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(54) Title: BLENDS OF A CELLULOSE DERIVATIVE AND BRAN DEGRADATION PRODUCT

(57) Abstract: Provided is a composition which comprises (a) one or more cellulose derivatives selected from one or more methyl-celluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation product made from bran, wherein the weight ratio between components (a) and (b) is from 0.2 : 1 to 5 : 1. The composition is useful for increasing the cohesion of solid food, such as soy patties or processed meat products.



BLEND OF A CELLULOSE DERIVATIVE AND BRAN DEGRADATION PRODUCT

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FIELD

This invention relates to a composition that comprises a cellulose derivative and a bran degradation product.

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INTRODUCTION

In certain formulations, it is desirable to create a mechanically robust structure. It is also often desirable that some or all of the ingredients in such a formulation be nutritionally beneficial. For example, vegetable patties are made from ingredients that include plant protein, vegetable oil, thickeners, and flavorings. A desirable characteristic of vegetable
15 patties is that they retain their shape well, especially after being cooked.

US Patent Publication US 2010/0112187 describes a meat analog patty containing soy protein, okara, and 1.5 weight % METHOCEL™ A4M. Some cellulose derivatives are known as binding agents in food products and to help foods to retain their shape. Increasing the amount of the cellulose derivative typically increases its binding capacity and its ability
20 to maintain the shape of the foods. However, it is desired to provide increased structural stability or cohesion to a formulation, for example to a vegetable patty, at a given concentration of a cellulose derivative. Alternatively, it is desired to provide good structural stability or cohesion to a formulation, for example to a vegetable patty, at a relatively low concentration of a cellulose derivative. One reason for these desires is that cellulose
25 derivative is usually more expensive than other typical ingredients. Another reason for desiring to reduce the amount of cellulose derivative is that some consumers find that when large amounts of cellulose derivative are used in some food products, the result can be an undesirable feeling in the mouth.

Surprisingly, it has been found that the binding capacity of certain cellulose
30 derivatives and/or their ability to maintain the shape of the foods can be increased by combining a certain cellulose derivative with a gellable degradation product made from bran.

SUMMARY

Accordingly, one aspect of the present invention is a composition which comprises (a) one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation
5 product made from bran, wherein the weight ratio between components (a) and (b) is from 0.2 : 1 to 5 : 1.

Another aspect of the present invention is a method of improving one or more of the properties of a food composition selected from water binding capacity, cohesion, firmness, juiciness, bite, freeze thaw stability or texture, resistance to shrinking during cooking, or
10 boil-out control, which method comprises the step of incorporating into the food composition a combination of (a) one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation product made from bran.

DESCRIPTION OF EMBODIMENTS

15 Component (a) of the composition of the present invention is one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof.

Methylcellulose (MC) is preferred as component (a). Methylcellulose has anhydroglucose units joined by 1-4 linkages. Each anhydroglucose unit contains hydroxyl
20 groups at the 2, 3, and 6 positions. Partial or complete substitution of these hydroxyl groups creates cellulose derivatives. For example, treatment of cellulosic fibers with caustic solution, followed by a methylating agent, yields cellulose ethers substituted with one or more methoxyl groups. If not further substituted with other alkyls, this cellulose derivative is known as methylcellulose. Methylcellulose is characterized by the weight percent of
25 methoxyl groups. By convention, the weight percent is an average weight percentage based on the total weight of the cellulose repeat unit, including all substituents. The content of the methoxyl group is reported based on the mass of the methoxyl group (i.e., —OCH₃). The determination of the % methoxyl in methylcellulose (MC) polymer is carried out according to the United States Pharmacopeia (USP 37, "Methylcellulose", pages 3776-3778). The %
30 methoxyl can be converted into degree of substitution (DS) for methyl substituents, DS(methyl). DS(methyl), also designated as DS(methoxyl), of a methylcellulose is the average number of OH groups substituted with methyl groups per anhydroglucose unit.

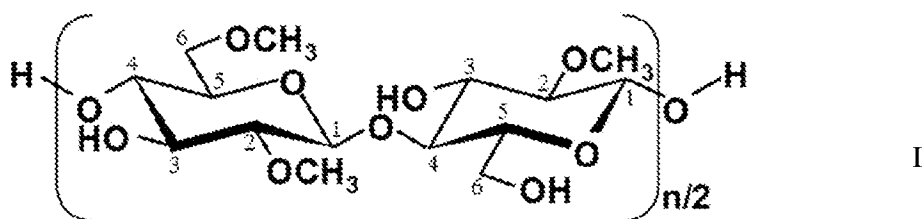
Preferably, methylcellulose has % methoxyl of 18% or more; more preferably 25% or more. Preferably, component (a) has % methoxyl of 50% or less; more preferably 40% or less; and even more preferably 35% or less. Even more preferably, methylcellulose has a DS(methyl) of 1.55 or higher; more preferably 1.65 or higher; and most preferably 1.70 or higher.

- 5 DS(methyl) is preferably 2.25 or lower; more preferably 2.20 or lower; and most preferably 2.10 or lower.

Methylcellulose is also characterized by the viscosity of a 2 wt.-% solution in water at 20°C. The 2 wt.-% by weight methylcellulose solution in water is prepared and tested according to United States Pharmacopeia (USP 37, "Methylcellulose", pages 3776-3778).

