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(57) Abstract

The present invention is a calcium and magnesium–based, chewy confectionery nougat formulation prepared by positively hydrating a mixture of components including a hydrobinding component and a saccharide–based material. The present invention also includes a new method of making a confectionery mass, such as a nougat, by hydrating sufficiently to form the mass without the need for cooking to drive off moisture.

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CALCIUM-BASED CHEWY NOUGAT FORMULATION WITH MAGNESIUM

This is a continuation-in-part of co-pending U.S. application Serial No. 08/881,853 filed June 24, 1997, which is a continuation-in-part of co-pending U. S. application Serial No. 08/773,025 filed December 24, 1996, which is a continuation-in-part of co-pending U.S. Application Serial No. 08/770,859, filed December 20, 1996, which is a continuation of U.S. Application Serial No. 08/455,936, filed May 31, 1995, now U.S. Patent 5,587,198.

Field of the Invention

The present invention relates to the art of unique delivery systems for comestibles, especially to novel methods of making a functionalized confectionery mass which do not require cooking to dehydrate and products therefrom. More particularly, the invention relates to comestible delivery systems, uncooked confectioneries and nougats, and methods for making same. The invention also provides a chewy confectionery nougat formulation containing bioassimilable sources of both calcium and magnesium.

Background of the Invention

It is generally considered a necessity in the art of preparing food or drug delivery systems like confectionery masses such as nougats to use water as a mixing medium and source of hydration for ingredients. Specifically with respect to nougats, a typical recipe calls for soaking egg albumen in water over a period of time, such as overnight, in order to fully hydrate the protein. Following hydration the egg albumen is stirred and strained before being beaten into a stiff foam. Other ingredients such as sugar, honey, and corn syrup are separately cooked with water to a relatively high cooking temperature of from about 135°C to about 138°C to achieve the necessary interaction among the ingredients. The cooked mixture is then poured into the egg and beaten with a nougat mixer. This

conventional nougat preparation method requires cooking the ingredients and using a significant amount of water to serve as a mixing medium and source of hydration.

The amount of water used is much larger than that which would permit the formation of the solid nougat. The water is supplied in more than sufficient quantity to ensure that specific ingredients are wetted and functionalized. Consequently, the excessive moisture must be driven off as much as possible to achieve the structural integrity and consistency necessary for the end product. Unless the water is forcibly removed, the process will result in an incoherent product having no significant structural integrity.

Removal of excess water is generally undertaken by a combination of mixing and boiling to drive off the moisture and bring the mass to proper viscosity and consistency. This process, however, can be highly energy-inefficient and very costly as it requires heat, excessive handling of nougat masses, flashing off of some critical fluids, and an inability to incorporate heat sensitive materials, as well as a less desirable overall stability of the product. Moreover, it is not effective in completely eliminating a substantial amount of the moisture contained in the confectionery mass.

One of the unwanted results of inefficient dehydration is that water remains as a separate phase in the end product. This water is not bound to other ingredients and can be referred to as free moisture or unbound water. Free moisture can detract from the end product because it weakens the structural integrity and/or reduces the quality of organoleptic perception. Moreover, excessive free moisture results in higher water activity, and thereby provides an environment in which microorganisms can grow. Microbiological growth in food products has also been used to measure the existence of free moisture.

Many food preservation processes attempt to eliminate microbial growth and spoilage by lowering the availability of water to microorganisms. Reducing the amount of free moisture or unbound water also minimizes other undesirable chemical changes which can occur in foods during storage. The processes used to reduce the amount of unbound water in foods include techniques such as concentration, dehydration, and freeze-drying. These processes require intensive expenditure of energy and are not cost efficient.

The present invention overcomes the difficulties set forth above as well as other difficulties generally associated with the prior art. In particular, both the necessity of cooking the confection and using excessive water to mix and hydrate one or more ingredients is eliminated, and the method and product of the invention are obtained without any need for dehydration. Consequently, the detrimental heat history generally associated with energy-intensive procedures is also eliminated. Separation of the water from the resulting product is avoided and the lowered water activity results in a product having superior physical, storage, and organoleptic properties with reduced microbial growth problems.

Finally, the present invention addresses the issue of producing a chewy nougat confectionery formulation containing calcium, and preferably also magnesium, which is palatable and storage stable, but which avoids the problems normally attendant in the production of these nutritional-type supplements.

Summary of the Invention

The present invention is a method of making a unique food and drug delivery system, and especially a novel confectionery delivery system, especially a nougat, via hydration, without the need for cooking or subsequent dehydrating in order to produce the confectionery mass. The present invention also includes the product resulting form the new method of preparation.

In one embodiment, a saccharide-based component is combined with a hydrated hydrobinding component to form the confectionery of the system.

In a more preferred embodiment, it is also contemplated that active ingredients can be included in the confectionery mass which is formed as a result of the present invention. The active ingredients are typically ones which are intended to produce a biological and/or chemical response in the body.

Especially preferred actives as part of the composition of the invention include bioassimilable sources of calcium, and particularly combinations of calcium and magnesium.

The product resulting from the present invention is unique because it requires no cooking and no dehydration by traditional heating at high temperatures to produce, and has substantially no phase separation of moisture. The only moisture present is bound

therein in an amount sufficient to functionalize the mass. Thus, the product can be prepared without cooking.

As herein further described, the product may also be prepared using flash-flow processing, low or high shear mixing, or any combination thereof. As a result of one or more of these methods, many of the attendant processing problems associated with either calcium or magnesium additives can be substantially reduced or eliminated.

The final product furthermore exhibits improved content uniformity and improved taste perception qualities. Overall, the formulated confectionery delivery system herein described is more palatable (no grit or chalkiness) than many of the current products available in the art.

Detailed Description of the Invention

The confectionery-mass delivery systems in accordance with the present invention includes a saccharide-based component and a hydrobinding component, the latter component being hydrated sufficiently to provide controlled water delivery to the saccharide-based component and/or other ingredients. Controlled water delivery means delivery of water in an amount and at a rate which is sufficient to provide internal viscosity and cohesivity to the saccharide-based component. The word hydrated as used in the term hydrated hydrobound component herein means containing sufficient water to provide the requisite controlled water delivery.

