MINERA-CONTAINING COMPOSITION AND METHOD OF USE THEREOF

A mineral-containing composition comprising a water-soluble dietary fiber and a mineral; use of the mineral-containing composition as an additive to a diet; and a method of supplementing a mineral, comprising the step of calculating an amount of the mineral deficient in an individual based on an amount taken from a diet by the individual, and supplying the mineral in an amount corresponding to a deficient amount, wherein the mineral-containing composition is added to a diet. The mineral-containing composition of the present invention can be easily used as a mineral supplement used in food rationing facilities and in general households.
DESCRIPTION

MINERAL-CONTAINING COMPOSITION AND METHOD OF USE THEREOF

TECHNICAL FIELD

The present invention relates to a mineral-containing composition and a method of use thereof.

BACKGROUND ART

The insufficient mineral uptake due to the current change of dietary life causes problems. In addition, when the Food Composition Table of Japan was revised from the fourth version to the fifth version, minerals were reexamined; the results of the reexamination have proved in the decrease of the amount of minerals contained in foods, thereby making the problem of deficient mineral uptake more serious.

To improve the deficient mineral uptake, generally used is a method to take tablets containing minerals. The tablets, however, not only give an impression of a medicine which is taken beside diet, but also are very difficult to be ingested by individuals, who have swallowing difficulty such as the care-needed and the like, or have narrow esophagus.

Furthermore, for example, suppose a tablet containing 2 mg of iron per a tablet; if a person who has to supplement 1 mg of iron takes the tablet, he results in over uptake of 1 mg. In other words, there arises a problem that the amount of minerals supplied is determined by the amount contained in a tablet when the
tablet is taken.

On the other hand, various processed foods enhanced by minerals have been made commercially available to compensate the mineral deficiency; the enhancement is, however, formulated based on an average amount of mineral deficiency, which causes the problem that the enhancement is insufficient or excess depending upon individuals.

In addition, many of minerals as nutrients are generally hard to be absorbed into a body; on the other hand, the minerals well absorbed into the body have colors, odors and tastes, and has various disadvantages such as being easily reactive with other components contained in foods, thereby leading high irritation to digestive tract mucosae, and the like.

In order to solve the problems mentioned above, an insoluble mineral-containing composition coated with enzymatically decomposed lecithin which little affects to the color and taste of foods, is disclosed (for example, see WO 98/14072).

The disclosed composition is, however, formulated for the use of dispersing to processed foodstuff during the production, and does not take into consideration the use of dispersing at food service institutions and general households; therefore, thereby making it difficult to be used as it is in the food service institutions and the general households.

An object of the present invention is to provide a mineral-containing composition which little affects to the color and taste of foods, is capable of being used in the food service institutions and the general households, and further capable of taking minerals in a given amount.

These and other objects of the present invention will be apparent from the
following description.

DISCLOSURE OF INVENTION

Specifically, the present invention relates to:

The present invention relates:

(1) a mineral-containing composition comprising a water-soluble dietary fiber and a mineral;

(2) the mineral-containing composition according to the above (1), further comprising an enzymatically decomposed lecithin;

(3) the mineral-containing composition according to the above (1) or (2), further comprising trehalose;

(4) the mineral-containing composition according to any one of the above (1) to (3), wherein the composition is in a form of granule;

(5) use of the mineral-containing composition according to any one of the above (1) to (4) as an additive to a diet;

(6) the use according to the above (5), wherein the diet is a soup, a beverage, a rice-based diet and/or a side dish;

(7) the use according to the above (5) or (6), which is added to the diet when the diet is taken; and

(8) a method of supplementing a mineral, comprising the step of calculating an amount of the mineral deficient in an individual based on an amount taken from a diet by the individual, and supplying the mineral in an amount corresponding to a deficient amount, wherein the mineral-containing composition as defined in any one of the above (1) to (4) is added to a diet.
BEST MODE FOR CARRYING OUT THE INVENTION

The present invention provides a mineral-containing composition little affecting color and taste of foods and having excellent water-dispersibility, allowing easy use by adding to a diet which being fed by the food service institutions or taken at the general households, and further allowing an intake of a given amount of a mineral.

One of the distinguished features of the mineral-containing composition of the present invention resides in that the mineral-containing composition comprises a water-soluble dietary fiber and a mineral.

Since the mineral-containing composition has the above feature, the dispersibility in water is improved as compared with conventional mineral-containing compositions, thereby providing a mineral-containing composition which can be easily added to the diet upon food intake in the food service institutions or the general households. In addition, since the mineral-containing composition can be used in the food service institutions and the general households, the conventional problem of causing a difference in the amounts of mineral taken by individuals.

The mineral usable in the present invention includes calcium, phosphorus, sulfur, potassium, sodium, chlorine, magnesium, iron, zinc, silicon, manganese, copper, boron, molybdenum, selenium, iodine, chromium, cobalt, nickel, vanadium, arsenic, and the like. Among them, calcium, magnesium and iron are preferable from the viewpoints of nutrition science, and iron is more preferable. These minerals may be used alone or in a mixture of two or more kinds.

