

TITLE OF THE INVENTION: HONEY POWDER AND METHOD OF PREPARATION

FIELD OF THE INVENTION

[0001] The present invention relates to honey powder and a method of preparation.

5

BACKGROUND OF THE INVENTION

[0002] Honey is believed to be a healthy and functional food. Honey in liquid form (termed liquid honey) is less practical in terms of handling and transporting. Hence, honey powder is an alternative with advantage of easiness and practical handling.

10 However, the composition of honey generally makes it impossible or difficult to dry without the addition of a filler. The composition of honey is predominantly monosaccharides, glucose and fructose, with the amount being more than 85 % of the total honey solid (Chmielewska, 2004, Chemical and Functional Properties of Food Saccharides). The amount of fructose is a bit higher than glucose. The anhydrous
15 glass transition temperature of glucose and fructose are 30 °C and 5 °C, respectively. As a result of the honey composition, the anhydrous glass transition temperature of honey is around 15-17 °C which is lower than the ambient temperature in most places. This means that even if all water from honey is eliminated, the honey is still in an amorphous rubbery form. A filler or glass former with high glass transition temperature
20 such as maltodextrin may be added to increase the glass transition temperature of the honey (Nurhadi and Roos, 2016, International Journal of Food Properties, 19, 1370-1380). The addition of maltodextrin up to 50 % (solid/total solid) could increase the anhydrous glass transition temperature of honey powder to 43 °C (Nurhadi and Roos, 2016). This means that the honey powder could be stored stably at ambient
25 temperature with packaging material with low water vapour transmission rate.

[0003] Maltodextrin is a starch derivative product and is relatively cheap that makes it as a common filler in drying of difficult material like honey. The glass transition temperature of maltodextrin depends on its dextrose equivalent value (DE Value). The DE value depicts the hydrolysis level of starch into oligosaccharide. Generally, the
30 higher the hydrolysis of the starch (i.e. the higher the DE value), the lower the molecular weight of oligosaccharide and as a result the lower the glass transition

temperature of maltodextrin. The glass transition temperature of maltodextrin is in the range of 140 – 188 °C. The disadvantage of maltodextrin is its high glycaemic index of 110 that could increase glucose blood level quickly and is strongly connected to diabetic disease.

5 [0004] The drying of honey may be done by adding a glass former with high glass transition temperature and drying with a high drying rate method. Most existing honey powder is made with the mixture of honey liquid and maltodextrin at certain ratios. The glass transition temperature of maltodextrin depends on the degree of hydrolysis (DE Value). The higher the degree of hydrolysis of the maltodextrin would usually mean its
10 molecular weight and the glass transition temperature are lower. The ratio of maltodextrin used in honey powder is commonly 50 % of the total solid (Nurhadi and Roos, 2016). The mixture of honey and maltodextrin is then dried using a spray dryer, vacuum dryer or freeze dryer. An anti-caking material may be added in honey powder to make it stable during storage. Examples of an anti-caking material used were
15 calcium phosphate and calcium stearate (Nurhadi and Roos, 2017, Journal of Food Engineering, 210, 76-82). The addition of a small amount of protein (1% of total solid) would prevent the attachment of high sugar material to the drying surface of the drying chamber in the spray dryer. This improves the yield and recovery of the drying process. Spray drying is a preferred method of honey drying because the process is continuous
20 and fast. In the spray drying process, there is an optimum temperature where the yield or product recovery obtained is optimal. In addition, honey powder obtained from a spray dryer method generally had better properties than that produced by other method (Nurhadi et al., 2012, International Food Research Journal, 19, 907-912).

25 **SUMMARY OF THE INVENTION**

[0005] In a first aspect, there is provide a honey powder comprising 30% to 75% by weight of honey and 25% to 70% by weight of a sugar polymer, the sugar polymer having a glycaemic index of 50 or less and a glass transition temperature of at least 80 °C. The components of the honey powder should add up to 100% by weight.

[0006] Preferably, the honey powder further comprises 0.5% to 1.5% by weight of a protein, preferably the protein comprises whey protein concentrate, soy protein concentrate, or combinations thereof.

5 [0007] In an embodiment, the honey powder comprises 38% to 74% by weight of the honey and 25% to 62% by weight of the sugar polymer. In an embodiment, the honey powder comprises 38% to 70% by weight of the honey and 30% to 62% by weight of the sugar polymer.

10 [0008] In a second aspect there is provided, a honey powder comprising honey and a sugar polymer, the honey to the sugar polymer ratio is 75-85 to 30-120, the sugar polymer having a glycaemic index of 50 or less and a glass transition temperature of at least 80 °C.