Furthermore, the system created by the combination of the present invention is a water-starved system, which means that the system has only enough moisture to bind the ingredients together and provide internal lubricity. Since the ingredients are competing for moisture due to enhanced wettability, there is virtually no free moisture available to separate from the mass, and thus no attendant problems associated therewith.

In the present invention, the hydrobinding component is used to provide a functionalized hydrobound confectionery mass. The hydrobinding component is thus an ingredient which imbibes, delivers and maintains water in an amount sufficient to functionalize the resulting mass. The water which is hydrobound does not separate and become a separate phase. A hydrobinding component cooperates with other ingredients to deliver and maintain water sufficient to functionalize the mass of ingredients (including those ingredients which have been subjected to flash-flow processing – e.g. the saccharide-based component, hereinafter described).

Ingredients useful in the present invention which make up the hydrobinding component include, for example, proteinaceous materials known to those skilled in the art, and preferably gelatins of various grades and types. Also preferred are food grade gums such as gum arabic, carrageenan, guar gum, and locust bean gum, and mixtures thereof. Hydrobinding components constituting a mixture of ingredients are desirable in some situations. Highly preferred hydrobinding ingredients include, for example, a mixture of gelatin and gum arabic, or a mixture of carrageenan and locust bean gum with a crosslinking agent, such as potassium citrate or potassium chloride, which induces crosslinking between these materials. These mixed hydrobinding materials are advantageous not only for their hydrobinding capacities, but also because they impart viscoelasticity to the resulting confectionery. It is possible that crosslinking in these materials contributes to their desirable physical properties. The hydrobinding material can also benefit from inclusion of a wetting agent or humectant such as a polyol known in the art, desirable glycerin, or other functionally similar materials which are commercially available.

The hydrobinding component will comprise about 0.5-20% of the confectionery system of the invention. Preferable, the hydrobinding component will be within the range of about 5-15%, and even more desirably within the range of about 5-10% of the final confectionery composition. Of the foregoing hydrobinding component, water will comprise about 30 – 80% thereof, and preferably about 40 – 70% of the hydrobinding component. The proteinaceous material or the gum, or combination thereof, will make up about 0.5 to 60% of the hydrobinding component, and more preferably be within the range of about 3 to 50%, more desirably about 5 to 20% (unless otherwise set forth, all %s herein are percentages by weight, or weight percent).

Another material which may be included as part of the hydrobinding component is a wetting or softening agent, such as a polyol, preferably glycerin, which may be included in amounts equal to about 0 – 15%, preferably about 0.1 – 10% of the composition of the invention, even more desirably about 5-10%. The glycerin (or other selected material) can also function as a humectant, and thereby keep moisture in the system.

The hydrobinding component may also be aerated, preferably in the presence of an aerating agent, before or after being combined with the other components making up the confectionery composition of the invention. Preferred aerating agents include egg

whites and soy protein. Aerating agents are desirably added in amounts within the range of about 0 - 5%, more desirably 0.1 – 3% of the confectionery mass of the invention.

It is also within the scope of the invention that ingredients which are used in the hydrobinding component may also be added as part of the saccharide-based component, hereinbelow described. Thus, in a somewhat less preferred embodiment, gelatins and food grade gums such as gum arabic, carrageenan, guar gum, locust bean gum, etc., can be used to prepare the saccharide-based component, e.g., by being included in the feedstock used to prepare that component.

The invention also employs a saccharide-based material as another major component (the hydrobinding material being the heretofore set forth first major component). The saccharide-based material can include any of a large variety of saccharide materials, such as small sugars, e.g., dextrose, sucrose, fructose, etc., and larger saccharides such as corn syrup solids and polydextrose, as well as mixtures of two or more of these materials.

Corn syrup solids are highly preferred for use as the saccharide-based material in the composition of the invention. Corn syrup solids are commonly known as maltodextrins. Maltodextrins are composed of water soluble glucose polymers obtained from the reaction of the starch with acid or enzymes in the presence of water.

Polydextrose is a non-sucrose, essentially non-nutritive, carbohydrate substitute. It can be prepared from polymerization of glucose in the presence of polycarboxylic acid catalysts and polyols. Generally, polydextrose is known to be commercially available in three forms: Polydextrose A and Polydextrose K, which are powdered solids, and Polydextrose N supplied as a 70% solution. Each of these products can also contain some low molecular weight components, such as glucose, sorbitol, and oligomers.

Sugars can also be used as saccharide-based materials according to the invention. Sugars are those substances which are based on simple crystalline mono- and di-saccharide structures, *i.e.*, based on C_5 (pentose) and C_6 (hexose) sugar structures. Sugars include dextrose, sucrose, fructose, lactose, maltose, etc., and sugar alcohols such as sorbitol, mannitol, maltitol, etc.

Typically, the foregoing saccharide-based component can comprise about 30 – 99.5% of the confectionery delivery system according to the embodiments herein set

forth. Preferably, there will be about 40 – 75% of this component present, and even more desirably about 50-70% present. In addition, those skilled in the art may discover a higher or lower percentage of the saccharide-based component, or other ingredients herein set forth, will produce a suitable final product, depending upon the final characteristics, *e.g.* texture, mouth feel, product consistency, etc., which are desired. A highly preferred saccharide-based material will comprise a mixture of corn syrup solids and sucrose in a ratio of approximately 50/50 or 40/60.

In addition to the heretofore described hydrobinding- and saccharide-based components, other materials may also be incorporated into the material of the invention, to enhance its appearance, taste, texture, and other perceptions of the consumer, and can include, for example, flavors, sweeteners, colorants, surfactants or emulsifiers, and fats or oils. Any one or a combination of more than one of the foregoing may comprise from about 0 – 20% of the confectionery mass, and more desirably be within the range of about 5 – 10% or even up to 15% of the comestible mass.

Flavors may be chosen from natural and synthetic flavoring liquids. An illustrative list of such agents includes volatile oils, synthetic flavor oils, flavoring aromatics, oils, liquids, oleoresins or extracts derived from plants, leaves, flowers, fruits, stems and combination thereof available to the skilled artisan.