The mineral used in the present invention may be used in the form as it is, or preferably in the form of an inorganic or organic salt (simply referred to
herein as a mineral salt in some cases). The mineral salt is not particularly limited, and a mineral salt little affecting to taste is preferable. The mineral salt little affecting to taste includes a soluble mineral salt such as a calcium lactate. Taking into consideration the effect to taste and the irritation to digestive tract mucosae, preferable is a mineral salt corresponding to the salts regulated by the test method of general notice 29 in the Seventh Edition of Japan’s Specifications and Standards for Food Additives in which the mineral salt is defined as “very slightly soluble” (the amount of water required to solve 1 g of a solute is 1000 ml or more and less than 10000 ml) or “practically insoluble” (the amount of water required to solve 1 g of a solute is 10000 ml or more); more preferable is a mineral salt pertinent to “practically insoluble.”

Specific examples of the preferable mineral salt include calcium salts such as calcium pyrophosphate, calcium phosphate, and calcium carbonate, including a material containing eggshell calcium, seashell calcium, seaweed calcium, dolomite, or natural calcium carbonate; magnesium salts such as magnesium hydroxide and magnesium phosphate; iron salts such as ferrous hydroxide, ferrous phosphate, ferric pyrophosphate, and ferrous carbonate; zinc salts such as zinc hydroxide, zinc pyrophosphate, and zinc oxide; copper salts such as cuprous chloride and cupric carbonate; and the like. Among them, preferable are calcium pyrophosphate, calcium phosphate, calcium carbonate, magnesium hydroxide, magnesium phosphate, ferrous phosphate, ferric pyrophosphate, and cuprous chloride; more preferable are calcium pyrophosphate, calcium phosphate, calcium carbonate, magnesium hydroxide, magnesium phosphate, ferrous phosphate and ferric pyrophosphate; still more preferable are calcium carbonate and ferric pyrophosphate. Those mineral salts may be used alone or in a mixture
of two or more kinds.

The average particle size of the mineral salt used in the present invention is preferably 1 μm or less, more preferably 0.5 μm or less, from the viewpoints of absorbability and palatability. The average particle size is determined by, for example, a laser diffraction particle size distribution analyzer. The method for obtaining the mineral salt having the average particle size includes a physical powdering method employing a homomixer, a ball-mill, a jet mill or the like, or a method of neutral salt formation. Among them, the method of neutral salt formation is preferable because fine particles having even particle sizes can be easily obtained. The method of neutral salt formation refers to a method for obtaining a salt by reacting an acid with a base. As the method of neutral salt formation, known are a method employing neutralization reaction between a strong acid and a strong basic salt such as ferric chloride and tetrascocodium pyrophosphate in the case of ferric pyrophosphate, a method employing neutralization reaction between a weak acid and a strong basic salt, for instance, a carbonate such as calcium carbonate and calcium hydroxide or the like.

The content of the mineral in the mineral-containing composition of the present invention is not particularly limited, as long as the mineral is contained in a desired amount in the mineral-containing composition. The content of the mineral in the mineral-containing composition is preferably from 0.1 to 100 mg/g, more preferably from 1 to 50 mg/g.

The water-soluble dietary fiber used for the present invention includes, for example, pectin, sodium alginate, a part of hemicellulose, glucomannan, galactomannan, and partial decomposition products thereof. Among them, the decomposition product of the galactomannan is preferable.
The galactomannan in the present invention means a polysaccharide in which a sugar chain comprising mannose as a main component thereof is bound to a side chain comprising a galactose as a main component thereof. Specific examples of the galactomannan include guar gum, locust bean gum, tara gum, and the like, preferably guar gum or locust bean gum.

The decomposition product of the galactomannan in the present invention can be obtained by mixing one or more kinds of the galactomannan mentioned above, followed by decomposition. Alternatively, the decomposition product can be obtained by decomposing them, followed by mixing the decomposed.

The method for decomposing the galactomannan is not particularly limited. The method includes an enzymolysis method, an acidolysis method and the like; preferably is an enzymolysis method due to capability of obtaining a product having a given quality. An enzyme used for the enzymolysis method may be a commercial product or a natural product as long as being capable to hydrolyze the sugar chain including a mannose as the major component; preferably β-galactomannanase derived from Aspergillus strains or Rhizopus strains, more preferably β-galactomannanase derived from Aspergillus strains. One or more kinds of the enzymes may be used for the decomposition.

The viscosity of a 1% by weight solution of the decomposed galactomannan product obtained in the manner described above is preferably 10 mPa•s or less at 25°C. The weight-average molecular weight of the decomposed galactomannan product is preferably from 2000 to 100000.

The above-mentioned viscosity can be measured by a B-type viscometer for a 1% by weight aqueous solution of the decomposed galactomannan product. The weight-average molecular weight can be measured by a method of
calculating from the molecular distribution determined by high-performance liquid chromatography (column: YMC-Pack Diol-120, manufactured by YMC) using a polyethylene glycol (molecular weight: 2000, 20000, 100000 and the like) as markers.

As the above-mentioned water-soluble dietary fiber, there may be used a commercial product, for example, such as SUNFIBER (decomposed galactomannan product) manufactured by Taiyo Kagaku Co., Ltd.

The content of the water-soluble dietary fiber in the mineral-containing composition of the present invention is preferably from 0.1 to 5% by weight, more preferably from 0.3 to 1% by weight, from the viewpoints of improving dispersibility, suppressing increase of viscosity and securing excellent palatability.