- 10 As described in the United States Pharmacopeia, viscosities of less than 600 mPa•s are determined by Ubbelohde viscosity measurement and viscosities of 600 mPa•s or more are determined using a Brookfield viscometer. Preferably, methylcellulose has a viscosity of 1,000 mPa•s or more; more preferably 2,500 mPa•s or more; and most preferably 5,000 mPa•s or more. Preferably, methylcellulose has a viscosity of 70,000 mPa•s or less; more
15 preferably 60,000 mPa•s or less, and most preferably 50,000 mPa•s or less. All these viscosities are as a 2 wt.-% solution in water at 20°C.

Another useful characterization of methylcellulose is the quotient s23/s26. The numerals 2, 3, and 6 refer to the carbon atoms on the anhydroglucose units, defined as in structure I:



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- The parameter s23 is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 3-positions of the anhydroglucose unit are substituted with methyl groups, and the parameter s26 is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 6-positions of the anhydroglucose unit are
25 substituted with methyl groups. For determining the s23, the term "the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 3-positions of the anhydroglucose unit are substituted with methyl groups" means that the two hydroxy groups in the 2- and 3-positions are substituted with methyl groups and the 6-positions are unsubstituted hydroxy groups. For determining the s26, the term "the molar fraction of
30 anhydroglucose units wherein only the two hydroxy groups in the 2- and 6-positions of the

anhydroglucose unit are substituted with methyl groups” means that the two hydroxy groups in the 2- and 6-positions are substituted with methyl groups and the 3-positions are unsubstituted hydroxy groups. The quotient s_{23}/s_{26} is determined by dividing s_{23} by s_{26} . Generally s_{23}/s_{26} is 0.36 or less, preferably 0.34 or less, more preferably 0.32 or less, most preferably 0.30 or less, and particularly 0.28 or less. Moreover, s_{23}/s_{26} is generally 0.10 or more, preferably 0.14 or more, more preferably 0.16 or more, most preferably 0.18 or more and particularly 0.20 or more. Methylcellulose having an above-described s_{23}/s_{26} ratio and a method of preparing it are described in International Patent Application, publication No. WO 2013/059064.

Alternatively, hydroxypropyl methylcellulose (HPMC) is used as component (a). HPMC is characterized by the weight percent of methoxyl groups and of hydroxypropyl groups. The weight percentages are based on the total weight of the hydroxypropyl methylcellulose. By convention, the weight percent is an average weight percentage based on the total weight of the cellulose repeat unit, including all substituents. The content of the methoxyl group is reported based on the mass of the methoxyl group (i.e., $-\text{OCH}_3$). The content of the hydroxypropoxyl group is reported based on the mass of the hydroxypropoxyl group (i.e., $-\text{O}-\text{C}_3\text{H}_6\text{OH}$). The determination of the % methoxyl and the % hydroxypropoxyl in HPMC is carried out according to the United States Pharmacopeia (USP 37, “Hypromellose”, pages 3296-3298).

The % methoxyl in HPMC can be converted into degree of substitution (DS) for methyl substituents, DS(methyl). DS(methyl), also designated as DS(methoxyl), of a HPMC is the average number of OH groups substituted with methyl groups per anhydroglucose unit. For determining the DS(methyl), the term “OH groups substituted with methyl groups” does not only include the methylated OH groups at the polymer backbone, i.e., that are directly a part of the anhydroglucose unit, but also methylated OH groups that have been formed after hydroxypropoxylation. Preferably the HPMC has a DS(methyl) of 1.2 or higher; more preferably 1.4 or higher; and most preferably 1.65 or higher or even 1.75 or higher. DS(methyl) is preferably 2.2 or lower; more preferably 2.1 or lower; and most preferably 2.05 or 2.00 or lower.

The % hydroxypropoxyl in HPMC can be converted into MS(hydroxypropoxyl). The degree of the substitution of hydroxyl groups of the anhydroglucose units by hydroxypropoxyl groups is expressed by the molar substitution of hydroxypropoxyl groups, the MS(hydroxypropoxyl). The MS(hydroxypropoxyl) is the average number of moles of

hydroxypropoxyl groups per anhydroglucose unit in the HPMC. It is to be understood that during the hydroxypropoxylation reaction the hydroxyl group of a hydroxypropoxyl group bound to the cellulose backbone can be further etherified by a methylation agent, and/or a hydroxypropylation agent. Multiple subsequent hydroxypropylation etherification reactions with respect to the same carbon atom position of an anhydroglucose unit yields a side chain, wherein multiple hydroxypropoxyl groups are covalently bound to each other by ether bonds, each side chain as a whole forming a hydroxypropoxyl substituent to the cellulose backbone. The term “hydroxypropoxyl groups” thus has to be interpreted in the context of the MS(hydroxypropoxyl) as referring to the hydroxypropoxyl groups as the constituting units of hydroxypropoxyl substituents, which either comprise a single hydroxyalkoxyl group or a side chain as outlined above, wherein two or more hydroxypropoxyl units are covalently bound to each other by ether bonding. Within this definition it is not important whether the terminal hydroxyl group of a hydroxypropoxyl substituent is further methylated or not; both methylated and non-methylated hydroxypropoxyl substituents are included for the determination of MS(hydroxypropoxyl). Generally the HPMC has an MS(hydroxypropoxyl) of 0.11 or more, preferably of 0.13 or more, more preferably of 0.15 or more, and most preferably of 0.18 or more. Generally the HPMC has an MS(hydroxypropoxyl) of 1.00 or less, preferably of 0.80 or less, more preferably of 0.70 or less and most preferably of 0.60 or 0.50 or less.

Hydroxypropyl methylcellulose is also characterized by the viscosity of a 2 wt.% solution in water at 20°C. The 2% by weight hydroxypropyl methylcellulose solution in water is prepared and tested according to United States Pharmacopeia (USP 37, “Hypromellose”, pages 3296-3298). As described in the United States Pharmacopeia, viscosities of less than 600 mPa•s are determined by Ubbelohde viscosity measurement and viscosities of 600 mPa•s or more are determined using a Brookfield viscometer.

