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(54) IMPROVED PROCESS FOR PREPARING A SOYBEAN BEVERAGE

(71) I, KWEE-SEONG LO, a citizen of Hong Kong, of 52-54, Ho Yuen Road, Kwun Tong, Kowloon, Hong Kong, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the preparation of a soybean beverage, and more specifically, to a process for the preparation of a soybean beverage which is nutritious, refreshing and which may be bottled.

In U.S.P. 3,563,762, a soybean beverage is described which may be bottled and stored without the danger of spoilage. The product is highly nutritious, refreshing and of bland flavor, suitable for the incorporation of other flavors. The beverage of this patent is made from a full fat soybean powder of substantially the following composition:

Protein	45%
Fat	20%
Ash	5%
Fiber	3%
Other Carbohydrates	23%
Water	4%

The term "carbohydrates" refers to the carbohydrate components within the soybean itself, and not to the added carbohydrates.

For the preparation of the soybean powder, the process described in U.S.P. 3,563,762 consists of (1) cleaning the soybeans to remove dirt and foreign matter (2) heating or toasting at a temperature of about 300°C, (3) cooling abruptly to facilitate dehulling, (4) subjecting to compression to flake the material, (5) cooking with steam at about 100°C under pressure and subjecting the material to extrusion to obtain the soybean meat in the form of pellets, (6) toasting, to reduce the moisture content to about 4%, (1) cooling, and (8) grinding. The extrusion step in the process of the same patent has been found to be essential to give a full fat soy-

bean flour free of growth inhibitors and exhibiting a bland taste, suitable for the incorporation of a variety of flavoring agents.

For the preparation of a soybean beverage which contains all of the insoluble carbohydrates in the process described in the same United States patent, the full fat soybean powder is combined with stabilizing ingredients, flavoring agents, possibly other additives, water, and the mixture is heated and cooked. The solution is then subjected to homogenization at high pressures and the beverage is bottled and sterilized. The particle size of the material after homogenization is between 2 and 10 microns.

In some instances, a beverage is desired with a limited amount of insoluble carbohydrates, because this beverage is of low consistency and is more suitable for certain uses. For this purpose, the soybean flour in water is cooked, homogenized at high pressure, centrifuged, to remove about 15% of coarse particles, then combined with a small amount of stabilizing agents, for instance, carrageenin, in addition to water and other additives and again cooked. The material is then homogenized at low pressure, bottled and sterilized.

U.S.P. 3,563,762 also describes a third beverage which is free of all the insoluble carbohydrates. For the preparation of this beverage, the full fat soybean powder is mixed with water, homogenized, centrifuged to remove about 30% of the coarse particles, and the two steps of cooking and homogenization are repeated. The addition of a stabilizer is omitted. Finally, the product is bottled and sterilized.

The particle size of the solids in the beverage is within a range, up to 10 microns, that is, small enough to be kept in suspension. It should be noted that two homogenization steps are required in the process of U.S.P. 3,563,762, to obtain a beverage containing only partially or no insoluble carbohydrates.

The process of U.S.P. 3,563,762 produces a very satisfactory full fat soybean powder.

[Price 33p]

In the adaptation of the process, to large scale industrial production, however, it has been found that the extrusion step, which requires a complex apparatus, for instance the Wenger extruder, is expensive and substantially increases the overall cost of manufacture. The extrusion step on the one hand, is very advantageous because it removes the growth inhibitors and gives a product which is more bland in flavor and more digestible, but on the other hand, it has the disadvantage that the full fat soybean powder does not contain active enzymes, because the enzymes are deactivated under the extrusion conditions.

There has been a need of a full fat soybean powder which is essentially the same as the powder of U.S.P. 3,563,762, but which still contains active enzymes.

The present invention may provide soybean beverages which are suitable for bottling, refreshing and nutritious and which may be prepared by a simpler and less expensive process than the process of U.S.P. 3,563,762. The present invention may provide beverages of very bland flavor, suitable for the incorporation of other flavoring agents.

Figure 1 illustrates in flow sheet form the essential steps for the production of a full fat soybean powder, which still contains active enzymes, because it is not subjected to cooking. This powder is known as "full fat soy enzyme-active flour". The elimination of the growth inhibitors from the final beverages is achieved during the subsequent cooking and sterilization steps.

Figure 2 illustrates schematically the preparation of a beverage still containing all insoluble carbohydrates.

Figure 3 illustrates the process involved in the preparation of a beverage containing only a limited amount of the insoluble carbohydrates, as well as a beverage which is free of insoluble carbohydrates.

A variety of additives may be incorporated into the beverages produced by the process of this invention, such as sucrose, a vegetable oil, salt, sodium bicarbonate, vitamins. The taste of the full fat soy enzyme-active flour is blander than the powder prepared by the process of U.S.P. 3,563,762, and is even more suitable for the incorporation of flavoring agents.