The mineral used in the present invention is preferably coated with an emulsifying agent from the viewpoints of absorbability to body and processing applicability to foodstuff. The state of coating with the emulsifying agent means a state of emulsification with an emulsifying agent, and the state can be confirmed whether or not the mineral is stably dispersed in water.

Specific examples of the emulsifying agent used for the emulsification is not particularly limited, as long as the emulsifying agent is able to coat the mineral. The emulsifying agent includes a glycerol fatty acid ester, a propylene glycol fatty acid ester, a sorbitan fatty acid ester, a pentaerythritol fatty acid ester, a sorbitol fatty acid ester, a polyglycerol fatty acid ester, a sucrose fatty acid ester, a fatty acid ester of an organic acid, lecithin, an enzymatically decomposed lecithin, and the like. Among them, preferable are an enzymatically decomposed lecithin, a polyglycerol fatty acid ester and a sucrose fatty acid ester. These
emulsifying agents can be used alone or in a mixture of two or more kinds.

The enzymatically decomposed lecithin in the present specification refers to those obtained by subjecting lecithin to hydrolysis with phospholipase or the like. The lecithin includes a plant-derived lecithin such as soybean or an animal-derived lecithin such as an egg yolk. The phospholipase may be a phospholipase having phospholipase A and/or D activity, regardless of whether the origin may be derived from animals such as a pig pancreas, plants such as a cabbage or bacteria such as fungi; preferably phospholipase A which hydrolyzes a primary or secondary position of the fatty acid ester bonding, more preferably phospholipase A2 which hydrolyzes secondary position of the diacyl glycerophospholipid. The enzymatically decomposed lecithin may use a commercial product, for example, such as SUNLECITHIN L manufactured by Taiyo Kagaku Co., Ltd.

The polyglycerol fatty acid ester in the present invention means an ester formed between a polyglycerol and a fatty acid. The average degree of polymerization of the polyglycerol, the kind of the fatty acid and an esterification ratio, which constitute the polyglycerol fatty acid ester are not particularly limited. The average degree of polymerization of the polyglycerol is preferably 3 or more, more preferably from 3 to 11. The fatty acid preferably has a hydroxyl group in a saturated or unsaturated, straight or branched chain having 6 to 22 carbon atoms, more preferably 8 to 18 carbon atoms, even more preferably 12 to 14 carbon atoms. As the polyglycerol fatty acid ester, there may be used a commercial product, for example, such as Sunsoft A-141E, Sunsoft A-143E, Sunsoft 14C, or Sunsoft A-12E manufactured by Taiyo Kagaku Co., Ltd.

The sucrose fatty acid ester of the present invention refers to an ester
formed between a sucrose and a fatty acid. The fatty acid constituting the sucrose fatty acid ester is not particularly limited. The fatty acid preferably has an HLB of 10 or more, more preferably 12 or more, wherein the HLB is calculated from a molecular weight ratio of a hydrophilic group and a lipophilic group. The fatty acid has a hydroxyl group in a saturated or unsaturated, straight or branched chain having 8 to 22 carbon atoms, more preferably 10 to 20 carbon atoms, even more preferably 14 to 18 carbon atoms. As the sucrose fatty acid ester, there may be used a commercial product, for example, such as SUNSOFT SE-14, SUNSOFT SE-16, or SUNSOFT SE-16P manufactured by Taiyo Kagaku Co., Ltd.

The method of coating the mineral with the emulsifying agent includes, for example, a method comprising subjecting the mineral to a neutral salt formation method as disclosed in WO 98/14072 in a solution prepared by dissolving an emulsifying agent to give precipitates, and subjecting the precipitates to a liquid-solid separation; a method comprising mixing a mineral with a solution prepared by dissolving an emulsifying agent in a solvent capable of dissolving the emulsifying agent such as water, thereafter properly mixing the resulting mixture with an excipient such as dextrin and the like, and removing the solvent by spray-drying, freeze-drying or the like; a method comprising melting an emulsifying agent with heating, and then mixing the melted solution with a mineral, and thereafter cooling the resulting mixture to solidify. In addition, when an emulsifying agent is liquid at an ambient temperature, the method of coating a mineral includes a method comprising mixing a mineral with the emulsifying agent, and uniformly powdering the resulting mixture.

Alternatively, as the mineral coated with the emulsifying agent, there may be
used commercially available products such as SUNACTIVE Fe-12, SUNACTIVE Fe-P80 manufactured by Taiyo Kagaku Co., Ltd., and the like.

The content of the emulsifying agent in the composition of the present invention is preferably from 0.01 to 20 parts by weight, more preferably from 0.1 to 15 parts by weight, based on 100 parts by weight of the mineral, from the viewpoints of absorbability to a living body and flavor.

It is preferable that the mineral-containing composition of the present invention further comprises trehalose for further improvement of dispersibility. The content of trehalose in the mineral-containing composition of the present invention is preferably 30% by weight or more, more preferably 40% by weight or more, from the viewpoint of improvement in dispersibility. The upper limit of the content is not particularly limited, as long as the effects of the present invention are not inhibited. The upper limit of the content is preferably 80% by weight or less, more preferably 60% by weight or less.