Preferably, hydroxypropyl methylcellulose has a viscosity of 1,000 mPa•s or more; more preferably 2,000 mPa•s or more; and most preferably 3,000 mPa•s or more as a 2 wt.% solution in water at 20°C. Preferably, hydroxypropyl methylcellulose has a viscosity of 70,000 mPa•s or less; more preferably 50,000 mPa•s or less, and most preferably 20,000 mPa•s or less.

Preferably the hydroxypropyl methylcellulose (HPMC) has a unique distribution of methyl groups on the anhydroglucose units such that $[s_{23}/s_{26} - 0.2 \cdot \text{MS}(\text{hydroxyalkyl})]$ is 0.35 or less, preferably 0.32 or less, more preferably 0.30 or less, most preferably 0.27 or

less, particularly 0.25 or less, and especially 0.23 or less. Typically $[s_{23}/s_{26} - 0.2 \cdot \text{MS}(\text{hydroxyalkyl})]$ is 0.07 or more, more typically 0.10 or more, and most typically 0.13 or more. As used herein, the symbol “ $\cdot$ ” represents the multiplication operator. The numerals 2, 3, and 6 refer to the carbon atoms on the anhydroglucose units, defined as in

5 structure I further above. In the ratio s_{23}/s_{26} , s_{23} is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 3-positions of the anhydroglucose unit are substituted with methyl groups and s_{26} is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 6-positions of the anhydroglucose unit are substituted with methyl groups. For determining the s_{23} , the term “the molar

10 fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 3-positions of the anhydroglucose unit are substituted with methyl groups” means that the 6-positions are not substituted with methyl; for example, they can be unsubstituted hydroxy groups or they can be substituted with hydroxypropyl groups or methylated hydroxypropyl groups. For determining the s_{26} , the term “the molar fraction of anhydroglucose units

15 wherein only the two hydroxy groups in the 2- and 6-positions of the anhydroglucose unit are substituted with methyl groups” means that the 3-positions are not substituted with methyl; for example, they can be unsubstituted hydroxy groups or they can be substituted with hydroxypropyl groups or methylated hydroxypropyl groups. Hydroxypropyl methylcellulose having a distribution of methyl groups on the anhydroglucose units such

20 that $[s_{23}/s_{26} - 0.2 \cdot \text{MS}(\text{hydroxyalkyl})]$ is 0.35 or less and a method of preparing it are described in International Patent Application, publication Nos. WO2012/051034 and WO 2012/173838.

A cellulose derivative selected from one or more MC, one or more HPMC, or a combination thereof, is referred to herein as component (a). Bran is known as outer

25 coverage of cereal grains. Along with germ, it is an integral part of whole grains and is often produced as by-product of milling in the production of refined grains. Bran is present in and may be milled from any cereal grain, including rice, corn (maize), wheat, oats, barley, rye and millet. Corn bran is preferred for producing the gellable degradation product that is used as component (b) of the composition of the present invention.

30 Component (b) of the composition of the present invention is a gellable degradation product made from bran. Gellable degradation products made from bran and procedures for obtaining them are known in the art. E.g., international patent application WO 97/19603 discloses a process wherein gellable degradation products made from bran are produced by

treating bran with alkali to produce a slurry comprising soluble and insoluble degradation products of bran, separating the insoluble degradation products from the slurry and treating the separated insoluble product in the presence of alkali and an oxidizing agent to produce a gel, recovering the gel from the slurry and optionally drying the gel.

5 In the first stage treatment ground bran is preferably slurried with 5 to 25 wt.-% aqueous alkali solution, preferably sodium hydroxide or potassium hydroxide. The alkali treatment is preferably conducted at 75 to 150 °C while applying shearing. The insoluble degradation products are preferably separated from the slurry by centrifugation or filtration, optionally with washing the solids with water.

10 The solids obtained in the first stage treatment are subjected to a second stage treatment with alkali. The solids are preferably suspended in water at about 2 – 15 wt. % solids content and treated with aqueous alkali solution at a pH of 8 – 12. In the second stage treatment an oxidizing agent, such as hydrogen peroxide or sodium hypochlorite is used. The amount of the oxidizing agent preferably is 1 to 25 %, more preferably 5 to 25%, by
15 weight of the solids in the suspension. Preferably the suspension is subjected to intensive shearing for 20 to 120 minutes at a temperature of 25 to 80 °C, more preferably of 40 to 70 °C. The wet solids are separated from the suspension, preferably by centrifugation or filtration. The separated solids are preferably resuspended in water and washed.

The recovered solids consist of cellular debris in the form of a hydrated gel. The
20 hydrated gel is typically white or very light in color, has little or no flavor, a smooth texture, and a pH of the range of about 6 to 9. The gel may be dried by any conventional means, such as drum drying, spray drying, warm air tray drying, or freeze drying. The dried products are readily dispersible in water and can be rehydrated to give high viscosity gels. For example, at 3% solids the reconstituted gels are characterized by viscosities of up to
25 120,000 mPa·s and hydration capacities of up to at least about 25, that is they absorb at least about 24 times their weight in water. WO 97/19603 discloses that the gels can be used as ingredients in meats such as hamburgers, in dairy products, such as cheeses, yoghurt and ice cream, and in baked goods.

A further development of the process disclosed in WO 97/19603 for producing
30 gellable degradation products from bran is described in U.S. Patent No. 7,625,591.