Other flavorings may include whole and partial fruits and nuts, peanut butter, candy bits, chocolate chips, bran flakes, etc.

Sweeteners may be added to the confectionery system of the invention. These may be chosen from the following non-limiting list: glucose (corn syrup), dextrose, invert sugar, fructose, and mixtures thereof (in addition to those which may be utilized as part of the saccharide-based component), saccharin and its various salts such as the sodium salt; dipeptide sweeteners such as aspartame; dihydrochalcone compounds, glycyrrhizin; Stevia Rebaudiana (Stevioside); chloro derivatives of sucrose such as sucralose; sugar alcohols such as sorbitol, mannitol, xylitol, and the like. Also contemplated are hydrogenated starch hydrolysates and the synthetic sweetener 3,6-dihydro-6-methyl-1-1-1,2,3-oxathiazin- 4-one-2,2-dioxide, particularly the potassium salt (acesulfame-K), and sodium and calcium salts thereof. Other sweeteners may also be used. The sweeteners are added in amounts equal to about 0 – 10% of the composition, and preferably about 0.1 – 5%.

Surfactants or emulsifiers may also be included in the composition of the invention. These may be any food grade emulsifying material, for example, lecithin or other phospholipid material, monoglycerides and/or diglycerides, and mixtures thereof in amounts of from about 0 – 3%, more desirably about 0.1 – 1%.

Fats may also be included in the composition, and these can include partially or entirely unsaturated fats such as palm oil and cocoa butter. Hard fats having melting points above body temperature (37 degrees C), and soft fats having a melting point of about or below body temperature, can be used alone or in combination. The texture and mouth feel of the resulting confection can be influenced by selecting the types and amounts of fats included in the saccharide-based component. Fats marketed under such trade names a Durem and Paramount have been found to be useful. Those skilled in the art will find that fats are optional as part of the composition of the invention, and may be eliminated altogether if so desired. Thus, fats will comprise about 0 – 10% of the product herein set forth, preferably less than about 7%, and even more preferably less than about 5%.

Additional materials which can be incorporated into the confectionery composition include, for example, biologically and chemically active ingredients such as medicinal substances, e.g. drugs, pharmaceuticals and antacids. These are referred to herein as active ingredients. Active ingredients may make up from about 0-5% of the product of the invention, and even more depending upon the needs and abilities of those skilled in the art. It is preferred, however, to include up to about 40% of active substance in the compositions set forth herein.

As active ingredients, the aforecited U.S. Patent No. 5,587,198 contains a non-exhaustive listing of active substances, the salient portion of which is incorporated herein by reference.

Calcium supplement products can be prepared by incorporation of a bioassimilable calcium source as an active ingredient in the comestible delivery system confectionery of the invention. Preferably, the calcium source is calcium carbonate, but other sources of calcium capable of absorption or bioassimilation can be employed, including finely divided bone meal, egg shell or oyster shell materials and the like, as well as calcium derived from milk solids. The calcium-containing material is preferably

very finely divided so as not to impart any unnecessary chalkiness or other unpalatable characteristic to the confection. Finely ground calcium materials are commercially available, e.g., from Specialty Minerals or Omya, for use either in antacid products or calcium supplement products. In one preferred embodiment of the invention, a calcium supplement product is prepared which incorporates about 500 mg. of bioassimable calcium, along with about 200 I.U.'s of vitamin D3 into a single dosage form of the final product, which represents 50% of the RDA of those nutrients. Another preferred embodiment will include about 1200 mg. of bioassimable calcium and about 400 I.U.'s of vitamin D3.

In an especially preferred embodiment of the invention, a calcium source may be combined with a magnesium source to yield a mineral supplement "active" included in various embodiments of the chewy nougat formulation. Magnesium has been recognized as an essential element which aids in metabolism. Magnesium also aids in the absorption of calcium, and is therefore highly desirable as an additional component of a chewable calcium supplement formulation. Any bioassimilable magnesium source may be utilized. Non-limiting examples include those selected from the group consisting of magnesiums oxide, hydroxide, phosphate, carbonate and lactate, for example. Of these, magnesiums oxide, carbonate and lactate are more preferred. Magnesium lactate is desirable because it is highly stable for extended periods, and its inclusion in a chewy supplement imparts very little or and color, flavor, sweetness or textural off-notes thereto. These attributes may be particularly important from a commercial point of view.

An especially preferred dietary supplement therefore includes about 500 mg. of bioassimable calcium, about 40mg. magnesium, and about 200 I.U.'s of Vitamin D3 into a single dosage form. This represents 50% of the RDA for these nutrients. More or less of the foregoing nutrients may be added, depending upon the particular needs of the skilled artisan. For example, a proportional scale-up or down of the foregoing substituents could be utilized to yield a formulation having, for example, 75%, 100% or even 25% of the foregoing nutrients.

It is certainly within the scope of the invention to include in a chewy nougat dietary supplement from about 0 - 40% of a calcium source, about 0 - 5% of Vitamin D3 and about 0 - 50% of a magnesium source. More preferably, about 10 - 40% of a calcium

source, about 1 – 5% of Vitamin D3, and about 1 – 20% of a magnesium source may be included in the chewy nougat dietary supplement.

The products according to the various embodiments of the invention are tasty and sweet chewy nougat confectioneries, with a smooth texture and consistency, with no grit or chalkiness. These products are well hydrated, and yet evidence no phase separation of moisture upon extended periods of storage.

One of the advantages of the present invention is that a large proportion of the product can be displaced by a bulky material such as calcium and magnesium sources. For example, as alluded to above, up to about 25-35% or in some embodiments, up to about 40% or even up to about 50% or more of the total weight of the resulting product can be an added bioassimilable calcium source (or more desirably calcium with magnesium, etc.) without imparting undesirable taste or texture to the product. In fact, the product according to several embodiments of the invention exhibits improved taste and texture characteristics as compared with similar commercially-available products. "Improved" means that individual consumers rate the product overall to be superior when such characteristics as firmness, flavor, bite, sweetness, chewiness, melt characteristics, stickiness, juiciness, freedom from grit, and aftertaste are analyzed.