In the mineral-containing composition of the present invention, other optional components such as excipients and nutrient components can be added within the range so as not to inhibit the effects of the present invention. Specific examples of the other components include monosaccharides and disaccharides such as fructose, lactose, glucose, saccharose, maltose, galactose, and xylose; oligosaccharides such as xylooligosaccharide, fructooligosaccharide, galactooligosaccharide, lactulose, palatinose, soybean oligosaccharide, raffinose, isomaltooligosaccharide; starch, dextrin and decomposed products thereof; a polysaccharide thickener; sugar alcohols such as sorbitol, xylitol, erythritol, maltitol, and lactitol; vitamins such as vitamin A, vitamin B₁, vitamin B₂, vitamin B₆, vitamin B₁₂, vitamin C, vitamin D, vitamin E, niacin (nicotinic acid),
pantothenic acid, and folic acid; essential amino acids such as a lysine, a threonine, a tryptophan and the like; and others such as α-linolenic acid, EPA, DHA, evening primrose oil, octacosanol, casein phosphopeptide (CPP), a casein calcium peptide (CCP), and an insoluble dietary fiber. These optional components may be used alone or in a mixture of two or more kinds.

The mineral-containing composition of the present invention may be prepared by mixing each of the components mentioned above in given amounts. Alternatively, the composition may be prepared by, for example, using one or more granulation devices selected from a fluidized-bed granulator, a tumbling-bed granulator, a spray-drying granulator, an extrusion granulator, a disintegrating-type granulator, a compression granulator, a mixing granulator, a vertical-type granulator, and the like. Among them, those prepared by employing the fluidized-bed granulator are preferable, from the viewpoint of dispersibility.

When the mineral-containing composition of the present invention is prepared by the fluidized-bed granulator, it is preferable that the water-soluble dietary fiber described above is added to a sprayed solution during the granulation from the viewpoint of improving dispersibility.

The form of the mineral-containing composition of the present invention after the preparation is not particularly limited. The form includes solution, powder, granule, tablet and the like, preferably granule from the viewpoint of improving dispersibility. The particle size of the granule is not particularly limited. It is preferable that 70% or more of the granule has a particle size of preferably from 10 to 1000 μm, more preferably 50 to 500 μm, from the viewpoint of improving dispersibility.
The mineral-containing composition of the present invention obtained in the manner as described above can be used as a food additive.

The diet includes soups, beverages, rice-based diets and side dishes. Specific examples of the soups include miso soup, butajiru, kenchinjiru, osuimono, Western soup, Chinese noodles (ramen), wheat noodles (udon), buckwheat noodles (soba), stew, and the like. Specific examples of the beverages include teas such as green tea, oolong tea, black tea, and herbal tea, concentrated fruit juices, concentrated reduced juices, straight juices, fruits mixed juice, pulp-containing fruit juices, fruit-juice containing beverages, fruit and vegetable mixed juices, vegetable juices, carbonated beverages, cold beverages, milk beverages, Japanese sake, beers, wines, cocktails, syocho, whiskies, and the like. Specific examples of rice-based diets include white rice, onigiri, rice porridge, sushi rice, chirashi-sushi, rice boiled with barley, kamameshi, takikomi rice, gomoku rice, festive red rice, donburio, stir-fried rice, pilaf, rice with curry roux, dried curry, paella, stir-fried chicken and rice, and the like. The side dishes as used herein mean dishes other than the main dishes, and the side dishes may be served as a main course or side course in a diet. Among them, the soups are preferable because the composition of the present invention can be easily used.

The additive to a diet as used herein means an additive added to the diet described above. The method of addition includes addition during cooking, addition after being cooked, addition upon the intake of the diet, and the like. Among them, the method of addition upon the intake of the diet is preferable since the addition is easily performed and adjustable to a required amount depending upon individuals.
It is preferable that the mineral-containing composition of the present invention is used for addition to a food ration of mass feeding and/or a household cooking, more preferably for addition to food ration provided at hospitals, elder care facilities, schools, sport facilities, facilities of the Self Defense Force and the like.

The mineral-containing composition of the present invention is preferably provided, for example, with a small portion packaged in a small pack, bottle or the like, in consideration of user-friendliness in the food service institutions and the general households. For example, the mineral-containing composition of the present invention is provided with a bottle with a cap having a small hole. Since the composition is provided in such a form, the composition can be sprinkled and/or dispersed to each dish as handy as table salt, thereby remarkably improving usefulness in the food service institutions and the general households. Furthermore, since the composition can be added to each dish considering the amount of deficient minerals of an individual, the conventional problem that there is a difference in the amounts of intake of the mineral by individuals.

The present invention further provides a method of supplementing a mineral, comprising the step of calculating an amount of the mineral deficient in an individual from an amount of the diet taken by the individual, and supplementing the mineral corresponding to the deficient portion, wherein the mineral-containing composition as defined above is added to a diet.

The amount of the mineral deficient can be calculated, for example, by subtracting an amount of mineral contained in a diet of an individual from the essential amount of intake disclosed in the sixth edition of “The nutrition necessary for Japanese (dietary reference intakes)” (edited by the Institute of
Health and Nutrition Information, published by DAI-ICHI SHUPPAN PUBLISHING Co. Ltd.).