Gellable degradation products from bran are commercially available from Z-Trim Holdings, Inc, USA, under the trademark Z-Trim, and preferably under the trademark Z-Trim corn fiber. K. Warner and G.E. Inglett studied the effects of partial replacement of fat

and flour in foods with Z-Trim corn and oat fibers, see their article “Flavor and Texture Characteristics of Foods Containing Z-Trim Corn and Oat Fibers as Fat and Flour Replacers” in Cereal Foods World, October 1997, Vo. 42, No. 10, pages 821 – 825.

The combination of (a) one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation product made from bran is useful for improving one or more of the properties of a food composition selected from cohesion, firmness, juiciness, freeze thaw stability or texture; resistance to shrinking during cooking, or boil-out control. The combination of the components (a) and (b) is particularly useful for improving the cohesion and/or firmness of a food composition. Surprisingly, it has been found that the combination of the components (a) and (b) is much more effective than the components (a) or (b) individually, i.e., that a synergistic effect can be achieved by using the components (a) or (b) in combination.

The weight ratio between components (a) and (b) in the composition of the present invention is at least 0.2 : 1, preferably at least 0.3 : 1, more preferably at least 0.5 : 1, even more preferably at least 0.75 : 1, and most preferably at least 0.9 : 1. The weight ratio between components (a) and (b) in the composition of the present invention is up to 5 : 1, preferably up to 3 : 1, more preferably up to 2 : 1, even more preferably up to 1.3 : 1, and most preferably up to 1.1 : 1. A weight ratio between components (a) and (b) of about 1 : 1 is particularly preferred. Preferred as component (a) is methylcellulose, more preferred a methylcellulose having the quotient s_{23}/s_{26} as described further above. Preferred as component (b) is a gellable degradation product made from corn bran.

Preferably the amount of component (a) is, by weight based on the weight of the composition, 0.1% or more, more preferably 0.2% or more; even more preferably 0.3% or more, and most preferably 0.4% or more. Preferably the amount of component (a) is, by weight based on the weight of the composition, 3.0 % or less, preferably 2.0% or less; even more preferably 0.8 % or less; and most preferably 0.6 % or less.

Preferably the amount of component (b) is, by weight based on the weight of the composition, 0.1% or more, more preferably 0.2% or more; even more preferably 0.3% or more, and most preferably 0.4% or more. Preferably the amount of component (a) is, by weight based on the weight of the composition, 3.0 % or less, preferably 1.5% or less; even more preferably 1.2 % or less; and most preferably 0.75 % or less.

Preferably, the composition of the present invention comprises water. Preferably, the amount of water, by weight based on the composition, is 20% or more; more preferably 30% or more; even more preferably 40% or more; and most preferably 50% or more.

Preferably, the amount of water, by weight based on the composition, is 80% or less; more
5 preferably 70% or less.

Preferably, the composition of the present invention comprises from 5% to 80% by weight, based on the weight of the composition, of one or more dry ingredients selected from one or more proteins, one or more animal fats or oils, sodium chloride, sodium
10 chloride with nitrite (= curing salt; Nitritpökelsalz), sodium phosphates, sodium ascorbates, caseinates, citrates, sodium carbonates, one or more sugars, flavoring agents, gluten and combinations thereof.

Preferably, the composition of the present invention comprises one or more proteins. Proteins are molecules that contain chains of amino acid residues. Proteins contain 30 or more residues of amino acids. Proteins that have been removed from a plant are known as
15 plant proteins. Preferred proteins are plant proteins; more preferred are proteins from soy, proteins from wheat, and combinations thereof. Other preferred proteins are meat proteins. Preferably the amount of proteins, by weight based on the weight of the composition, is 2% or more, more preferably 5% or more; and most preferably 10% or more. Preferably the amount of proteins, by weight based on the weight of the composition, is 40% or less; more
20 preferably 30% or less; and most preferably 20% or less.

When the composition of the present invention is a processed meat product, it preferably comprises one or more animal fats or oils. Animal fats or oils are known; they are esters derived from glycerol and three fatty acids. Pork fat, chicken fat, and cow fat is preferred. Preferably, the amount of animal fat, by weight based on the processed meat
25 product, is 5% or more; more preferably 10% or more; even more preferably 15% or more. Preferably, the amount of animal fat, by weight based on the processed meat product, is 40% or less; more preferably 30% or less, and more preferably 25% or less.

Preferably, the composition of the present invention comprises one or more sugars. As used herein, the term "sugar" refers to monosaccharides and disaccharides. Preferred
30 sugars are sucrose, fructose, glucose (also known as dextrose), and combinations thereof. Preferably the amount of sugar is, by weight based on the weight of the composition, 0.1% or more; more preferably 0.2% or more; and most preferably 0.3% or more. Preferably the

amount of sugar is, by weight based on the weight of the composition, 5% or less; more preferably 3% or less; and most preferably 1% or less.

Preferably, the composition of the present invention comprises sodium chloride. Preferably, the amount of sodium chloride is, by weight based on the weight of the
5 composition, 0.05% or more; more preferably 0.1% or more; and most preferably 0.2% or more. Preferably, the amount of sodium chloride is, by weight based on the weight of the composition, 5% or less; more preferably 2% or less; even more preferably 1% or less; and most preferably 0.5% or less.

Preferably, the composition of the present invention comprises one or more vegetable
10 oils. Vegetable oils are compounds that have been removed from plants. Vegetable oils are triglycerides, which have the structure of tri-esters of carboxylic acids with glycerol. In vegetable oils, each residue of the carboxylic acids has 12 or more carbon atoms. Preferably, the amount of vegetable oils is, by weight based on the weight of the composition, 1% or more; more preferably 2% or more. Preferably, the amount of
15 vegetable oils is, by weight based on the weight of the composition, 20% or less; more preferably 10% or less.

