PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Process for Increasing the Vitamin and Mineral Content of Cereal Grains.

We, ROCHE PRODUCTS LIMITED, a British Company, of Broadwater Road, Welwyn Garden City, Hertfordshire (Assignees of MAX FRANK FURTER, of Montclair, Essex County, New Jersey, and WERNER M. LAUTER, of Glen Rock, Bergen County, New Jersey, United States of America), Citizens of Switzerland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a process for increasing the vitamin and mineral content of cereal grains.

Rice and corn grits are generally washed prior to use. Rice is also dehulled in order to produce the white rice of commerce. Both the dehulling and washing of these grains remove the major part of the naturally-present vitamins and minerals. Therefore, various proposals have been made to treat such cereal grains with vitamins and minerals.

Thus it has been proposed in Industrial and Engineering Chemistry (1946), pages 486 to 493, to treat rice with a solution containing vitamins, dry the rice, coat it with a protective solution, then to treat it with iron pyrophosphate and again coat it with a protective solution. The nature and composition of the protective solution is not stated except that it is stated to form a water-resistant film.

The present invention provides a process for increasing the vitamin and mineral content of cereal grains, which consists in impregnating the cereal grains with a solution containing vitamins and mineral substances and coating the impregnated grains with ~~a edible~~ an edible coating comprising a film-forming agent, an adhesive agent and a plasticiser, which coating is insoluble in cold water but removable in hot water. It is not essential to treat the whole quantity of grains in respect of which the vitamin and mineral content is to be raised. It suffices if only a fraction thereof is strongly enriched, for example up to 200 to 800 times the content of the normal grain. This premix is then mixed, according to its vitamin and mineral content, with the required quantity of non-treated grains. On cooking, the protective coating of the treated grains is removed, the vitamins and minerals are liberated and uniformly distributed in the whole mass.

The vitaminisation is advantageously effected in an aqueous mineral acid solution, e.g., in dilute sulphuric or phosphoric acid. The use of such acidic solutions is especially suitable for enriching cereal grains with ribo-flavin and niacin which are better soluble therein than in water. If niacin sulphate is used, there is no need for an acid to be added since niacin sulphate is readily soluble in water. The acid reaction of the vitaminisation solution permits complete penetration of the vitamins throughout the grains and converts part of the starches present into starch esters and sugars.

It is of advantage to use as protective coating a mixture containing corn protein, such as zein, as a film-forming ingredient, abietic acid, to impart adhesiveness, and a higher fatty acid, such as palmitic acid or stearic acid, as a plasticising agent. This mixture is dissolved in an alcohol, such as ethanol or isopropanol, the latter being the preferred solvent since it does not have any dissolving action on the vitamins with which the grains have been treated. The protective coating does not interfere with the physiological availability of the vitamins in the enriched grains.

The protective coating is insoluble in cold water or slightly warm water as is normally employed in the washing operation. Furthermore, the coating is such that it does not flake off from the grain surfaces during mixing and shaking. At cooking temperature, the protective coating is removed. In particular, it has the following advantages:

In cold water (below 55°C.) it is insol-

[Price 2/-]

28 DEC

uble. It is removed by water above 70°C. It is not attacked by enzymatic action, does not become rancid, it is free from colour and odour, easily soluble in solvents in which the added vitamins are difficultly soluble, readily adheres to the grains, possesses plasticity even at temperatures of -10°C., and is non-sticky at temperatures up to 40°C.

The process for increasing the vitamin and mineral content of cereal grains may, for example, be carried out in a rotary drum used for mixing rice grains provided with rubber-coated mixing blades. The vitamin solution is added to the grains while stirring, suitably as a spray by means of a spraying apparatus. Thereupon pre-heated air is blown over the grains until they are thoroughly dry. A portion of the coating solution in an alcohol, such as ethanol or isopropanol, is then sprayed on to the grains. After thorough mixing during which the solvent is evaporated, a mineral agent such as iron pyrophosphate or ferrous sulphate in talc (to prevent lumping of the iron salt) may be applied to the coated grains. The remainder of the coating solution is then applied, and the coated grains may, if desired, be finally mixed with talc to effect smoothness and to prevent balling of the grains.

The following examples illustrate how the process of the invention may be carried into effect:

EXAMPLE 1.

An acidic solution of niacin and vitamin B_1 is prepared as follows: To 225 fluid oz. of distilled water there are added 134.5 oz. by weight of concentrated sulphuric acid and 282.2 oz. by weight of niacin in small portions. The mixture is stirred vigorously during the addition of the ingredients, the niacin being added in amounts of 16 oz. at a time. When the solution has become clear, there is rapidly added 1.375 kilograms of vitamin B_1. After clear solution is attained, 30.5 fluid oz. of a tackifier and drying retarder such as corn syrup, or fructose, dextrose, or sorbitol, are added. The tackifier and drying retarder assists in the adherence of the vitamins to the grain and prevents too rapid drying of the vitamin solution before it has penetrated the grains. While advantageous for this purpose, the tackifier and retarder may be omitted, if desired, and the rate of drying, after application of the vitamin solution, controlled so as to prevent too rapid drying.

The above solution is sprayed on to 2194 lbs. of polished, uncoated white rice with stirring in a trumbol (a rotary drum) for about 42 minutes. To dry the rice, warm air of about 60°C. is blown over the rice for about 1 hour while the latter is stirred.

The vitaminised rice is now mixed with 88 oz. by weight of talc until the talc is evenly distributed over the rice.

A coating is prepared as follows:

(a) To 98.7 oz. by weight of molten palmitic acid are added 381 oz. of abietic acid, and the mixture heated until the abietic acid is dissolved in the palmitic acid.