Other bulky materials can also be included as "actives", i.e. active ingredients, in the confectionery composition of the invention. These can include such food material as fiber and other vegetable and fruit materials. Of course, useful comestible delivery systems can also be produced wherein as little as only a trace amount of the total weight of the product is a deliverable active ingredient.

The products resulting from the present invention are unique, in part because they require no dehydration to produce, i.e., the product can be prepared without cooking. Moreover, there is substantially no separation of moisture in the resulting product. The only moisture present is supplied by the hydrated hydrobinding component an amount sufficient to functionalize the mass. No excess water is thus present, and thus the final product of the invention is stabilized with regard to nutritional content, microbial growth, organoleptic characteristics and other factors.

In the present invention water activity is significantly lower than water activity of similar products found in the candy bar industry. For example, candy bars usually have a water activity of 62% - 68% equilibrium relative humidity (ERH). The confectionery

product of the invention, however, has at most only about 60% ERH, and is preferably not greater than about 55% ERH.

Another measure of free water in foodstuffs can be provided by the amount of biological growth within the composition. In the present invention, the biological activity is less than about 100 ppm, preferably less than about 25 ppm, and most preferably less than 10 ppm.

It is a further aspect of the invention that at least some of the confectionery compositions according to the various embodiments set forth above be advantageously provided in the form of a shearform matrix, as that term is defined hereunder, as shearform matrix materials can exhibit significantly enhanced wettability because of a randomized structure resulting from flash-flow processing or high or low shear mixing, hereinafter described.

Shearform matrix refers to the product prepared by the method of flash-flow processing, a method which mixes and conditions ingredients for intimate contacting and enhanced hydration described, for example, in U.S. Patent No. 5,587,198. The term flash-flow has become recognized in the art as referring to a process which uses conditions of temperature and force to transform a solid feedstock having a certain morphological and/or chemical structure into a new solid having a different morphological and./or chemical structure without subjecting the solids to excessive heat or other requirements inherent in extrusion processing. The resultant structure has now been referred to as a "shearform matrix." The terms flash-flow and shearform matrix are further described and set forth in commonly-owned U.S. Patent Nos., 5,236,734, 5,238,696, 5,518,730, 5,387,431, 5,429,836, 5,582,855.

Flash-flow processing can be advantageous in the present invention since it is useful for preparing ingredients to be easily and quickly mixed and hydrated. Another very important result of flash-flow processing is intimate mixing of the ingredients. Intimate mixing has traditionally been achieved by the use of water as a mixing medium. Flash-flow processing, however, intimately contacts ingredients and randomizes ingredient location and structure of the resulting shearform matrix. Randomizing the structure can be thought of as opening the physical and/or chemical structure for hydration. Thus, flash-flow processing not only ensures intimate mixing of ingredients

without the use of water as a medium, but also conditions the ingredients for subsequent wetting with a minimum of water.

Flash-flow processing can be accomplished either by a flash-heat method or via the somewhat less preferred flash-shear method, as described further herein. In the flash-heat process, the feedstock is heated sufficiently to create an internal flow condition, which permits internal movement of the feedstock at a subparticle level, and to exit openings provided in the perimeter of a spinning head. The centrifugal force created in the spinning head flings the flowing feedstock material outwardly from the head so that it reforms with a changed structure, i.e. a shearform matrix. The force necessary to separate and discharge flowable feedstock is provided by centrifugal force and the force of the ambient atmosphere impinging on feedstock exiting the spinning head.

One apparatus for implementing a flash-heat process is a cotton candy fabricating type machine, such as the Eocene-floss model 3017 manufactured by Gold Medal Products company of Cincinnati, Ohio. Other apparatus which provides similar forces and temperature gradient conditions substantially equivalent to flash-heat can also be used.

In particular, a spinning machine developed by Fuisz Technologies Ltd. of Chantilly, VA and patented under U.S. Patent No. 5,458,823 may be especially preferred for the flash-heat process. This patent describes a spinning machine which has a series of elongated heating elements arranged in between a base and a cover. The heating elements, base and cover together define a chamber into which a non-solubilized feedstock material is inserted which is capable of intraparticle flow upon application of heat and force. Means are provided for individually heating each of the elongated heating elements, and restriction means in the form of a cylindrical shell or annular plate which circumscribes the heating elements permits restrictive flow of the processed feedstock which is expelled from the chamber.

In the flash-shear process, a shearform matrix is produced by raising the temperature of the feedstock, which includes a non-solubilized carrier such as a saccharide material, until the carrier undergoes internal flow upon application of a fluid shear force. The feedstock is advanced and ejected while in internal flow condition, and subjected to disruptive fluid shear force to form multiple parts or masses which have a morhpology different from that of the original feedstock.

The flash-shear process can be carried out in an apparatus which has means for increasing the temperature of a non-solubilized feedstock and means for simultaneously advancing it for ejection. A multiple heating zone twin screw extruder can be used for increasing the temperature of the non-solubilized feedstock. A second element of the apparatus is an ejector which reduces the feedstock to a condition for shearing. The ejector is in fluid communication with the means for increasing the temperature and is arranged at a point to receive the feedstock while it is in internal flow condition. The flash-shear process and apparatus are described in U.S. Patent No. 5,380,473, which is incorporated herein by reference. Of the flash-heat and flash-shear processes herein described, flash-heat appears to be much more readily adaptable to the process of the invention. However, those skilled in the art may find that flash-shear methodology can be adjusted to their particular needs.

Thus, one or more components of the composition of the invention may be advantageously processed using flash-flow procedures, e.g. flash-heat or flash-shear. Particularly well adapted for flash-flow processing is the saccharide-based component of the invention. Maltodextrin, for example, may be utilized as the feedstock to process through the flash-flow apparatus. The saccharide-based component can also serve as a "carrier" material for piggybacking some of the other constituents which may also be flash-flow processed with the saccharide-based component, e.g. one or more of the emulsifiers, oils, fats, flavorings, and sweeteners etc., as well as one or more of the active materials. As a result of being flash-flow processed, the saccharide-based component and any optional ingredients are provided in the form of a shearform matrix, as set forth above.

