a salt thereof.

[0020]

As shown in Examples (described later), L-ergothioneine has an activity to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase.

Thus, L-ergothioneine can be used as an active ingredient for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase. The activity to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase can be measured by a known method. For example, as shown in Examples (described later), the activity can be measured with an assay system using insect cells.

[0021]

Having an action to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase, L-ergothioneine or a salt thereof has an action to activate innate immunity. L-ergothioneine or a salt thereof can be used as an active ingredient for activating innate immunity.

The expression "activity to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase" encompasses selective binding of a ligand to EGFR and no action being expressed by EGFR upon binding (i.e., EGFR is not activated).

[0022]

The composition according to the first embodiment and/or the composition according to the second embodiment of the present invention can be used in a composition for activating innate immunity. Thus, a composition for activating innate immunity which contains the composition according to the first embodiment and/or the composition according to the second embodiment of the present invention is also encompassed by the present invention. In one embodiment, the composition according to the first embodiment of the present invention can be used to activate innate immunity. The composition according to the second embodiment of the present invention can be used to activate innate immunity.

The composition according to the first embodiment of the present invention, the composition according to the second embodiment of the present invention, and the composition for activating innate immunity of the present invention (also referred to as "the composition according to the third embodiment of the present invention") each have an action for activating innate immunity and can be used to prevent or ameliorate a condition or disease caused by a decline in innate immunity.

Preventing a condition or disease encompasses preventing the onset, delaying the onset, reducing the incidence rate, reducing the onset risk, and the like. Ameliorating a condition or disease encompasses helping a subject recover from a condition or disease, alleviating a symptom of a condition or disease, favorably changing a symptom of a condition or disease, delaying or preventing the progress of a condition or disease, and the like.

[0023]

Examples of the condition or disease caused by a decline in innate immunity include infectious diseases caused by microorganisms such as viruses and bacteria and

various malignant tumors. Examples of the infectious diseases include infectious enteritis caused by bacteria such as cholera, enterotoxigenic *Escherichia coli*, *Shigella*, and *Salmonella*, and viruses through oral
5 infection; influenza and common cold syndromes through respiratory tract infection; and stomatitis and periodontal disease through intraoral infection. Examples of the malignant tumors include epithelial malignant tumors that occur in solid organs such as the gastrointestinal tract,
10 respiratory mucosa, liver, and kidney; and non-epithelial malignant tumors that occur in locomotor organs, soft tissues, and the like. Examples of the infectious diseases also include symptoms from a virus or the like, such as herpes virus, with which a subject has been infected in the
15 past and which has been dormant in the body of the subject.
[0024]

Hereinafter, the composition for increasing leukocytes and/or basophils of the present invention, the composition for inhibiting epidermal growth factor receptor
20 (EGFR) tyrosine kinase of the present invention, and the composition for activating innate immunity of the present invention are sometimes simply referred to as "the composition of the present invention" as a collective term. Preferably, the composition of the present invention does
25 not contain Toll-like receptor ligands.
[0025]

The composition of the present invention is applicable for therapeutic use (medical use) and non-therapeutic use (non-medical use). The term "non-
30 therapeutic" is a concept that does not include medical activities, i.e., a concept that does not include methods of surgery, therapy, or diagnosis of humans.

The composition of the present invention can be provided as an agent or the like, for example, but it is
35 not limited thereto. The agent can be directly provided as

a composition or can be provided as a composition containing the agent. In one embodiment, the composition for increasing leukocytes and/or basophils of the present invention can also be referred to as an agent for
5 increasing leukocytes and/or basophils. In one embodiment, the composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase of the present invention can also be referred to as an agent for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase.
10 In one embodiment, the composition for activating innate immunity of the present invention can also be referred to as an agent for activating innate immunity.

In order to sufficiently obtain the effect of the present invention, preferably, the composition of the
15 present invention is an oral composition. The oral composition may be a food or beverage, an oral pharmaceutical product, an oral quasi-pharmaceutical product, or feed, preferably a food or beverage or an oral pharmaceutical product, more preferably a food or beverage.
20 [0026]

The composition of the present invention may contain optional additives and optional components in addition to L-ergothioneine or a salt thereof, as long as the effect of the present invention is not impaired. Such additives and
25 components can be selected according to the composition form or the like. Those that can be generally used in food and beverages, pharmaceutical products, quasi-pharmaceutical products, feed, and the like can be used. Preferably, the composition of the present invention does
30 not contain Toll-like receptor ligands. When the composition of the present invention is provided as a food or beverage, a pharmaceutical product, a quasi-pharmaceutical product, feed, or the like, the production method is not limited, and any common method can be used
35 for production.