Preferably, the composition of the present invention comprises gluten. Preferably, the amount of gluten is, by weight based on the weight of the composition, 1% or more; more preferably 2% or more. Preferably, the amount of gluten is, by weight based on the weight
20 of the composition, 10% or less; more preferably 5% or less.

Components (a) and (b) of the composition of the present invention, i.e., (a) one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation product made from bran, are preferably incorporated in solid food compositions, particularly in solid food compositions designed to be heat-treated, such as food compositions to be fried, roasted, grilled, cooked, baked or poached. Preferred food compositions are vegetable, meat, fish and soy patties and balls, vegetable, meat, fish and soy sausages, shaped vegetable, meat, fish and soy products, reformed seafood; reformed cheese sticks; onion rings; pie filling; pasta fillings, heated and baked sweet and savory fillings, starch based fried, baked, grilled, roasted, cooked, baked and poached products, meat analogues, shaped potato products, such as croquettes, pommes duchesses, hash browns, pancakes, waffles, and cakes; chewing sweets, pet foods; leavened and unleavened baked goods, such as breads; and the like.

In a preferred aspect of the invention, the food composition is a proteinaceous food composition, particularly proteinaceous vegetarian food, such as soy sausages and patties, meatless meatballs and tofu turkey rolls. Preferably, the composition of the present invention either comprises no meat or else, if meat is present, comprises an amount of meat
5 that is 0.1% or less by weight, based on the weight of the composition.

In forming food compositions, components (a) and (b) are typically admixed with foodstuffs during the process and formation of the compositions. The food composition of the present invention can be a frozen shaped or pre-cut product, an uncooked premix or a shaped or pre-cut cooked product, such as a fried, roasted, grilled, cooked or poached
10 product. Components (a) and (b) in combination provide excellent stability of the food composition during and after cooking. The achieved stability is much higher than achieved with components (a) or (b) individually. As shown in the Examples, a portion of component (a) can be replaced by component (b) while still providing a high stability to food compositions during and after cooking. This is very surprising because component (b) alone
15 provides no or insufficient stability to food compositions during and after cooking, as shown in the Examples. Partial replacement of the highly efficient but expensive component (a) is desirable.

A preferred use for the composition of the present invention is the formation of patties, such as soy patties. A patty is a solid object that typically weighs from 50 grams to
20 500 grams. Preferred patties have smallest dimension of 3 cm or less; more preferably 2 cm or less. Preferred patties have circular, hexagonal, or square symmetry around the axis defined by the smallest dimension; more preferred is circular symmetry.

Preferably, patties are formed by a process that takes place at temperatures between 5°C and 30°C. Preferably, the process of forming the patties includes bringing the
25 ingredients of the composition of the present invention into contact with each other, then mechanically mixing to blend the ingredients. Preferably, portions of the resulting mixture are formed into patties. Preferably, patties are frozen, e.g., at a temperature of from -15° C to -20° C, after formation and prior to cooking. Preferably, patties are cooked after freezing. Cooking may be performed by any method that exposes the patties to elevated temperature
30 sufficient to raise the internal temperature of the patty to 60°C or higher. Preferably, patties hold their shape when placed on a flat surface at 25°C for 10 minutes, after the completion of the cooking process.

Another preferred use for the composition of the present invention is incorporation into processed meat products, such as emulsified meat products, chopped meat products, pet food or ham. The term “processed meat” as used herein means any meat which has been modified in order either to improve its taste or extend its shelf life. Methods of meat processing are salting, curing, fermentation, boiling, smoking or other processes. Processed meat products include, for example, bacon, ham, hotdogs, sausages, cold cuts (Aufschnitt), salami, corned beef, beef jerky, canned meat and meat-based sauces. Emulsified meat products, such as sausages are preferred. The processed meat product preferably comprises beef, veal, pork, lamb, fish or poultry.

Components (a) and (b) are incorporated into the meat product before or during its processing. The term “processing” as used herein means any individual step or a combination of steps that is or are applied in the production of processed meat products, such as mixing and/or chopping the components of the meat product to be prepared, heat treatment or freezing, or bringing the processed meat products into the desired shape. The combination of components (a) and (b) is able to form a strong gel in the processed meat product. Hence, an increased structural stability or cohesion of the processed meat is achieved. Alternatively, the use of components (a) and (b) in the processed meat product allows higher water content in the processed meat product while still obtaining a similar consistency and texture as compared to a processed meat product that has a lower amount of water and that does not comprise components (a) and (b).

Processes for preparing processed meat products are known in the art. For example, in a process for preparing liverwurst, the fat/water/liver emulsion typically is heated/cooked during the cutter procedure. Sausages are prepared in a process where crushed ice/water, fat, meat, sodium chloride or sodium chloride with nitrite, additives such as caseinate, citrate, carbonate, phosphate or a mixture thereof, spices/seasonings and optionally coloring agents are mixed and processed. Chopped meat products (e.g. hamburgers) are prepared by finely grinding meat in a meat mincer, adding spices, salt, and water, and forming the meat product to a desired shape using a mold. In the processed meat products industry, two different procedures are used for preparing boiled and smoked hams, i.e. the injection of whole meat parts or coarse meat chunks followed by a tumbling process and a tumbling process of coarse meat chunks followed by pressing into natural or artificial casings. Components (a) and (b) can be mixed in a known manner with the other ingredients of the processed meat products before or during one or more processing steps.