(b) 954.5 fluid oz. of isopropanol and 61 fluid oz. of tap water are mixed together and warmed to about 60°C. 324.5 oz. by weight of zein are added and stirred until dissolved.

Molten mixture (a) is then added slowly to solution (b) and the resulting solution is kept just below the boiling point while adding half its volume to the vitaminised rice, the rice being stirred during the addition. A finely powdered and thoroughly mixed mixture of 932 oz. by weight of iron pyrophosphate and 1322 oz. of talc which prevents the iron pyrophosphate from forming lumps is now added evenly to the rice while being mixed. As soon as the rice has become dry, which usually takes about one hour, the remainder of the coating solution is added to the rice while stirring. After about ten minutes, 2131 oz. of talc are added and the stirring of the rice is continued for about 15 minutes. The treated rice is dried for about 1½ hours and then screened. In this manner vitaminised rice premix is obtained which may be mixed with polished rice to form enriched rice. The premix rice is stable to storage and substantially retains the added vitamins on washing and cooking. One ounce of the rice premix is sufficient to enrich 199 oz. of dehulled rice.

EXAMPLE 2.

A vitamin solution containing the following ingredients is prepared in the same manner as in Example 1:

598 grams	Vitamin B_1
5880 grams	Niacin
2804 grams	Concentrated sulphuric acid
9171 c.c.	Water
756 c.c.	Corn syrup as a tackifier and retarder.

This solution is mixed with 310 lbs. of 40 mesh corn grits (i.e., grits which will pass through a screen of 40 meshes per sq. in.). The thus vitaminised corn grits are coated in three steps with a coating solution prepared in the same manner in Example 1, but containing the following proportions of ingredients:

333.5 oz.	Zein
240.0 oz.	Abietic acid
85 ⅛ oz.	Palmitic acid
57333 c.c.	Isopropanol
2225 c.c.	Water

While stirring the vitaminised rice, about 37.5 per cent. of the coating is

applied followed by a powder mixture of 47 lbs. of iron pyrophosphate and 32 lbs. of talc. After drying, another 37.5 per cent. of the coating is applied followed by 50 lbs. of talc. Then the remainder of the coating is applied followed by 12 lbs. of talc. The vitaminised and coated corn grits are screened. One ounce of this premix is sufficient to enrich 50 lbs. of ordinary corn grits by simply mixing it with the latter.

EXAMPLE 3.

A vitamin solution containing the following ingredients is prepared as in Example 1:

480.0	c.c.	Water
151	grams	Sulphuric acid
295.7	grams	Niacin
38.7	grams	Vitamin B_1
31	c.c.	Corn syrup as a tackifier and retarder.

The solution is mixed with 6000 grams of corn grits which will pass through a screen of 10 meshes per sq. in. but are retained by a screen of 40 meshes per sq. in. in a pony mixer (a mixing machine) equipped with rubber-coated blades. The grits are dried with warm air.

The coating solution containing the following ingredients is prepared in the same manner as in Example 1:

506	grams	Zein
371.7	grams	Abietic acid
132.5	grams	Palmitic acid
2875	c.c.	Isopropanol
90	c.c.	Water

25 per cent. of the above coating solution is added to the dried rice while mixing, followed by a powdered mixture of 1030 grams of iron pyrophosphate and 23.2 grams of vitamin B_2.

After drying for one hour, another 25 per cent. of the coating solution is added, followed by 500 grams of talcum. After drying for one hour another 25 per cent. of the solution followed by 500 grams of talcum are added. After drying for two hours, the last 25 per cent. of the coating solution is added. When the material has become nearly dry, 100 grams of talcum are added. Each ounce of the premix thus obtained will enrich 50 lbs. of ordinary corn grits. It is highly stable on storage and retains the added vitamins and mineral ingredients on washing.

It is to be understood that the above examples are illustrative and that the above-mentioned and other cereal grains may be enriched with other vitamins such as vitamin A, vitamin B_6 and pantothenic acid, and other minerals such as calcium salts can be added in the same manner. It is also to be understood that by the expression "grains" we include whole grains as well as granulations thereof such as grits.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A process for increasing the vitamin and mineral content of cereal grains, which consists in impregnating the cereal grains with a solution containing vitamins and mineral substances and coating the impregnated grains with an edible coating comprising a film-forming agent, an adhesive agent and a plasticiser, which coating is insoluble in cold water but removable in hot water.

2. A process as claimed in Claim 1, wherein a mineral acid solution of vitamins and mineral substances is used.

3. A process as claimed in Claim 1 or 2, wherein only a portion of the grains the vitamin and mineral content of which is to be raised is enriched, and wherein the said portion after treatment is mixed with the required quantity of non-treated grains.

4. A process as claimed in any one of the preceding claims wherein the film-forming agent is a corn protein such as zein.

5. A process as claimed in any one of the preceding claims wherein the adhesive agent is abietic acid.

6. A process as claimed in any one of the preceding claims wherein the plasticiser is a higher fatty acid such as palmitic acid or stearic acid.

7. A process for increasing the vitamin and mineral content of cereal grains, substantially as described with reference to the examples given.

8. Grain products when prepared by the process claimed in any one of the preceding claims.

Dated the 23rd day of April, 1948.

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applied followed by a powder mixture of 47 lbs. of iron pyrophosphate and 32 lbs. of talc. After drying, another 37.5 per cent. of the coating is applied followed by 50 lbs. of talc. Then the remainder of the coating is applied followed by 12 lbs. of talc. The vitaminised and coated corn grits are screened. One ounce of this premix is sufficient to enrich 50 lbs. of ordinary corn grits by simply mixing it with the latter.

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