By reference to Figure 1, the whole soybeans are cleaned at 10, then subjected to milling and scouring as indicated schematically by numerals 11 and 12, respectively. In this manner, the soybean cotyledons are separated from the hulls. In the next step, the material is flaked at 13 by compression. Finally, the material is ground and classified as indicated by numerals 14 and 15. The resulting powder is of particle size between 270 and 300 United States Standard mesh. The flour has the following composition:

Protein	42%	65
Fat	21%	
Ash	5%	
Fiber	3%	
Other Carbohydrates	24%	
Moisture	5%	70

The process described herein, for the preparation of the enzyme-active full fat soybean flour, is much simpler than the process of U.S.P. 3,563,762 because it involves only six steps. Moreover, it has now been found that the elimination of the growth inhibitors from the final beverages may be achieved, even if the extrusion step in the preparation of the full fat soybean powder is eliminated, because the growth inhibitors are destroyed in the cooking and sterilization steps used in the preparation of the soybean beverages.

Figure 2 illustrates the preparation of a beverage containing all the insoluble carbohydrates. The flour is subjected to soaking at 22, for about 30 minutes, at 70°F, under agitation, in water, in the ratio of about 1:8 by weight; then the flour is cooked, as shown by numeral 23 for about 30 minutes at the boiling point. After addition of flavoring agents and a stabilizer, the material is then subjected to high pressure homogenization as indicated by the numeral 24, and is finally bottled and sterilized.

For the preparation of the other two types of beverages, which contain only a limited amount of the insoluble carbohydrates or no insoluble carbohydrates, Figure 3 illustrates the sequence of steps. The flour is soaked in water in the ratio of about 1:8, by weight, for about 30 minutes, at 70°F, as shown by numeral 16. This temperature is the optimum in order to allow enzymatic reactions to occur and to achieve the maximum yield of proteins in the beverages. The material is subsequently cooked as indicated by numeral 17 for about 30 minutes at the boiling point. The cooking step is carried out to stop the enzymatic reactions and to evaporate volatile substances responsible for the somewhat bitter soybean flavor which some individuals find objectionable. Still another purpose of the cooking step is to inactivate the trypsin inhibitor and lipoxidase and to reduce the amount of bacteria prior to bottling and sterilization.

Numerals 18 designates the centrifugation which is carried out to remove a predetermined amount of the coarse material, that is, about 30% of the total weight of the flour, if a beverage containing no insoluble carbohydrates is desired, and about 15% of the total weight of the flour, if a beverage containing only a limited amount of the insoluble carbohydrates is to be prepared. In this manner, a beverage may be obtained in which good suspension of the solid particles in the liquid is achieved. After addition of the additives, mainly flavoring agent, vitamins, as

shown schematically by numeral 19, and if a beverage with a limited amount of the insoluble carbohydrates, also a small amount of carrageenin, the material is again cooked to about 205°F for a period of time of about 15 minutes and then homogenized. The homogenization is carried out at high pressure if a beverage with a limited amount of insoluble carbohydrates is desired, and at low pressure, if a beverage with no insoluble carbohydrates is desired. The material is finally bottled and sterilized. It should be noted that only one centrifugation and one homogenization are carried out and this represents a substantial saving over the process of U.S.P. 3,563,762.

The following examples illustrate the preparation of the full fat soy enzyme active flour and several soybean beverages:

EXAMPLE 1

The whole beans are cleaned to remove dirt, splits and other foreign matter. After cleaning, the beans are transferred by means of a wire screen conveyor to a roller mill where the beans are cracked and pressed. In this manner the hulls are loosened from the cotyledons of the beans. The dehulling step is carried out by conventional means, for instance, a scouring apparatus where the beans are agitated to permit aspiration of the hulls from the top of the unit while the heavier cotyledons fall to the bottom. The resulting dehulled soybeans are then fed to a compression apparatus, for instance, a hammer mill, where they are converted into flakes. The material is then ground to a fine powder by means, for instance, of a pin mill marketed under the Registered Trade Mark "Alpine" and classified in order to obtain a full fat soy enzyme-active flour of approximately 270—300 mesh.

The resulting flour is totally enzymic-active.

EXAMPLE 2

This example illustrates the preparation of a beverage which contains all of the insoluble carbohydrates and proteins. Sixty pounds of the flour prepared in Example 1 are soaked at 70°F in water, in a ratio of 1:8, by weight, of flour to water. After soaking for about 30 minutes, under agitation, the mixture is cooked by direct steam injection and maintained at about 210°F for 30 minutes. This cooking step is essential to soften the soybean flour and to remove the growth inhibitors.

After cooking, the ingredients shown in Table I hereinbelow are blended in:

TABLE I

	Sucrose	50 lb.
60	Carrageenin	0.49 lb.
	Refined vegetable oil	7.5 lb.
	Table salt	0.625 lb.

Sodium Bicarbonate	0.41 lb.	
Vitamin A		
(1.0 m.I.U./gm.)	5.81 gm.	65
Vitamin B1	1.31 gm.	
Vitamin B2	1.56 gm.	
Niacinamide	14.0 gm.	