It is preferable that the amount of the deficient mineral calculated as described above is supplemented by adding the mineral-containing composition of the present invention to a diet of an individual during cooking, after being cooked or upon intake of the diet, preferably upon intake of the diet.

Furthermore, the mineral-containing composition of the present invention can be applied not only for supplementing deficiency of minerals, but also for supplementing minerals for the purpose of amelioration of symptoms, such as iron supplement to patients suffering from anemia, or calcium supplement to patients suffering from bone fracture. When the composition is used for this purpose, the amount of the mineral supplemented is calculated by adding the necessary amount suitable for symptoms of an individual to the essential intake amount described above.

Thus, the calculated amount of mineral to be supplemented is supplemented by adding the mineral-containing composition of the present invention to a diet of an individual during cooking, after being cooked or upon intake of a diet, preferably upon intake of a diet, in the same manner as described above.

EXAMPLES

The present invention will be described more specifically by means of Examples, without intending to limit the present invention thereto.

Example 1 Preparation of Mineral(Iron)-Containing Granule
(1) Preparation of Ferric Pyrophosphate Powder Coated with Emulsifying Agent

An iron solution prepared by dissolving 130 g of ferric chloride hexahydrate and 3 g of enzymatically decomposed lecithin ("SUNLECITHIN L," manufactured by Taiyo Kagaku Co., Ltd.) in 600 g of ion-exchanged water was gradually added while stirring to a pyrophosphate solution prepared by dissolving 200 g of tetrasodium pyrophosphate decahydrate and 17 g of pentaglycerol monomyristate ("SUNSOFT A-141E," manufactured by Taiyo Kagaku Co., Ltd.) in 5 kg of ion-exchanged water. Thereafter, the pH of the mixed solution was adjusted to 3.0. After the termination of salt formation of ferric pyrophosphate by neutralization reaction, the reaction mixture was subjected to solid-liquid separation by centrifugation (3000 G, 5 minutes) to give an iron salt coated with the emulsifying agent. Next, 800 ml of ion-exchanged water was added to the iron salt, and the mixture was dispersed, to give 860 ml of a solution of the iron salt coated with the emulsifying agent.

The average particle size of the iron salt in the resulting solution was determined by a laser diffraction particle size distribution analyzer ("HELOS & RODOS," manufactured by SYMPATEC). As a result, the average particle size was 0.5 \( \mu m \).

Dextrin was added to the resulting solution, and the mixture was spray-dried, to give a ferric pyrophosphate powder coated with the emulsifying agent, containing 8% by weight of iron.

(2) Preparation of Mineral(Iron)-Containing Granule

A fluidized-bed granulator was charged with 2.5 g of the powder obtained
in the above (1), 50.0 g of trehalose ("TREHA," manufactured by HAYASHIHARA SHOJI) and 47.0 g of branched dextrin ("BLD" manufactured by Sanmatsu Kogyo). The mixture was granulated while spraying a solution prepared by dissolving 0.5 g of decomposed galactomannan product ("SUNFIBRE," manufactured by Taiyo Kagaku Co., Ltd.) in 10 ml of water, to give a mineral (iron)-containing granule A of the present invention in which the iron content in 1 g of the composition was 2 mg.

The particle size distribution of the resulting granule was determined. As a result, 80% of the granules fall within the range of from 50 to 500 μm.

Example 2. Preparation of Mineral (Calcium)-Containing Granule

(1) Preparation of Calcium Carbonate Powder Coated with Emulsifying Agent

A calcium solution prepared by dissolving 200 g of calcium chloride dihydrate and 30 g of enzymatically decomposed lecithin ("SUNLECITHIN L," manufactured by Taiyo Kagaku Co., Ltd.) in 1.2 kg of ion-exchanged water, was gradually added while stirring to a carbonate solution prepared by dissolving 110 g of sodium carbonate and 140 g of a polyglycerol fatty acid ester ("SUNSOFT A-12E," manufactured by Taiyo Kagaku Co., Ltd.) in 2.6 kg of ion-exchanged water. Thereafter, the pH of the mixture was adjusted to 9.0. After the termination of salt formation of calcium carbonate by neutralization reaction, the solution was subjected to liquid-solid separation by centrifugation (3000 G, 5 minutes) to give a calcium salt coated with the emulsifying agent. Next, 800 ml of ion-exchanged water was added to the calcium salt, and the mixture was dispersed, to give 860 ml of a solution of the calcium salt coated with the
emulsifying agent.

The average particle size of the calcium salt in the resulting solution was determined by a laser diffraction particle size distribution analyzer ("HELOS & RODOS." manufactured by SYMPATEC). As a result, the average particle size was 0.6 μm.

Dextrin was added to the resulting solution, and the mixture was spray-dried to give a calcium carbonate powder coated with the emulsifying agent, containing 25% by weight of calcium.

(2) Preparation of Mineral (Calcium)-Containing Granule

A fluidized-bed granulator was charged with 40 g of the powder obtained in above (1), 35 g of trehalose ("TREHA," manufactured by HAYASIHARA SHOJI), 19.5 g of branched dextrin ("BLD," manufactured by Sanmatsu Kogyo) and 5 g of casein calcium peptide ("CCP," manufactured by Taiyo Kagaku Co., Ltd.). The mixture was granulated while spraying a solution prepared by dissolving 0.5 g of decomposed galactomannan product ("SUNFIBRE," manufactured by Taiyo Kagaku Co., Ltd.) in 10 ml of water, to give a mineral(calcium)-containing granule B of the present invention in which the calcium content 1 g of the composition was 100 mg.