Components (a) and (b) in combination provide excellent stability to solid food compositions, such as soy patties or processed meat products, during and after cooking. A portion of component (a) can be replaced by component (b) while still providing a high stability to solid food compositions, such as patties or processed meat products during and after cooking. This is very surprising because component (b) alone provides no or insufficient stability to solid food compositions during and after cooking, as shown in the Examples. Partial replacement of the highly efficient but expensive component (a) is desirable.

Some embodiments of the invention will now be described in detail in the following Examples.

EXAMPLES

Unless otherwise mentioned, all parts and percentages are by weight. In the Examples the following test procedures are used.

15

Examples 1 - 3 and Comparative Examples A-G: Use in Soy Patties

Soy patties were prepared from the formulations listed in Tables 1 and 2 below. The amounts are percent by weight, based on the weight of the formulation.

Ingredients were as follows:

20 Soy1 = ResponseTM 4401 soy protein from Dupont Corporation;

Soy2 = ResponseTM 4320 soy protein from Dupont Corporation;

Gluten = FPTM 600 modified wheat gluten from MPG Ingredients;

Oil = vegetable oil;

Flavor = beef flavoring;

25 Sugar = ClintoseTM dextrose from ADM Corporation;

Z-trim Corn = a gellable degradation product made from corn bran and commercially available from Z-Trim Holdings, Inc, USA under the trademark Z-TrimTM Corn;

MethocelTM SGA16M = methylcellulose from Dow Chemical Company having a methoxyl content of 27.5% - 31.5%, a viscosity of about 16,000 MPa•s, measured as a 2 wt.-%

30 solution in water at 20°C, and a ratio s23/s26 of 0.26 – 0.32;

MethocelTM MX = methylcellulose from Dow Chemical Company having a methoxyl content of 27.5% - 31.5%, a viscosity of about 50,000 MPa•s, measured as a 2 wt.-% solution in water at 20°C, and a ratio s23/s26 of 0.26 – 0.32.

The ingredients were mixed as follows. Gluten, Methocel™ SGA16M (if present), Methocel™ MX (if present), and Z-trim Corn (if present) were mixed as dry powders in a mixer. Water at 5°C was added, and the mixture was agitated with a whip attachment at medium speed until a uniform slurry was formed. Flavoring, sugar, and NaCl were added, and the agitation continued for 1 minute at high speed. Then Soy1 was added, and the formulation was mixed for 5 minutes, continually pushing the mixture down on the sides of the container. Then Soy2 was added, and the formulation was mixed for 5 minutes, continually pushing the mixture down on the sides of the container. Then oil was added, and the formulation was mixed for 5 minutes, continually pushing the mixture down on the sides of the container. The mixture was placed in a refrigerator at 5°C for 2 hours.

To form each patty, 80 g of the mixture was placed into a cylindrical mold. Mold dimensions were 1 cm height and 9 cm diameter. Patties were then placed in a freezer at a temperature of -15 to -20°C until frozen, and then each patty was separately wrapped and re-placed into the freezer until testing.

Patties were removed from the freezer and cooked as follows. Frozen patties were placed in a lightly oiled (PAM™ cooking spray) 25.4 cm (10 inch) diameter frying pan on medium heat for 4 minutes on each side.

One patty was heated at a time and immediately transferred to a texture analyzer to be tested at an internal patty temperature of 70°C to 75°C. If the patties held their shape, they were tested for hardness (strength). The patty hardness was measured with a Texture Analyzer (model TA.XTPlus, from Texture Technologies, Corp, NY, USA) using a 2.5 cm diameter acrylic cylindrical probe. The patty was compressed at the approximate middle point with the probe for the patty hardness. As a result of these characterization techniques, a plot of the resulting force vs. time compression was obtained. The maximum force at break is taken as the patty hardness force in Newtons.

Table 1

(Comp.) Example	A (wt. %)	B (wt. %)	C (wt. %)	D (wt. %)	E (wt. %)	F (wt. %)	1 (wt. %)	2 (wt. %)
water	63.51	63.51	63.51	63.51	63.51	63.51	63.51	63.51
Soy1	21.32	21.09	20.9	20.48	20.9	20.48	20.9	20.48
Gluten	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53
Oil	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Soy2	4.04	4.02	3.96	3.88	3.96	3.88	3.96	3.88
Flavor	2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72
sugar	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
NaCl	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methocel™ SGA 16M	0	0.25	0.5	1.0	0	0	0.25	0.5
Z-trim Corn	0	0	0	0	0.5	1.0	0.25	0.5
Patty strength, N	Unable to measure	Unable to measure	5	19	Unable to measure	9	7	19
Appearance after cooking	Broken patty, just crumbs	Broken patty, just crumbs	Weak patty with some cracks	good; coherent patty	Broken patty, just crumbs	Good, but not strong	Weak patty with some cracks	good; coherent patty

Table 2

(Comp.) Example	A (wt. %)	E (wt. %)	F (wt. %)	G (wt. %)	3 (wt. %)
water	63.51	63.51	63.51	63.51	63.51
Soy1	21.32	20.9	20.48	20.48	20.48
Gluten	4.53	4.53	4.53	4.53	4.53
Oil	3.18	3.18	3.18	3.18	3.18
Soy2	4.04	3.96	3.88	3.88	3.88
Flavor	2.72	2.72	2.72	2.72	2.72
sugar	0.45	0.45	0.45	0.45	0.45
NaCl	0.25	0.25	0.25	0.25	0.25
Methocel™ MX	0	0	0	1.0	0.5
Z-trim Corn	0	0.5	1.0	0	0.5
Patty strength, N	Unable to measure	Unable to measure	9	23	26
Appearance after cooking	Broken patty, just crumbs	Broken patty, just crumbs	Good, but not strong	Very good; coherent patty	Very good; coherent patty

The results in Table 1 above illustrate the synergistic effect of methylcellulose and
5 Z-trim Corn in binding a solid food formulation, such as patties, and increasing the
coherence and/or strength of the food formulation.