The carrageenin is dispersed in a small amount of water prior to adding it to the mixture. After blending in all the ingredients the mixture is stirred and homogenized with a Manton-Gaulin homogenizer, at high pressure, about 8000 pounds per square inch. The resulting product is a homogenous aqueous suspension of proteins, fats and carbohydrates which has a particle size of about 2—10 microns. The liquid beverage is then bottled. Sterilization is carried out in conventional manner by sealing the bottles and heating at 250°F. for 15 minutes. After sterilization, the bottles are cooled gradually to about 140°F. with constant shaking in order to promote the gel formation of the carrageenin which contributes to achieving a permanent suspension.

The soybean beverage so obtained has the following composition:

Protein	2.5%	
Fat	2.0%	90
Ash	0.40%	
Fiber	0.2%	
Carbohydrate	1.4%	
Sucrose	5.0%	
Water	88.4%	95

EXAMPLE 3

This example illustrates the preparation of a beverage containing only a limited amount of the insoluble carbohydrates of the soybean. Sixty-five pounds of the full fat soy enzyme active flour of Example 1 are soaked with 100 imp. gallons of water at 70°F. with agitation for about 30 minutes. The mixture is cooked by direct steam injection under agitation to facilitate vigorous boiling. The cooking step is allowed to proceed for about 30 minutes. The product is then centrifuged to remove 15% of the total weight of the flour. A small amount, about 0.20 pound of carrageenin is added, together with 51 pounds of sucrose, 5.9 pounds of refined vegetable oil, 0.63 pounds of table salt, 0.41 pound of sodium bicarbonate, 1.31 gms. of Vitamin B1, 1.56 gms. of Vitamin B2, 5.81 gms. of Vitamin A and 14 gms. of Niacinamide. The product is again cooked to about 205°F for about 15 minutes, and then homogenized at high pressure, about 8000 pounds per square inch, to achieve a particle size of 2—10 microns. The resulting beverage, after bottling and sterilization, is a stable suspension with the solids of particle size between 2 and 10 microns. The composition is about:

	Protein	2.5%	Protein	42%	
	Fat	2.0%	Fat	21%	
	Sucrose	5.0%	Ash	5%	45
	Other Carbohydrates*	0.4%	Fiber	3%	
5	Ash	0.4%	Other Carbohydrates	24%	
	Water	89.7%	Moisture	5%	

* Carbohydrates from soybeans which are water soluble and dispersable.

EXAMPLE 4

10 This example illustrates the preparation of a beverage free of insoluble carbohydrates and which contains about 70% of the total weight of the enzyme-active flour. The following ingredients are used:

15	Water	100 imp. gal.
	Flour of Example 1	72 lb.
	Sucrose	51 lb.
	Refined Vegetable Oil	5.9 lb.
	Table Salt	0.63 lb.
20	Sodium Bicarbonate	0.41 lb.
	Vitamin B1	1.31 gm.
	Vitamin B2	1.56 gm.
	Vitamin A	5.81 gm.
	Niacinamide	14.0 gm.

25 The steps of soaking and cooking are carried out as in the previous examples. Centrifugation is carried out to remove about 30% of the total weight of the flour. The other steps of formulation and cooking are carried out as described in Example 3, except that homogenization is carried out at 2500 pounds per square inch. The resulting product is a stable homogeneous oil and solid suspension.

35 WHAT WE CLAIM IS:—

1. A process for the preparation of a soybean beverage comprising (1) dehulling the beans, compressing them into flakes and grinding the resulting product, thus obtaining a full fat soy enzyme-active flour, (2) soaking in water said full fat soy enzyme-active flour of approximate composition:

(3) cooking, (4) adding flavoring components and (5) homogenizing the product under pressure to reduce the size of the soybean particles to less than 10 microns. 50

2. The process according to claim 1 wherein the beverage still contains all of the insoluble carbohydrates of the soybean and homogenization is carried out at a pressure of about 8000 pounds per square inch. 55

3. The process according to claim 1 wherein the product after cooking is centrifuged to remove about 15% of the total weight of the flour and again cooked prior to said homogenization step. 60

4. The process according to claim 1 wherein the product after cooking is centrifuged to remove about 30% of total weight of the flour and again cooked prior to said homogenization step. 65

5. The process according to claim 2 wherein a stabilizer is added after the cooking step. 70

6. The process according to claim 3 wherein a stabilizer is added before the second cooking step.

7. A process according to anyone of the preceding claims wherein said flavoring components comprise sucrose, sodium bicarbonate, table salt and vegetable oil. 75

8. The process according to claim 7 wherein vitamins are added to the flavoring components. 80

9. A process for the preparation of a soybean beverage as claimed in claim 1, substantially as described in any of the examples 2 to 4.

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	Protein	2.5%
	Fat	2.0%
	Sucrose	5.0%
	Other Carbohydrates*	0.4%
5	Ash	0.4%
	Water	89.7%

	Protein	42%
	Fat	21%
	Ash	5%
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	Moisture	5%

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