[0027]

For example, when the composition of the present invention is provided as a food or beverage, various types of food or beverages can be provided by adding a component
5 usable in food and beverages (e.g., a food material or an optional food additive) to L-ergothioneine or a salt thereof. Non-limiting examples of the food or beverage include general food and beverages, health foods, health
10 beverages, foods with function claims, foods for specified health uses, dietary supplements, and food and beverages for the sick. The health foods, foods with function claims, foods for specified health uses, dietary supplements, and the like can be used, for example, in various forms of preparations such as fine granules,
15 tablets, granules, powders, capsules, chewable tablets, syrups, liquids, and liquid foods.

[0028]

When the composition of the present invention is provided as a pharmaceutical product or a quasi-
20 pharmaceutical product, for example, a pharmacologically acceptable carrier, an optional additive, or the like can be added to L-ergothioneine or a salt thereof to provide pharmaceutical products or quasi-pharmaceutical products in various dosage forms. Such a carrier, an additive, or the
25 like may be any pharmacologically acceptable one that can be used in pharmaceutical products or quasi-pharmaceutical products. Examples thereof include excipients, binders, disintegrants, lubricants, antioxidants, and colorants. One or more of these can be used. The administration form
30 of pharmaceutical products or quasi-pharmaceutical products may be oral or parenteral. Oral administration is preferred in order to obtain the effect of the present invention more sufficiently. When the composition of the present invention is provided as a pharmaceutical product
35 or a quasi-pharmaceutical product, preferably, it is an

oral pharmaceutical product or an oral quasi-pharmaceutical product. Examples of dosage forms for oral administration include liquids, tablets, powders, fine granules, granules, sugar-coated tablets, capsules, suspensions, emulsions, and
5 chewable tablets. Examples of dosage forms for parenteral administration include injection and infusion. The pharmaceutical product and the quasi-pharmaceutical product may be for non-human animals.

[0029]

10 When the composition of the present invention is provided as feed, L-ergothioneine or a salt thereof is simply added to feed. The feed includes feed additives. Examples of the feed include livestock feed for animals such as cows, pigs, chickens, sheep, and horses; feed for
15 small animals such as rabbits, rats, and mice; and pet food for animals such as dogs, cats, and birds.

[0030]

The amount of L-ergothioneine or a salt thereof in the composition of the present invention is not limited and
20 can be set according to the composition form and the like.

The amount of L-ergothioneine or a salt thereof in the composition of the present invention is, for example, preferably 0.0001 wt% or more, more preferably 0.001 wt% or more and is preferably 90 wt% or less, more preferably 50
25 wt% or less in terms of L-ergothioneine. In one embodiment, the amount of L-ergothioneine or a salt thereof in the composition is preferably 0.0001 to 90 wt%, more preferably 0.001 to 50 wt% in terms of L-ergothioneine. In one embodiment, when the composition of the present
30 invention is provided as a food or beverage, a pharmaceutical product, a quasi-pharmaceutical product, feed, or the like, preferably, the amount of L-ergothioneine or a salt thereof is in the above ranges.

In the case of L-ergothioneine, the expression "the
35 amount in terms of ergothioneine" or a similar expression

refers to the amount of L-ergothioneine. In the case of a salt of L-ergothioneine, the expression refers to a value obtained by multiplying the molar number of the salt by the molecular weight of L-ergothioneine.

5 [0031]

The composition of the present invention can be fed or administered by a method appropriate to the composition form. In order to more sufficiently obtain the effect of the present invention, preferably, the composition of the
10 present invention is orally fed (orally administered). The intake (administration amount) of the composition of the present invention is not limited as long as it is an amount that provides an effect of increasing leukocytes and/or basophils, an effect of inhibiting epidermal growth factor
15 receptor (EGFR) tyrosine kinase, or an effect of activating innate immunity. The intake may be appropriately set according to the administration form, administration method, body weight of a subject, and the like.

[0032]

20 In one embodiment, when orally feeding or administering the composition of the present invention to a human (adult) as a subject, the intake of L-ergothioneine or a salt thereof is preferably 2 mg or more, more preferably 5 mg or more, still more preferably 10 mg or
25 more, and is preferably 50 mg or less, more preferably 25 mg or less, still more preferably 20 mg or less in terms of L-ergothioneine per day. In one embodiment, when orally feeding or administering to a human (adult) as a subject, the intake of L-ergothioneine or a salt thereof is
30 preferably 2 to 50 mg, more preferably 5 to 25 mg, still more preferably 5 to 20 mg, particularly preferably 10 to 20 mg in terms of L-ergothioneine per day. Preferably, the above amount of the composition is fed or administered in one or more portions per day, for example, in one portion
35 or several portions (for example, two or three portions)

per day. In one embodiment of the present invention, the composition of the present invention may be an oral composition for feeding or administering a human with the above amount of L-ergothioneine or a salt thereof per 60 kg
5 body weight per day.