One embodiment of the present invention may also include pre-flash-flow processing of certain ingredients. Pre-flash-flow processing is simply flash-flow processing of one or more ingredients before combining these with either the saccharide-based component or the hydrobinding component for additional flash-flow processing or additional admixing. Flash-flow processing results in creased surface area and increased solubility of the ingredients subjected thereto, and contributes to actual binding of the ingredients to each other, and therefore, preliminary or pre-flash-flow processing may particularly advantageous to the skill artisan.

For example, in one embodiment of the invention, it may be especially desirable to pre-flash-flow the magnesium component as part of the calcium/magnesium active ingredient of the calcium-based chewy confectionery nougat formulation of the invention. Attendant problems associated with using magnesium as an additive are in this way largely avoided. Because the magnesium is "bound up" or encapsulated as a result of pre-flash-flow, it is far less likely to subsequently interact with any moisture or humidity, light or heat, however small these quantities may be. A preferred pre-flash-flow magnesium formulation may comprise from about 0.1 – 50%, more preferably about 15 – 40% of magnesium from whatever source; together with about 5 – 95%, more preferably about 25 – 75% saccharide material; along with 0 - 15% of one or more optional materials such as emulsifiers, fats, oils. Especially desirable is about 20 – 30% magnesium source, about 35 – 70% saccharide material, and about 0 – 10% optional materials. Once this material is pre-flash-flow processed, it will constitute the active ingredient (together with the calcium source) and is further mixed with the saccharide-based component for further flash-flow processing or shear-mixing (because the encapsulated magnesium contains saccharide material, the amount in the actual saccharide-based component of the final formulation may be proportionately reduced). Magnesium oxide is well adapted to pre-flash-flow processing because it is a strong oxidizing agent, and will react with a minimum of water, air or light, and thereby may alter the organoleptic properties of the final chewy nougat formulation. Other magnesium sources which may also be processed in this manner include magnesiums carbonate, phosphate and lactate. Any other sources of magnesium are also contemplated by the foregoing method, depending upon the needs of the technician and the attributes one desires in the final product.

Another means for processing the components making up the compositions of the invention is via low and high shear mixing processes. In some instances, the added time and expense associated with flash-flow processing (or pre-flash-flow processing) may be avoided. The same qualities associated with the final product (e.g. shear-form matrix attributes, intimate mixing, no cooking) can be attained through the use of the shear mixing methods as would be attained through the use of flash-flow processing.

As that term is used herein, "high shear mixing" refers to relatively intensive mixing action concentrated in a localized area. The high speed impact of mixing

mechanisms such as blades or choppers results in shearing action. This in turn creates localized high shear force and a fluidizing effect at the point of contact, which causes particular scale diffusion and disagglomeration and faster mixing in a relatively small area of the entire mixing volume, i.e. the formation of a localized shearform matrix. High shear mixing may also result in increased temperature at the point of impact of the shearing apparatus with the mix, thereby further contributing to the effective mixing action.

High shear mixing should be contrasted with low shear mixing in which the main action of mixing is due to the relative motion of a much larger volume of mix being circulated by the spinning or churning action of a lower impact type mechanism, such as a paddle-blade typically found in a Sigma or Hobart mixer. Whenever high or low shear mixing is utilized to produce the functionalized confectionery mass of the present invention, the resultant product can be referred to as both uncooked (in the sense that excessive heat is no utilized) and unspun (in the sense that a flash-flow apparatus is not utilized).

Thus, any number of the components comprising the composition of the invention may be mixed together through the use of high or low shear mixing, as well as flash-flow processing, as well as any combination thereof. For example, as heretofore noted, it may be particularly preferred to flash-flow process the saccharide-based component along with certain of the above-cited adjunct ingredients, including any active material(s). (As also previously noted, it may also be desirable to pre-flash-flow process one or more of the actives before further flash-flow processing with the saccharide material). The materials making up the hydrobinding component such as the cited gums, gelatin and glycerine can then be combined and hydrated, for example, using high or low shear mixing. The final composition can then be formed by combining all the aforementioned components, again by utilizing either high or low shear mixing, preferably high shear mixing. Upon combining the hydrated hydrobinding component, the saccharide-based component, the other ingredients, and any actives, moisture is readily imbibed and disseminated throughout the non-hydrated components and/or ingredients. Again, unlike prior art methods and confectionery compositions, additional moisture is not required to form a

hydrated mixture. Thus, excess water is not present in the resulting mass, and no cooking or heating is then required to drive off this excess moisture.

In still another embodiment of the invention, it may be desirable to process all materials using high shear mixing. For example, the saccharide-based component, optional ingredients, and any actives may be admixed using high shear. The ingredients constituting the hydrobinding component may also be processed using high shear. The final formulation can be achieved by then submitting all components to high shear mixing. Alternative, it is also contemplated to process all components using low shear mixing.

An especially preferred high-shear mixer for use with the invention is known as a Littleford FKM 1200. This device provides high shear mixing by proximal shearing blades which are at right angles to one another. The shearing blades consist of "plowers" and choppers, both of which are utilized for high shear mixing action. While not wishing to be bound by any particular theory, it is believed that high shear action provides both mixing and heating at the localized points of blade contact with the mix ingredients, thereby resulting in excellent dispersibility without the undesired effects of lumping etc. Other high shear mixers (with one or more mixing blades), currently available or yet to be developed, are also contemplated by the method of the invention.

If desired, the high shear mixer can be further equipped with a jacket heater to provide the benefits of additional warming. A preferred temperature range is from about 30 degrees C to about 60 degrees C, more desirably within the range of about 30 degrees to about 45 degrees C.