[0009] Preferably, the honey powder further comprises a protein, the honey to the protein ratio is 75-85 to 1.3-1.6.

15 [0010] In an embodiment, the sugar polymer comprises a fructose-based fibre, a glucose-based fibre, gum Arabic, or a combination thereof. In an embodiment, the fructose-based fibre is inulin. In an embodiment, the glucose-based fibre is a dextrin resistant to digestive enzymes or polydextrose. In an embodiment, the sugar polymer comprises the fructose-based fibre and the glucose-based fibre in a weight ratio of 4:1 to 1:4.

20 [0011] Preferably, the glycaemic index of the sugar polymer is 35 or less.

[0012] Preferably, the glass transition temperature of the sugar polymer is at least 100 °C.

25 [0013] Preferably, the honey powder consists essentially of the honey, the sugar polymer, and the protein if present, more preferably the honey powder consists of the honey, the sugar polymer, and the protein if present.

[0014] In an embodiment, the honey powder has a diastase value of at least 8.

30 [0015] In a third aspect, there is provided a method of preparing a honey powder according to the first two aspects, the method comprising providing a mixture comprising a liquid honey, the sugar polymer, and the protein if present; stirring the mixture to obtain a solution; and spray drying the solution.

[0016] Preferably, spray drying is done with an inlet temperature of 140 °C to 170 °C and an outlet temperature of 82 °C to 90 °C.

[0017] Advantageously, the honey powder as described above has a low GI value and is suitable for almost everyone including those suffering from diabetes and with a similar taste to liquid honey.

[0018] Advantageously, the honey powder is easier to handle, store and transport than liquid honey.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Figure (FIG.) 1 is a schematic of a process to produce honey powder.

DETAILED DESCRIPTION OF THE INVENTION

[0020] In the following description, numerous specific details are set forth in order to provide a thorough understanding of various illustrative embodiments of the invention. It will be understood, however, to one skilled in the art, that embodiments of the invention may be practiced without some or all of these specific details. Embodiments described in the context of one of the methods or devices are analogously valid for the other methods or devices. Similarly, embodiments described in the context of a method are analogously valid for a device, and vice versa.

[0021] Unless defined otherwise or the context clearly dictates otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods and materials are now described.

[0022] The terms “about”, “approximately”, “substantially” must be read with reference to the context of the application as a whole, and have regard to the meaning a particular technical term qualified by such a word usually has in the field concerned. For example, it may be understood that a certain parameter, function, effect, or result can be performed or obtained within a certain tolerance, and the skilled person in the relevant technical field knows how to obtain the tolerance of such term.

[0023] The phrase "at least one of A and B" means it requires only A alone, B alone, or A and B, i.e. only one of A or B is required. As used herein, the articles "a", "an" and "the" as used with regard to a feature or element include a reference to one or more of the features or elements. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0024] Where a combination is disclosed, each subcombination of the elements of that combination is also specifically disclosed and is within the scope of the invention. Conversely, where different elements or groups of elements are disclosed, combinations thereof are also disclosed. Where any element of an invention is disclosed as having a plurality of alternatives, examples of that invention in which each alternative is excluded singly or in any combination with the other alternatives are also hereby disclosed; more than one element of an invention can have such exclusions, and all combinations of elements having such exclusions are hereby disclosed.

[0025] Where a range of values is recited, it is to be understood that each intervening integer value, and each fraction thereof, between the recited upper and lower limits of that range is also specifically disclosed, along with each subrange between such values. The upper and lower limits of any range can independently be included in or excluded from the range, and each range where either, neither or both limits are included is also encompassed within the invention. Where a value being discussed has inherent limits, for example where a component can be present at a concentration of from 0 to 100%, or where the pH of an aqueous solution can range from 1 to 14, those inherent limits are specifically disclosed. Where a value is explicitly recited, it is to be understood that values which are about the same quantity or amount as the recited value are also within the scope of the invention, as are ranges based thereon.

[0026] Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, a further aspect includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent "about," it will be understood that the particular value forms a further aspect. It will be further understood that the endpoints of each of the ranges are significant both in

relation to the other endpoint, and independently of the other endpoint. It is also understood that there are a number of values disclosed herein, and that each value is also herein disclosed as "about" that particular value in addition to the value itself. For example, if the value "10" is disclosed, then "about 10" is also disclosed. It is also understood that each unit between two particular units are also disclosed. For example, if 10 and 15 are disclosed, then 11, 12, 13, and 14 are also disclosed.