In one embodiment, when parenterally administering the composition of the present invention to a human (adult), the administration amount of L-ergothioneine or a salt thereof is, for example, preferably 2 to 50 mg, more
10 preferably 5 to 25 mg, still more preferably 5 to 20 mg, particularly preferably 10 to 20 mg in terms of L-ergothioneine per day.

In one embodiment, in the case of a human (adult), preferably, the above amount of L-ergothioneine or a salt thereof is fed or administered per 60 kg body weight per
15 day.

[0033]

In one embodiment, preferably, the amount of L-ergothioneine or a salt thereof in the composition of the present invention per adult daily intake is 2 to 50 mg in
20 terms of L-ergothioneine. The amount of L-ergothioneine or a salt thereof in the composition of the present invention per adult daily intake is more preferably 5 to 25 mg, still more preferably 5 to 20 mg, particularly preferably 10 to
25 20 mg in terms of L-ergothioneine.

[0034]

Continuous feeding or administration of L-ergothioneine or a salt thereof is expected to result in a higher effect of increasing leukocytes and/or basophils.
30 Continuous feeding or administration of L-ergothioneine or a salt thereof is expected to result in a higher effect of inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase. Continuous feeding or administration of L-ergothioneine or a salt thereof is expected to result in a
35 higher effect of activating innate immunity.

Thus, in a preferred embodiment, the composition of the present invention is continuously fed or administered. In one embodiment of the present invention, the composition of the present invention is continuously fed or administered preferably for at least one week, more preferably for at least two weeks.

[0035]

The composition of the present invention may be fed or administered to any subject (subject to administration). The subject is preferably a human or non-human mammal, more preferably a human.

The composition of the present invention may be fed or administered, for example, to a subject needing or wanting to increase leukocytes and/or basophils, a subject needing or wanting to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase, and a subject needing or wanting to activate innate immunity. In one embodiment, examples of the subject to administration of the present invention include subjects with a decline in innate immunity and patients with any of the above-described conditions or diseases caused by a decline in innate immunity. In one embodiment, the subject to administration of the composition of the present invention may be a healthy person. The subject to administration of the composition of the present invention may also be a healthy person exhibiting an aging-related decline in immune function of immunocompetent cells.

[0036]

The composition of the present invention may be labeled with a function claim based on the increase in leukocytes and/or basophils, a function claim based on the inhibition of epidermal growth factor receptor (EGFR) tyrosine kinase, and a function claim based on the activation of innate immunity. For example, the

composition of the present invention may be labeled with one or more function claims such as "increasing leukocytes", "increasing basophils", "inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase", and
5 "activating innate immunity".

In one embodiment of the present invention, preferably, the composition of the present invention is a food or beverage labeled with such a function claim. The label may be one indicating use of the composition to
10 obtain the function. The label may be directly attached to the composition or may be attached to a container or a package of the composition.

[0037]

The present invention encompasses the following
15 methods and uses:

a method of increasing at least one of leukocytes or basophils, including feeding or administering L-ergothioneine or a salt thereof;

a method of inhibiting epidermal growth factor
20 receptor (EGFR) tyrosine kinase, including feeding or administering L-ergothioneine or a salt thereof;

a method of activating innate immunity, including feeding or administering L-ergothioneine or a salt thereof;

use of L-ergothioneine or a salt thereof to increase
25 at least one of leukocytes or basophils;

use of L-ergothioneine or a salt thereof to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase;
and

use of L-ergothioneine or a salt thereof to activate
30 innate immunity.

Administering or feeding L-ergothioneine or a salt thereof to a subject can increase the leukocyte count and/or basophil count and can also inhibit epidermal growth factor receptor (EGFR) tyrosine kinase, thus achieving the
35 effect of activating innate immunity and the like.

Preferably, L-ergothioneine or a salt thereof is orally administered or fed.

The methods may be therapeutic or non-therapeutic. The uses may be therapeutic or non-therapeutic.