A preferred procedure for high shear mixing is as follows: The jacket heater on the high shear mixer is first activated and allowed to warm to a temperature of about 40 degrees C. Next, the saccharide-based component and other dry ingredients, e.g. calcium and/or magnesium source, may be fed through the open hopper and allowed to mix using the plowers (the magnesium may be provided as a dry encapsulation as a result of flash-flow processing). For an 18 pound mixture, for example, the device is first run for about 2 minutes. Any added fat, along with emulsifiers, and the liquid-based hydrobinding component (which has been previously prepared using low shear mixing), together with

any flavorings, sweeteners and coloring, are then fed into the mixer, and the choppers or high shear blades are activated to further complete the mixing. During this time, the jacket temperature may be increased to within the range of about 50-60 degrees C, preferably about 58-60 degrees to assist in the mixing, especially if fat is present in the mixture. The mixer is then run for about 5-10 minutes more, perhaps longer, to complete the mixing of the saccharide-based component and the hydrobinding component. Once mixing is complete, the entire matrix is then emptied into an appropriate container for slicing, sorting, packaging and shipping etc., e.g. is extruded and cut into dosage size pieces.

In certain instances, the use of a low shear mixing apparatus can also provide the product of the invention. Of these, a Sigma mixer and/or Hobart industrial paddle mixer may be suitable. In one preferred embodiment, the dry ingredients (saccharide-based component and any additional materials) are mixed in a Sigma mixer until a good consistency is obtained. Separately, the liquid ingredients (hydrobinding components) are mixed and allowed to hydrate in a Hobart mixer, and then added to the Sigma mixer with the dry ingredients. The whole mixture is then run in the Sigma mixer for about 3 minutes. Variations of the foregoing process are certainly within the scope of the invention, depending upon the characteristics of the individual ingredients, and the attributes desired within the final product.

Another method of formulating the product of the invention may comprise the utilization of both high- and low-shear mixing apparatus set forth above, depending upon the needs of the skilled artisan.

EXAMPLES-

For a better understanding of the present invention, together with other and further objects, the following examples and tables are provided to illustrate the unique methods of making confectionery mass and products resulting therefrom. These examples should not be construed as limiting the scope of the invention. Unless otherwise specified, percentages of components in the compositions are given as percentage by weight (wt%). Also, unless otherwise indicated, all materials were obtained from commercial suppliers.

EXAMPLE 1

A series of confectionery-type masses was prepared according to the invention for the delivery of a bioassimilable calcium source, in this case powdered calcium carbonate. The hydrobinding material was selected to be a mixture of medium weight gelatin (250 Bloom) and gum arabic. The saccharide-based material was selected to be sucrose (6X) or a mixture of sucrose and corn syrup solids. The components and the preparation conditions for these batches are given below in Table 1.

In this series of batches, the gelatin and gum arabic were premixed with glycerin using low shear mixing methods. Then a controlled amount of water was added thereto, along with flavoring and color. The calcium carbonate and the saccharide-based material (corn syrup solids and sucrose) were added to a Littleford FKM-1200 high shear mixer. The mixer was then operated for 2 minutes using the plowers only. The premixed fat/emulsifier/sorbitan mixture was added to the mixer. The hydrobinding material above (gelatin et al.) was also added., and the resulting mass was mixed with the FKM-1200 high shear mixer for approximately 5-10 minutes.

TABLE 1

MATERIAL (wt%)	BATCH 1A	BATCH 1B	BATCH 1C	BATCH 1D	BATCH 1E
Gelatin	1-5%	------>	------>	------>	------>
Gum Arabic	0.1-1%	------>	------>	------>	------>
Flavoring	0.1-1%	------>	------>	------>	------>
Water	5-10%	------>	------>	------>	------>
Glycerin (99%)	0.1-3%	------>	------>	------>	------>
Color	0.1-0.5%	------>	------>	------>	------>
Calcium Carbonate	28.57%	------>	------>	------>	------>
Sugar 6X	25-40%	25-40	60-70	25-40	25-40
Corn Syrup Solids	25-40%	25-40	---	25-40	25-40
Fat Solids	3-10%	------>	------>	------>	------>
Lecithin	0.1-1%	------>	------>	------>	------>
Sorbitan	0.1-1%	------>	------>	------>	------>
Kettle Temp	43°C	40°C	40°C	35°0	40°C
Dry Powder Temp	39°C	36°C	40°C	32°C	40°C
Fat System Temp	74°C	55°C	54°C	56°C	86°C
Binder Temp	45°C	44°C	44°C	45°C	48°C
Final Product Temp	39°C	50°C	40°C	42°C	43°C
Mixing Time (Min)	5	5	5	5	5
Mixing Speed (%)	40	40	40	60	60

All of these batches yielded products which were extruded and cut into pieces calculated to deliver about 500 mg of bioassimilable calcium. The products varied in the degree of tackiness to touch, but all were chewy, with more than acceptable mouthfeel with at most only a minor amount of chalky texture on chewing. Thus, a nougat product quite acceptable to consumers is produced 1) without driving off excess water, and 2) without cooking the material.

EXAMPLE 2

A nougat composition was prepared without cooking or removal of water. The ingredients set forth in Table 2-A were mixed using the aforementioned Littleford high shear mixer for 5 min at 40-50 cycles/min.

TABLE 2-A

Ingredient	Percent of Composition
Calcium Carbonate	28.75 wt%
Powdered Sugar	30-40 wt%
Corn Syrup Solids, DE 36	30-40 wt%
Fat Solids	3-8 wt%
Emulsifiers	0.1-1 wt%
TOTAL	100 wt%

This mixed composition was then mixed with colors and flavors in a Sigma mixer, again for 5 min at 40-50 cycles/min.

In a separate vessel, glycerin and a vegetable gum were mixed and low shear-stirred to smoothness. Water was added, and again the mixture was stirred to smoothness. Gelatin was then added along with flavoring and coloring, and the mixture was low shear-stirred again for about 1 minute to thicken. This mixture was then warmed to about 50°C for about 15-20 minutes. The warmed mixture was added to the primary mixture, and stirred with the Sigma mixer for about 5 min at 40-50 cycles/min. The final product is present in Table 2-B.

TABLE 2-B	
Ingredient	**Percent of Composition**
Primary Mixture	80-90 wt%
Flavoring	0.1-1 wt%
Coloring	0.1-1 wt%
Glycerin	0.5-3 wt%
Vegetable Gum	01.1 wt%
Water	5-10 wt%
Gelatin	1-5 wt%
TOTAL	100 wt%

The resulting mass was removed from the mixer, and rolled to the desired thickness, e.g. about 3 cm. This product was completely homogeneous, and had a chewy texture.