The particle size distribution of the resulting granule was determined. As a result, 80% of the granules fall within the range of from 50 to 500 μm.

Example 3. Preparation of Mineral (Calcium)-Containing Granule

(1) Preparation of Eggshell Calcium Powder Coated with Emulsifying Agent

There were mixed together 90 g of middle-chain fatty acid triglyceride (
(“SUNSOFT MCT-6,” manufactured by Taiyo Kagaku Co., Ltd.) and 10 g of polyglycerol condensed ricinoleate (“SUNSOFT 818H,” manufactured by Taiyo Kagaku Co., Ltd.). Next, 100 g of eggshell calcium (“EGGSHELL CALCIUM TS-800,” manufactured by Taiyo Kagaku Co., Ltd., average particle size: about 5 μm) was added thereto to give an oily suspension. The suspension was dispersed with “READY MILL” (manufactured by AIMEX), to give a dispersion of the eggshell calcium.

The average particle size of the eggshell calcium in the resulting suspension was determined by a laser diffraction particle size distribution analyzer (“HELOS & RODOS,” manufactured by SYMPATEC). As a result, the average particle size was 0.7 μm.

There were mixed together 130 g of the resulting dispersion, 18.6 g of polyglycerol stearate (“SUNSOFT PS-68,” manufactured by Taiyo Kagaku Co., Ltd.), 1.8 g of citric acid monostearic acid ester (“SUNSOFT NO. 621B,” manufactured by Taiyo Kagaku Co., Ltd.), 2.6 g of polyglycerol stearate (“SUNSOFT Q-182S,” manufactured by Taiyo Kagaku Co., Ltd.), 40 g of sodium caseinate, 67 g of dextrin and 750 g of water. Next, the mixture was subjected to high-speed agitation with T.K. Homo Mixer (manufactured by Tokushu Kika Kogyo), to prepare a W/O/W emulsion. Thereafter, the emulsion was spray-dried to give an eggshell calcium powder coated with the emulsifying agent, containing 10% by weight of calcium.

(2) Preparation of Mineral (Calcium)-Containing Granule

A fluidized-bed granulator was charged with 50 g of the powder obtained in the above (1), 35 g of trehalose (“TREHA,” manufactured by HAYASHIARA SHOJI) and 14.5 g of branched dextrin (“BLD,” manufactured by Sanmatsu
Kogyo). The mixture was granulated while spraying a solution prepared by dissolving 0.5 g of decomposed galactomannan product (“SUNFIBRE,” manufactured by Taiyo Kagaku Co., Ltd.) in 10 ml of water, to give a mineral(calcium)-containing granule C of the present invention in which the calcium content in 1 g of the composition was 50 mg.

The particle size distribution of the resulting granule was determined. As a result, 80% of the granules fall within the range of from 50 to 500 μm.

Example 4  Preparation of Mineral (Magnesium)-Containing Granule

(1) Preparation of Magnesium Phosphate Powder Coated with Emulsifying Agent

A phosphoric acid solution was prepared by dissolving 270 g of 85% phosphoric acid and 20 g of enzymatically decomposed lecithin (“SUNLECITHIN L,” manufactured by Taiyo Kagaku Co., Ltd.) in 5 kg of ion-exchanged water. Thereafter, a solution was prepared by dispersing 200 g of magnesium hydroxide in 15 kg of ion-exchanged water, adding 150 g of a polyglycerol fatty acid ester (“SUNSOFT A-14C,” manufactured by Taiyo Kagaku Co., Ltd.) to dissolve. To the resulting solution was gradually added the prepared phosphoric acid solution while stirring, to give a mixture. The pH of the mixture was adjusted to 5.0. After the termination of salt formation of magnesium hydroxide by neutralization reaction, 80 g of gum arabic (“NEOSOFT AB,” manufactured by Taiyo Kagaku Co., Ltd.) was added to the solution. The mixture was subjected to a solid-liquid separation by centrifugation (3000 G, 10 minutes) to give a magnesium salt coated with the emulsifying agent. Next, 800 ml of ion-exchanged water was added to the
magnesium salt, and the mixture was dispersed, to give 860 ml of a solution of the magnesium salt coated with the emulsifying agent.

The average particle size of the magnesium salt in the resulting solution was determined by a laser diffraction particle size distribution analyzer ("HELOS & RODOS," manufactured by SYMPATEC). As a result, the average particle size was 0.3 μm.

Dextrin was added to the resulting solution, and the mixture was spray-dried to give a magnesium phosphate powder coated with the emulsifying agent, containing 20% by weight of magnesium.

(2) Preparation of Mineral (Magnesium)-Containing Granule

A fluidized-bed granulator was charged with 25 g of the powder obtained in the above (1), 40 g of trehalose ("TREHA," manufactured by HAYASHIHARA SHOJI) and 34.5 g of branched dextrin ("BLD," manufactured by Sanmatsu Kogyo). The mixture was granulated while spraying a solution prepared by dissolving 0.5 g of decomposed galactomannan product (SUNFIBRE," manufactured by Taiyo Kagaku Co., Ltd.) in 10 ml of water, to give a mineral (magnesium)-containing granule D of the present invention in which the magnesium content in 1 g of the composition was 50 mg.