5 [0038]

In the methods and uses, L-ergothioneine or a salt thereof, preferred embodiments thereof, and the like are as described above for the composition of the present invention. In the methods and uses, preferably, L-
10 ergothioneine or a salt thereof is fed or administered to a subject one or more times per day, for example, one to several times (e.g., two to three times) per day. The use is preferably for humans or non-human mammals, more preferably for humans. In one embodiment, L-ergothioneine
15 or a salt thereof can be used to provide the effect of activating innate immunity by increasing leukocytes and/or basophils or by inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase. In one embodiment, the method of increasing leukocytes and/or basophils can be used to
20 activate innate immunity. In one embodiment, the method of inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase can be used to activate innate immunity.

[0039]

In the methods and uses, L-ergothioneine or a salt
25 thereof is simply used in an amount (effective amount) that provides the effect of increasing leukocytes and/or basophils.

In the methods and uses, L-ergothioneine or a salt thereof is simply used in an amount (effective amount) that
30 provides the effect of inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase.

In the methods and uses, L-ergothioneine or a salt thereof is simply used in an amount (effective amount) that provides the effect of activating innate immunity.

35 L-ergothioneine or a salt thereof, preferred

administration amounts thereof, preferred administration subjects, and the like are as described above for the composition of the present invention. L-ergothioneine or a salt thereof may be directly fed or administered or may be
5 fed or administered as a composition containing L-ergothioneine or a salt thereof. For example, the composition of the present invention may be fed or administered.

[0040]

10 L-ergothioneine or a salt thereof can be used to produce a food or beverage, a pharmaceutical product, a quasi-pharmaceutical product, feed, or the like for use in increasing leukocytes and/or basophils. In one embodiment, the present invention also encompasses use of L-
15 ergothioneine or a salt thereof to produce a composition for increasing leukocytes and/or basophils.

The present invention also encompasses L-ergothioneine or a salt thereof for use in increasing leukocytes and/or basophils.

20 L-ergothioneine or a salt thereof can be used to produce a food or beverage, a pharmaceutical product, a quasi-pharmaceutical product, feed, or the like for use in inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase. In one embodiment, the present invention also
25 encompasses use of L-ergothioneine or a salt thereof to produce a composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase.

The present invention also encompasses L-ergothioneine or a salt thereof for use in inhibiting
30 epidermal growth factor receptor (EGFR) tyrosine kinase.

L-ergothioneine or a salt thereof can also be used to produce a food or beverage, a pharmaceutical product, a quasi-pharmaceutical product, feed, or the like for use in activating innate immunity. In one embodiment, the present
35 invention also encompasses use of L-ergothioneine or a salt

thereof to produce a composition for activating innate immunity.

The present invention also encompasses L-ergothioneine or a salt thereof for use in activating
5 innate immunity.

EXAMPLES

[0041]

The present invention is described in further detail
10 below with reference to examples, but the scope of the present invention is not limited thereto.

[0042]

<Example 1>

(Study on evaluation of blood leukocyte count and basophil
15 count in humans)

In order to evaluate the influence of supplements containing ergothioneine on blood leukocyte count and basophil count in humans, a placebo-controlled, randomized, double-blind, parallel-group study was conducted on
20 subjects including male and female adults (46 subjects in a test food group; 46 subjects in a control food group; 92 subjects in total). In this study, one capsule containing 20 mg ergothioneine (test food) or one capsule not containing ergothioneine (control food) was fed per day for
25 four weeks. The blood leukocyte count and basophil count in each subject were measured for pre-testing before starting the study (before starting ingestion of the test food or control food). After ingestion of the test food or control food for four weeks, the blood leukocyte count and
30 basophil count in each subject were measured again (testing on week 4).

[0043]

(Food for evaluation)

Two types of food for evaluation, which were
35 indistinguishable in appearance, flavor, and the like, were

used.

- Test food: capsule containing a test substance (20 mg L-ergothioneine)

- Control food: capsule containing no test substance

5 Each type of food for evaluation contained raw materials such as dextrin, hydroxypropyl cellulose, carrageenan, potassium chloride, and titanium oxide, in addition to the test substance. The control food was produced using the same raw materials used in the test
10 food, except that the test substance (L-ergothioneine) was not added.

[0044]

FIG. 1 shows the amount of change in blood leukocyte count in the test food group and the control food group.
15 FIG. 2 shows the amount of change in basophil count in the test food group and the control food group. In FIG. 1 and FIG. 2, ■ (black square) indicates the test food group, and □ (white square) indicates the control food group.