EXAMPLE 3

Another chewy nougat product was made using the same materials and proportions described in Example 1, except that the components described there as being part of the saccharide-based component were processed together using flash-flow processing to provide a shearform matrix. This shearform matrix was then added to the coloring and flavoring, and used as described. Again, the resulting product was homogenous, chewy in texture, and flavorful.

EXAMPLE 4

The primary mixture prepared according to the method described in Example 1 was used to make a gelatin-free confection product suitable for use as a calcium supplement. The primary mixture, together with flavorant, colorant, and an artificial sweetener, was mixed together in a kettle for 5 min. Potassium citrate was then dissolved in water with warming to – 85 degrees C. The hot solution was immediately added to a mixture of locust bean gum, carrageenan, and glycerin in a beaker and mixed, to provide a warm paste. This paste was then added to the pre-mixed primary mixture, and mixed for about 5 min. The final temperature of the resulting nougat was –50 degrees C. The amounts of the ingredients in this chewy nougat confection are given in Table 3.

TABLE 3

Ingredient	Percent of Composition
Primary Mixture	85-95 wt%
Flavoring	1-3 wt%
Coloring	0.001 wt%
Aspartame	0.009 wt%
Locust Bean Gum	0.1-1 wt%
Carrageenan	0.1.1 wt%
Glycerin	2-7 wt%
Potassium Citrate	0.1-1 wt%
Potable Water	2-7 wt%
TOTAL	100 wt%

This pleasant-tasting and chewy gelatin-free nougat material was cut into approximately 5.3 g pieces, each of which provided 500 mg of calcium.

EXAMPLE 5

An additional chewy nougat product was made according to the method set forth in Example 1 which delivered 500 mg of calcium and 200 I.U.'s of vitamin D3 in chocolate, mint and cherry flavors in a 5.3 gram piece according toTable 4 below:

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TABLE 4

Ingredient	Percent of Composition
Calcium Carbonate	23.7%
Corn Syrup Solids	18.1-27.1%
6X Powered Sugar	26.6-35.6%
Additional Corn Syrup Solids	2.6-3.0%
Fat Solids (Paramount B)	5.9%
Lecithin 3F UB	0.35%
Emulsifier (DurEm 117)	0.25%
Sorbitan Stearate (Sorbitan 60K)	0.25%
Vitamin D3*	2%
Glycerin	3.0%
Gum Arabic	0.4%
Gelatin (250 Bloom)	1.5-1.8%
Water	6-7%
Flavoring**	0.64-1.2%
Coloring	0.01%
Acesulfame K (Hoechst)	0.10%

*Vitamin D3 was dissolved in a small amount of corn syrup and added with the liquid components.

**Flavorings included the following: Peppermint, Spearmint, Vanilla, Cream, Chocolate, Cocoa Powder and Cherry.

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CONSUMER TASTE PREFERENCES

A mint-flavored chewy nougat formulation according to the foregoing embodiment was compared with three leading commercially-available (store bought) calcium supplement preparations in a random taste test. 100 consumers between the ages of 30-70 were chosen to participate and evaluate a total of four products according to the following criteria on a scale of 1-9: bite, firmness, flavor, sweetness, chewiness, melt, stickiness, juiciness, grit, aftertaste and coolness (the higher the score, the more positively the consumer judged each attribute). Each consumer was given an identical bite-size serving of each one of the four products in the same order (with crackers and a sip of water in between each serving). Consumers were not told the source or identify of the products they were evaluating, other than that each was a calcium supplement. Results are indicated below:

PRODUCT	PRODUCT A	PRODUCT B	PRODUCT C	INVENTION
BITE	5.95	3.78	4.11	6.49
FIRM	6.11	4.24	4.49	6.43
FLAVOR	5.65	4.43	4.81	6.57
SWEET	5.89	4.65	5.49	6.35
CHEW	6.41	3.78	4.00	5.81
MELT	5.62	4.65	4.43	5.86
STICK	5.22	4.95	4.81	4.81
JUICINESS	5.19	4.57	4.35	5.81
GRIT	6.27	3.59	3.22	5.84

PRODUCT	AFTERTASTE	COOLNESS
Product A	6.49	6.38
Product B	4.89	4.97
Product C	4.92	5.78
Invention	6.41	6.46

EXAMPLE 6

An additional chewy nougat product was made according to the method set forth in Example 1 which delivered 500 mg of calcium, 40 mg of magnesium and 200 I.U's of vitamin D3 in a cherry flavor in a 5.3 gram piece according to Table 5 below:

TABLE 5

Ingredient	Percent of Composition
Calcium Carbonate	23.7%
Magnesium Carbonate	2.9%
Corn Syrup Solids	18.1-27.1%
6X Powered Sugar	26.6-35.6%
Additional Corn Syrup Solids	2.6-3.0%
Fat Solids (Paramount B)	5.9%
Lecithin 3F UB	0.35%
Emulsifier (DurEm 117)	0.25%
Sorbitan Stearate (Sorbitan 60K)	0.25%
Vitamin D3*	2%
Glycerin	3.0%
Gum Arabic	0.4%
Gelatin (250 Bloom)	1.5-1.8%
Water	6-7%
Flavoring**	0.64-1.2%
Coloring	0.01%
Acesulfame K (Hoechst)	0.10%

*Vitamin D3 was dissolved in a small amount of corn syrup and added with the liquid components.

**Flavorings included the following: Vanilla and Cherry Flavors from various commercial sources.

EXAMPLE 7

A further chewy nougat confectionery product was made according to the method set forth in Example 1 which delivered 500 mg of calcium, 40 mg of magnesium and 200 I..U.'s of vitamin D3 in a cherry flavor in a 5.3 gram piece according to Table 6 below:

TABLE 6

Ingredient	Percent of Composition
Calcium Carbonate	24.5%
Magnesium Lactate	9.6%
Corn Syrup Solids	18.1-27.1%
6X Powered Sugar	26.6-35.6%
Additional Corn Syrup Solids	2.6-3.0%
Fat Solids (Paramount B)	4.9%
Lecithin 3F UB	0.30%
Emulsifier (DurEm 117)	0.20%
Sorbitan Stearate (Sorbitan 60K)	0.20%
Vitamin D3*	0.05%
Glycerin	3.0%
Gum Arabic	0.4%
Gelatin (250 Bloom)	1.5-1.8%
Water	6-7%
Flavoring**	0.64-1.2%
Coloring	0.04%
Acesulfame K (Hoechst)	0.10%

*Vitamin D3 was dissolved in a small amount of corn syrup and added with the liquid components.