The particle size distribution of the resulting granule was determined. As a result, 80% of the granule fall within the range of from 50 to 500 μm.

Comparative Example 1. Preparation of Mineral(Iron)-Containing Granule

A fluidized-bed granulator was charged with 2.5 g of the ferric pyrophosphate powder coated with the emulsifying agent prepared in item (1) of the Example 1 and 97.5 g of dextrin. The mixture was granulated while spraying
10 ml of water to give a mineral(iron)-containing granule E in which the iron content in 1 g of the composition was 2 mg.

The particle size distribution of the resulting granule was obtained. As a result, 80% of the granules fall within the range of from 50 to 500 μm basically in the same manner as in item (2) of Example 1.

**Test Example 1. Evaluation of Dispersibility**

The amount 5 g each of the mineral-containing granules obtained in each of Examples 1 to 4 and the Comparative Example 1 was added to 100 mL of water at an ambient temperature while stirring at 360 rpm. The dispersibility was evaluated by determining the time period until which the granules were completely dispersed (time period for complete dispersion). The results are shown in the Table 1.

<table>
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<tr>
<th>Time Period for Complete Dispersion</th>
<th>Ex. 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
<th>Ex. 4</th>
<th>Comp. Ex. 1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>About</td>
<td>About</td>
<td>About</td>
<td>About</td>
<td>1 minute or more</td>
</tr>
<tr>
<td></td>
<td>10 sec</td>
<td>10 sec</td>
<td>10 sec</td>
<td>10 sec</td>
<td></td>
</tr>
</tbody>
</table>

It can be seen from the results shown in the Table 1 that the mineral-containing granules of Examples 1 to 4 are more excellent in dispersibility as compared to the mineral-containing granule of Comparative Example 1.

**Test Example 2. Flavor Test 1**

To *miso* soup served as a food rationing in a hospital was added 0.7 g of
the mineral-containing granule A obtained in Example 1 and 1.0 g of the mineral-containing granule B obtained in Example 2, to give a mineral-supplemented *miso* soup. Thereafter, the flavor thereof was compared to that of *miso* soup without addition of the mineral-containing granules. As a result, it was confirmed that there is no significant difference in flavor therebetween.

**Test Example 3  Flavor Test 2**

200 g of polished rice was washed, and a proper amount of water was added thereto. Further, thereto were added 0.5 g of the mineral-containing granule A obtained in Example 1, 1 g of the mineral-containing granule C obtained in Example 3 and 0.5 g of the mineral-containing granule D obtained in Example 4, and the rice was cooked, to give a mineral-supplemented rice. The flavor of the mineral-supplemented rice was compared to rice without the addition of the mineral-containing granule. As a result, it was confirmed that there is no significant difference in flavor therebetween.

**Example 5  Use of Granule in Food Ration in Hospital**

In a food rationing in a hospital, the contents of iron and calcium in the food ration were calculated considering daily menu. As a result, as shown in the Table 2, the iron contents were 2 mg in the breakfast meal, 2 mg in the lunchtime meal and 3 mg in the evening meal, and the calcium contents were 140 mg in the breakfast meal, 120 mg in the lunchtime meal and 160 mg in the evening meal.
Table 2

<table>
<thead>
<tr>
<th>Daily Menu</th>
<th>Breakfast Meal</th>
<th>Lunchtime Meal</th>
<th>Evening Meal</th>
<th>Total for One Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Content</td>
<td>2 mg</td>
<td>2 mg</td>
<td>3 mg</td>
<td>7 mg</td>
</tr>
<tr>
<td>Calcium Content</td>
<td>140 mg</td>
<td>120 mg</td>
<td>160 mg</td>
<td>420 mg</td>
</tr>
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</table>

As shown in the Table 3, since the amounts of iron and calcium required in a male (40-years old) to be served in the food ration were 10 mg of iron per day and 600 mg of calcium per day, the deficiency per day were 3 mg in iron and 180 mg in calcium. Therefore, as shown in the Table 4, the amount of iron and calcium to be supplemented to each meal was 1 mg of iron for each of the meals, and 60 mg of calcium in the breakfast meal, 80 mg in the lunchtime meal and 40 mg in the evening meal.

As the method of supplement, as shown in the Table 4, to the miso soup served in each meal, 0.5 g each of the mineral(iron)-containing granule A obtained in Example 1 was added to the miso soup, and the mineral(calcium)-containing granule B obtained in Example 2 was added in an amount of 0.6 g in the breakfast meal, 0.8 g in the lunchtime meal and 0.4 g in the evening meal.

Further, as shown in the Table 3, since the amounts of iron and calcium required in a female (32 years old) were 12 mg of iron per day and 600 mg of calcium per day, the deficiencies per day were 5 mg in iron and 180 mg in calcium. Therefore, as shown in the Table 4, the amounts of iron and calcium to be supplemented to each meal were 1.2 mg of iron to the breakfast meal and 1.4 mg each to the lunchtime meal and the evening meal, and 60 mg of calcium to the breakfast meal, 80 mg to the lunchtime meal and 40 mg to the evening.
meal.