[0045]

20 FIG. 1 shows the amount of change in blood leukocyte count (Δ in leukocytes (cells/ μ L)) between at the time of pre-testing and at the time of testing on week 4 in the test food group and the control food group. The amount of change in blood leukocyte count (cells/ μ L) shown in FIG. 1
25 is the amount of change relative to the measurements at the time of pre-testing. Specifically, the amount of change in the test food group at the time of testing on week 4 was determined for the test food group by subtracting the blood leukocyte count (average) at the time of pre-testing from
30 the blood leukocyte count (average) at the time of testing on week 4. Similarly, the amount of change at the time of testing on week 4 was determined for the control food group by subtracting the blood leukocyte count (average) at the time of pre-testing from the blood leukocyte count
35 (average) at the time of testing on week 4. The amount of

change at the time of pre-testing was set to 0.

According to the results, the blood leukocytes were increased more in the test food group than in the control food group.

5 [0046]

FIG. 2 shows the amount of change in blood basophil count (Δ in basophils (%)) between at the time of pre-testing and the time of testing on week 4 in the test food group and the control food group. For each group, Δ in
10 basophils (%) was determined from the blood basophil count (average) using the following formula.

$$\Delta \text{ in basophils (\%)} = 100 \times ((\text{blood basophil count at the time of testing on week 4}) - (\text{blood basophil count at the time of pre-testing})) / (\text{blood basophil count at the time of pre-testing})$$

According to the results, the blood basophils were increased more in the test food group than in the control food group.

[0047]

20 <Example 2>

(Evaluation of activity to inhibit substrate binding of epidermal growth factor receptor (EGFR) tyrosine kinase)

The study was commissioned to Eurofins Panlabs. The study was performed using recombinant human epidermal
25 growth factor receptor (EGFR) tyrosine kinase expressed in insect cells. First, epidermal growth factor receptor (EGFR) tyrosine kinase (0.134 $\mu\text{g/mL}$) was incubated in HEPES buffer (pH 7.4) with 100 or 1000 μM L-ergothioneine at 37°C for 15 minutes. Then, 0.2 mg/mL Poly(Glu:Tyr), 10 μM ATP,
30 and 0.25 μCi [$\gamma^{32}\text{P}$] ATP were added. Thereby, an enzymatic reaction was initiated. After incubating at 37°C for 30 minutes, 3% H_3PO_4 was added to terminate the reaction. Lastly, the activity of ergothioneine to inhibit substrate binding was evaluated using the amount of
35 [^{32}P]Poly(Glu:Tyr) formed in the reaction as an index.

[0048]

FIG. 3 shows the results of evaluation of the activity of L-ergothioneine to inhibit substrate binding of epidermal growth factor receptor (EGFR) tyrosine kinase. The concentration (μM) on the horizontal axis is the concentration of L-ergothioneine. L-ergothioneine showed its activity in a concentration-dependent manner and showed an activity to inhibit substrate binding of epidermal growth factor receptor (EGFR) tyrosine kinase. L-ergothioneine was found to have an activity to inhibit epidermal growth factor receptor (EGFR) tyrosine kinase.

CLAIMS

Claim 1. A composition for increasing at least one of leukocytes or basophils, comprising

5 L-ergothioneine or a salt thereof as an active ingredient.

Claim 2. A composition for inhibiting epidermal growth factor receptor (EGFR) tyrosine kinase, comprising

10 L-ergothioneine or a salt thereof as an active ingredient.

Claim 3. A composition for activating innate immunity, comprising

15 the composition according to claim 1 or 2.

Claim 4. The composition according to any one of claims 1 to 3,
wherein the composition is an oral composition.

20

Claim 5. The composition according to any one of claims 1 to 4,
wherein the composition is a food or beverage.

25 Claim 6. The composition according to any one of claims 1 to 5,

wherein an amount of L-ergothioneine or a salt thereof in the composition per adult daily intake is 2 to 50 mg in terms of L-ergothioneine.

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Claim 7. A method of increasing at least one of leukocytes or basophils, comprising
administering L-ergothioneine or a salt thereof.

35 Claim 8. A method of inhibiting epidermal growth

factor receptor (EGFR) tyrosine kinase, comprising
administering L-ergothioneine or a salt thereof.

5 Claim 9. A method of activating innate immunity,
comprising
administering L-ergothioneine or a salt thereof.

10 Claim 10. Use of L-ergothioneine or a salt thereof
for increasing at least one of leukocytes or basophils.

 Claim 11. Use of L-ergothioneine or a salt thereof
for inhibiting epidermal growth factor receptor (EGFR)
tyrosine kinase.

15 Claim 12. Use of L-ergothioneine or a salt thereof
for activating innate immunity.