**Flavorings included the following: Vanilla and Cherry Flavors from various commercial sources.

In both Examples 6 and 7, the calcium-magnesium chewy nougat confectioneries had a smooth consistency, and were very tasty, with a pronounced cherry flavor.

Thus, while there have been described what are primarily believed to be the preferred embodiments, those skilled in the art will appreciate that other and further changes and modifications can be made without departing from the true spirit of the invention, and it is intended to include all such changes and modifications within the scope of the claims which are appended hereto.

WE CLAIM:

1. A method of making a calcium and magnesium based, chewy nougat confectionery formulation, comprising:
combining a saccharide-based component, a hydrated hydrobinding component, and at least one active ingredient comprising at least one bioassimilable source of calcium and at least one bioassimilable source of magnesium.

2. A method according to Claim 1, wherein said saccharide-based component, said hydrobinding component and said active are combined by at least one method selected from the group consisting of high shear mixing, low shear mixing and flash-flow processing

3. A method according to Claim 2, wherein said method is high shear mixing or low shear mixing.

4. A method according to Claim 2, wherein said saccharide-based component is subjected to flash-flow processing prior to shear mixing with said hydrobinding component.

5. A method according to Claim 4, wherein at least one of said calcium and said magnesium is subjected to pre-flash-flow processing.

6. A method according to Claim 5, wherein said magnesium is subjected to pre-flash-flow processing.

7. A method according to Claim 6, wherein said magnesium is selected from the group consisting of magnesium oxide, magnesium carbonate, and magnesium phosphate.

8. A method according to Claim 1, wherein said hydrobinding component comprises one or more ingredients selected from the group consisting of a food grade gum and gelatin.

9. A method according to Claim 8, wherein said food grade gum is selected from the group consisting of gum arabic, carrageenan, locust bean gum, guar gum, and mixtures thereof.

10. A method according to Claim 1, wherein said hydrobinding component comprises a mixture of carrageenan and locust bean gum, and further comprises a cross-linking agent.

11. A method according to Claim 1, wherein said saccharide-based component comprises a saccharide material selected from the group consisting of sucrose, corn syrup solids, polydextrose, and mixtures thereof.

12. A method according to Claim 11, wherein said saccharide material is polydextrose.

13. A method according to Claim 11, wherein said saccharide material comprises sucrose and corn syrup solids.

14. A method according to Claim 1, wherein said saccharide-based component further comprises an oleaginous material, an emulsifier, or a mixture thereof.

15. A method according to Claim 1, wherein said hydrobinding component further comprises a wetting agent.

16. A method according to Claim 15, wherein said wetting agent comprises glycerin.

17. A calcium and magnesium based, chewy nougat confectionery formulation, comprising a fully functionalized hydrobound mass having substantially no phase separation of moisture, and further comprising a saccharide-based component, a hydrated hydrobinding component, and at least one active ingredient selected from the group consisting of at least one active ingredient selected from the group consisting of at least one bioassimilable source of calcium and at least one bioassimilable source of magnesium.

18. A confectionery formulation according to Claim 17, wherein said active ingredient comprises calcium carbonate, and at least one member selected from the group consisting of magnesium lactate, magnesium oxide, magnesium carbonate, magnesium phosphate, and magnesium hydroxide.

19. A confectionery formulation according to Claim 18, wherein said magnesium is the form of shearform matrix as a result of flash-flow processing.

20. A confectionery mass according to Claim 17, wherein said hydrobinding component comprises a proteinaceous material selected from the group consisting of gelatin, gum arabic, carrageenan, locust bean gum, guar gum, and mixtures thereof.

21. A confectionery mass according to Claim 17, which has a water activity of not greater than 60% ERH.

22. A confectionery mass according to Claim 17, wherein the activity is less than about 25 ppm.

23. A confectionery mass according to Claim 17, wherein said saccharide-based component comprises a saccharide material selected from the group consisting of sucrose, corn syrup solids, polydextrose, and mixtures thereof.

24. A confectionery mass according to Claim 24, wherein said saccharide material comprises sucrose and corn syrup solids.

25. A confectionery mass according to Claim 17, wherein said hydrobinding component comprises a wetting agent.

26. A confectionery mass according to Claim 26, wherein said wetting agent comprises glycerin.

27. A confectionery mass according to Claim 40, having improved taste and texture properties.

28. A method of making a calcium and magnesium based chewy nougat confectionery formulation comprising:
combining a saccharide-based component, a hydrated hydrobinding component, and at least one active ingredient comprising at least one bioassimilable source of calcium and at least one bioassimilable source of magnesium under high shear mixing conditions, said hydrobinding component being first prepared under low shear mixing conditions.

INTERNATIONAL SEARCH REPORT

Interi nal Application No
PCT/US 99/03812

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23G3/00 A23G3/10

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23G

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 data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 587 198 A (CHERUKURI ET AL) 24 December 1996 cited in the application see column 8, line 1 - line 6 see column 9, line 3 - line 32 see column 10, line 33 - line 40 see claims; examples I-IV ---	1-28
P,X	WO 98 58549 A (FUISZ TECHNOLOGIES LTD.) 30 December 1998 see the whole document ---	1-28
A	US 4 582 709 A (PETERS ET AL.) 15 April 1986 see column 6, line 66 - column 7, line 63; examples 1,6 --- -/--	1-28

[X] Further documents are listed in the continuation of box C.

[X] Patent 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

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" 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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 June 1999	29/06/1999

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INTERNATIONAL SEARCH REPORT

Intern ial Application No
PCT/US 99/03812

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

information on patent family members

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