As a method of supplement, as shown in the Table 4, to the *miso* soup served in each meal was added 0.6 g of the mineral(iron)-containing granule A obtained in Example 1 in the breakfast meal, 0.7 g each in the lunchtime meal and the evening meal, and 0.6 g of the mineral(calcium)-containing granule B obtained in Example 2 in the breakfast meal, 0.8 g in the lunchtime meal and 0.4 g in the evening meal.

Furthermore, as shown in the Table 3, since the amounts of iron and calcium required in another female (15 years old) were 12 mg of iron per day and 700 mg of calcium per day, the deficiencies per day were 5 mg in iron and 280 mg in calcium. Therefore, as shown in the Table 4, the amounts of iron and calcium to be supplemented to each meal were 1.2 mg of iron to the breakfast meal and 1.4 mg each to the lunchtime meal and the evening meal; and 100 mg each of calcium to the breakfast meal and the lunchtime meal and 80 mg to the evening meal.

As a method of supplement, as shown in the Table 4, to the *miso* soup served in each meal was added 0.6 g of the mineral(iron)-containing granule A obtained in Example 1 in the breakfast meal, 0.7 g each in the lunchtime meal and the evening meal, and 1.0 g each of the mineral(calcium)-containing granule B obtained in Example 2 in the breakfast meal and the lunchtime meal and 0.8 g in the evening meal. Since both of the granules A and B were quickly dispersed into the *miso* soup and did not affect the color and the flavor of the soup, the minerals were supplemented without any resistances by taking the *miso* soups. Consequently, the mineral deficiencies required to be enhanced in individuals could be easily supplemented.
Table 3

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<th>Amount Required per Day</th>
<th>Amount Deficient per Day</th>
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<tbody>
<tr>
<td></td>
<td>Iron</td>
<td>Calcium</td>
</tr>
<tr>
<td>Male (40-year old)</td>
<td>10 mg</td>
<td>600 mg</td>
</tr>
<tr>
<td>Female (32-year old)</td>
<td>12 mg</td>
<td>600 mg</td>
</tr>
<tr>
<td>Female (15-year old)</td>
<td>12 mg</td>
<td>700 mg</td>
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</table>

Table 4

<table>
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<tr>
<th>Nutrient Component</th>
<th>Amount Supplemented for Each Meal</th>
<th>Amount of Mineral-Containing Granule</th>
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<tr>
<td></td>
<td>Breakfast Meal</td>
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<td>Male (40-years old)</td>
<td>Iron</td>
<td>1 mg</td>
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<tr>
<td></td>
<td>Calcium</td>
<td>60 mg</td>
</tr>
<tr>
<td>Female (32-years old)</td>
<td>Iron</td>
<td>1.2 mg</td>
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<tr>
<td></td>
<td>Calcium</td>
<td>60 mg</td>
</tr>
<tr>
<td>Female (15-years old)</td>
<td>Iron</td>
<td>1.2 mg</td>
</tr>
<tr>
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<td>Calcium</td>
<td>100 mg</td>
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INDUSTRIAL APPLICABILITY

The mineral-containing composition of the present invention can be easily used as a mineral supplement used in food rationing facilities and in general households.
CLAIMS

1. A mineral-containing composition comprising a water-soluble dietary fiber and a mineral.

2. The mineral-containing composition according to claim 1, further comprising an enzymatically decomposed lecithin.

3. The mineral-containing composition according to claim 1 or 2, further comprising trehalose.

4. The mineral-containing composition according to any one of claims 1 to 3, wherein the composition is in a form of granule.

5. Use of the mineral-containing composition according to any one of claims 1 to 4 as an additive to a diet.

6. The use according to claim 5, wherein the diet is a soup, a beverage, a rice-based diet and/or a side dish.

7. The use according to claim 5 or 6, which is added to the diet when the diet is taken.

8. A method of supplementing a mineral, comprising the step of calculating an amount of the mineral deficient in an individual based on an amount taken
from a diet by the individual, and supplying the mineral in an amount corresponding to a deficient amount, wherein the mineral-containing composition as defined in any one of claims 1 to 4 is added to a diet.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A23L1/304 A23L1/03 A23L1/05

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

B. FIELDS SEARCHED

Maximum documentation searched (classification system followed by classification symbols)
IPC 7 A23L A61K

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

Electronic data base consulted during the international search (name of database and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, BIOSIS, FSTA, MEDLINE, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of box C.

Patient family members are listed in annex.

* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
  *E* earlier document but published on or after the international filing date
  *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another document or other special reason (as specified)
  *C* document referring to an oral disclosure, use, exhibition or other means
  *P* document published prior to the international filing date but later than the priority date claimed

  *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  *X* document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  *Y* document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

  *F* document member of the same patent family

Date of the actual completion of the international search
9 June 2005

Date of mailing of the international search report
08/07/2005

Name and mailing address of the ISA
European Patent Office, P.B. 8818 Patentlaan 2 NL—2280 HV Rivierenpl. Tel. (+31-70) 940-9040, Tx. 31 651 epo nl, Facs (+31-70) 340-3016

Authorized officer
Muller, I
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INTERNATIONAL SEARCH REPORT

Box II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
   Although claim 8 is directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.

2. [ ] Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple Inventions in this International application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claim; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2004)