The individual use of 0.25 wt. % methylcellulose (Comparative Example B) or of
0.5 wt. % Z-trim Corn (Comparative Example E), did not show any effect in improving the
coherence of the patty, as compared to a comparable composition wherein neither
10 methylcellulose nor Z-trim Corn was used (Comparative Example A). In all patties of
Comparative Examples A, B and E just crumbs of about the same sizes resulted.

Surprisingly, a patty resulted when using a combination of only 0.25 wt. %
methylcellulose and 0.25 wt. % Z-trim Corn. The patty was weak, but in view of the low
amounts of methylcellulose and Z-trim Corn it is surprising that a patty was formed at all.

15 A strong patty was formed when using a combination of 0.5 wt. % methylcellulose
and 0.5 wt. % Z-trim Corn. The strength of the patty was nearly 4 times as high as the

strength of a comparable patty when only 0.5 wt. % methylcellulose was used (compare Example 2 and Comparative Example C).

The results in Examples 1 and 2 are surprising considering that Z-trim Corn alone did not show any effect in improving the coherence of the patty at amounts of 0.5 wt. %
5 (see Comparative Examples A and E).

Moreover, i) the comparison between Comparative Example C and Example 1 and ii) the comparison between Comparative Example D and Example 2 show that a portion of the methylcellulose, such as Methocel™ SGA16M, can be replaced by Z-trim Corn while still achieving the same cohesion and strength of the patty. Again, this finding is surprising
10 because the use of Z-trim Corn alone does not show any binding effect at a concentration of 0.5 wt.% and a low binding effect at a concentration of 1.0 wt.% (see Comparative Examples A, E and F).

Methocel™ SGA16M is a highly efficient but quite expensive binder in food. Some consumers find that when large amounts of such methylcellulose are used in some food
15 products, the result can be an undesirable feeling in the mouth. Partial replacement of the highly efficient but expensive Methocel™ SGA16M is desirable.

The results in Table 2 above also illustrate the synergistic effect of methylcellulose and Z-trim Corn in binding a solid food formulation, such as patties, and increasing the
20 coherence and/or strength of the food formulation.

A strong patty was formed when using a combination of 0.5 wt. % methylcellulose and 0.5 wt. % Z-trim Corn. The comparison between Comparative Example G and Example 3 shows that a portion of the methylcellulose, such as Methocel™ MX, can be replaced by Z-trim Corn while even achieving a higher cohesion and strength of the patty. Again, this
25 finding is surprising because the use of Z-trim Corn alone does not show any binding effect at a concentration of 0.5 wt.% and a low binding effect at a concentration of 1.0 wt.% (see Comparative Examples A, E and F).

Methocel™ MX is a highly efficient but quite expensive binder in food. Some consumers find that when large amounts of such methylcellulose are used in some food
30 products, the result can be an undesirable feeling in the mouth. Partial replacement of the highly efficient but expensive Methocel™ MX is desirable.

Example 4 and Comparative Examples H and I: Use in Beef Patties

Beef Patties were prepared from the formulations listed in Table 3 below. The amounts are percent by weight, based on the weight of the formulation.

Ingredients were as follows:

- 5 Beef 73/27: 73% lean / 27% fat ground beef, from Topco Associates LLC, purchased from local store;

Soy1 = ResponseTM 4401 soy protein from Dupont Corporation;

Soy3 = Promine DS soy protein concentrate from Solae LLC;

Flavoring: Luzianne Cajun Seasoning from Reily Foods Co;

- 10 Z-trim Corn: As in Examples 1 – 3;

Methylcellulose-2: methylcellulose from Dow Chemical Company having a methoxyl content of 27.5% - 31.5%, a viscosity of about 95,000 mPa•s, measured as a 2 wt.-% solution in water at 20°C, and a ratio s23/s26 of 0.18-0.26.

- Beef patties were produced as follows: Ground beef (1/4 inch, i.e., 6 mm grind size)
- 15 were blended with NaCl and flavoring for 2-3 minutes while the meat temperature was maintained between -2 °C and 1°C. Soy1 and Soy3 were pre-hydrated with water at a weight ratio of (Soy1 + Soy 3) / water of 1 / 2. Methylcellulose-2 and Z-trim corn were pre-blended as dry components and then blended together with an additional amount of water to achieve a total water content as listed in Table 3 below. The hydrated Soy1 was added and
- 20 the mixture was blended until uniform. The uniform blend of hydrated Soy1, Soy3 Methylcellulose-2 and Z-trim corn were blended with the ground beef. Beef patties were then formed with patty former, each having a weight of about 113 g. The patties were cooked in combi-therm steam injection oven at 177°C about 10 minutes (to an internal temperature of 74°C). The cooked patties were cooled on wire rack and then were frozen
- 25 and packaged in bags at -20°C.

- One beef patty was heated at a time and immediately transferred to a texture analyzer to be tested at a patty temperature of 50°C. The patty hardness was measured with a Texture Analyzer (model TA.XT. Plus, from Texture Technologies, Corp, NY, USA) using a 2.5 cm diameter acrylic cylindrical probe. The patty was compressed at one point in the center of
- 30 the patty. Multiple patties were tested. As a result of these characterization techniques, a plot of the resulting force vs. time compression was obtained. The maximum force at break is taken as the patty strength force in Newtons.

Table 3

(Comp.) Example	4 (wt. %)	H (wt. %)	I (wt. %)	J (benchmark) (wt. %)
water	32.23	32.23	32.23	28.23
Beef 73/27	55.00	55.00	55.00	60.00
Soy1	8.27	8.27	8.27	8.27
Soy3	2.00	2.00	2.00	2.00
NaCl	1.00	1.00	1.00	1.00
Flavoring	0.50	0.50	0.50	0.50
Methylcellulose-2	0.25	1.0	0	0
Z-trim Corn	0.75	0	1.0	0
beef patty strength, N	24.0	22.5	21.6	21.1
Cooking yield (%)*	76.2	72.2	75.9	72.8

* Cooking yield: (weight of patty after cooking / weight of patty before cooking) x 100.

- 5 The results in Table 3 above again illustrate that a portion of the methylcellulose can be replaced by Z-trim Corn while even achieving a higher strength and essentially the same or even a higher cooking yield of the beef patty (Compare Example 4 with Comparative Examples H and I). A higher cooking yield demonstrates improved water binding capacity, reduced resistance to shrinking during cooking, and improved boil-out control. A higher
- 10 cooking yield means reduced weight loss during cooking.

Again, this finding is surprising because the use of Z-trim Corn alone does not provide sufficient strength.

The strength of the beef patty of Example 4 is higher than the strength in the benchmark Comparative Example J. The benchmark Comparative Example J comprises a higher amount of lean beef. Example 4 illustrates that the composition of the present invention comprising components (a) and (b) in combination is suitable for producing processed meat products of reduced percentage of lean meat while still maintaining the strength of the benchmark product.

Claims

1. A composition comprising
 - (a) one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and
 - (b) a gellable degradation product made from bran,wherein the weight ratio between components (a) and (b) is from 0.2 : 1 to 5 : 1.
2. The composition of claim 1 wherein component (b) is a gellable degradation product made from corn bran.
3. The composition of claim 1 or 2 wherein the weight ratio between components (a) and (b) is from 0.5 : 1 to 2 : 1.
4. The composition of claim 3 wherein the weight ratio between components (a) and (b) is from 0.9 : 1 to 1.1 : 1.
5. The composition of any one of claims 1 to 4 being a food composition and comprising from 0.2 to 1.0 weight percent of component (a) and from 0.2 to 1.5 weight percent of component (b), based on the total weight of the composition.
6. The composition of claim 5 comprising from 0.3 to 0.8 weight percent of component (a) and from 0.3 to 1.2 weight percent of component (b), based on the total weight of the composition.
7. The composition of any one of claims 1 to 6 wherein component (b) has been produced by treating bran with alkali to produce a slurry comprising soluble and insoluble degradation products of bran, separating the insoluble degradation products from the slurry and treating the separated insoluble product in the presence of alkali and an oxidizing agent to produce a gel, recovering the gel from the slurry and optionally drying the gel.
8. The composition of any one of claims 1 to 7 wherein component (a) is a methylcellulose, wherein the methylcellulose has anhydroglucose units joined by 1-4

linkages wherein hydroxy groups of anhydroglucose units are substituted with methyl groups such that s_{23}/s_{26} is from 0.10 to 0.36,
wherein s_{23} is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 3-positions of the anhydroglucose unit are substituted with methyl groups and
wherein s_{26} is the molar fraction of anhydroglucose units wherein only the two hydroxy groups in the 2- and 6-positions of the anhydroglucose unit are substituted with methyl groups.

9. The composition of claim 8 wherein the methylcellulose has anhydroglucose units joined by 1-4 linkages wherein hydroxy groups of anhydroglucose units are substituted with methyl groups such that s_{23}/s_{26} is from 0.14 to 0.34.

10. The composition of any one of claims 1 to 9 additionally comprising from 20 to 80 weight percent of water, based on the weight of the composition.

11. The composition of any one of claims 1 to 10 additionally comprising from 5 to 80 weight percent of one or more dry ingredients selected from the group consisting of one or more proteins, sodium chloride, one or more sugars, flavoring agents, gluten and combinations thereof, based on the weight of the composition.

12. The composition of claim 11 comprising from 5 to 40 weight percent of one or more plant proteins.

13. The composition of any one of claims 1 to 12 in the form of a solid food composition.

14. The composition of claim 13 being a soy patty or a processed meat product.

15. A method of improving one or more of the properties of a food composition selected from water binding capacity, cohesion, firmness, juiciness, bite, freeze thaw stability or texture, resistance to shrinking during cooking, or boil-out control, which method comprises the step of incorporating into the food composition a combination of (a)

one or more cellulose derivatives selected from one or more methylcelluloses, one or more hydroxypropyl methylcelluloses, and combinations thereof, and (b) a gellable degradation product made from bran.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/067169

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L29/206 A23L29/238 A23L29/262
ADD.

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)
A23L

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 practicable, search terms used)

EPO-Internal, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2013/052324 A1 (SHARMA SHRI K [US] ET AL) 28 February 2013 (2013-02-28) paragraph [0002] - paragraph [0037]; tables 2, 3 paragraph [0039] - paragraph [0053]; example 1	1-15
A	----- WO 2014/168914 A1 (DOW GLOBAL TECHNOLOGIES LLC [US]) 16 October 2014 (2014-10-16) page 2, line 10 - line 29 page 8, line 22 - page 9, line 6; examples 2, 4	1-15
A	----- WO 2016/010751 A1 (DOW GLOBAL TECHNOLOGIES LLC [US]) 21 January 2016 (2016-01-21) page 1, line 13 - line 32 ----- -/-	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"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

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International application No

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