[0027] The word "substantially" does not exclude "completely" e.g. a composition which is "substantially free" from Y may be completely free from Y. Where necessary, the word "substantially" may be omitted from the definition of the invention.

[0028] Although each of these terms has a distinct meaning, the terms "comprising", "consisting of" and "consisting essentially of" may be interchanged for one another throughout the instant application. The term "having" has the same meaning as "comprising" and may be replaced with either the term "consisting of" or "consisting essentially of".

[0029] An alternative material to replace maltodextrin as a filler could provide alternative honey powder compositions. The alternative material should fulfil two main criteria - a high glass transition temperature and a low glycaemic index. In addition, the material should be soluble in water, have low viscosity and have plain taste (to avoid altering the taste of the honey).

[0030] Described herein is a honey powder produced by mixing honey liquid with a low glycaemic index glass former to replace maltodextrin and spray drying the mixture. A glycaemic index (GI) value of 50 or less (i.e. 0 to 50) is generally considered a low glycaemic index value. Hence, the low glycaemic index glass former should have a glycaemic index value of 0 to 50. The honey powder may contain 30% to 75% by weight of honey (specifically the honey solid as water removed is removed in the spray drying) and 25% to 70% by weight of the glass former. In an embodiment, the honey powder may contain 38% to 74% by weight of the honey and 25% to 62% by weight of the glass former. In an embodiment, the honey powder may contain 38% to 70% by weight of the honey and 30% to 62% by weight of the glass former. In an embodiment, the honey powder may contain 40% to 70% by weight of the honey and 30% to 60% by weight of the glass former. In an embodiment, the honey powder may contain 40%

to 50% by weight of the honey and 50% to 60% by weight of the glass former. The components in the honey powder should add up to 100%. In the honey powder, the honey is only the honey solid as water is removed in the drying process to form the powder. The honey solid is mainly sugars like glucose and fructose and may contain pollen and other minerals.

[0031] The low glycaemic index glass former that meets the criteria above may be a sugar polymer having a glycaemic index of 50 or less and a glass transition temperature of at least 80 °C. In an embodiment, the sugar polymer has a glycaemic index of 45 or less, preferably 35 or less. In an embodiment, the sugar polymer has a glass transition temperature of at least 100 °C.

[0032] The sugar polymer may be a fructose-based fibre, a glucose-based fibre, gum Arabic, or a combination thereof. The fructose-based fibre and the glucose-based fibre may be used alone or in combination with a weight ratio of 4:1 to 1:4 with respect to the weight of the sugar polymer, preferably 7:3 to 3:7.

[0033] An example of a fructose-based fibre includes inulin. Inulin is a natural dietary fibre most often extracted from chicory root. Inulin belongs to a class of dietary fibres known as fructans and is a fructose polymer that is not digestible by enzymes in the human digestive system. Inulin has a GI value of virtually zero. Inulin has a high glass transition temperatures of 120 °C (Zimeri and Kokini, 2002, Carbohydrate Polymers, 48, 299-304).

[0034] An example of a glucose-based fibre is a dextrin that is resistant to digestive enzymes (termed a resistant dextrin herein). An example of such a resistant dextrin is Nutriose. Nutriose is a type of modified dextrin produced from maize, wheat or pea starch by a heating process with food grade acid at high temperature. The high temperature hydrolyses the starch and converts the digestible glycosidic bond into the undigestible glycosidic bond of starch (i.e. a repolymerisation). In other words, the starch is converted into a fibre. Nutriose is a glucose polymer-based fibre with about 25% of its glycosidic linkages not being able to be hydrolysed by human digestive enzymes (Lefranc-Millot, 2008, Nutrition Bulletin, 33, 234-239). Hence, Nutriose may be termed a resistant dextrin or a dextrin that is resistant to digestive enzymes. It has been found that Nutriose has a predicted GI value of 25. Nutriose has a high glass

transition temperature of 170-180 °C (<https://www.roquette.com/innovation-hub/pharma/product-profile-pages/nutriose-fb-06>).

[0035] Another example of a glucose-based fibre is polydextrose. It may be produced by thermal polymerisation of glucose with sorbitol and an organic acid such as citric acid. Polydextrose is generally a polymer of randomly bonded glucose polymers with about 10% of sorbitol and a small amount (~1%) of citric acid if used.

[0036] Another sugar polymer that may be used is gum Arabic. Gum Arabic is a mixture of glycoproteins and polysaccharides, mainly arabinose and galactose.

[0037] Inulin and Nutriose are water soluble fibre or prebiotics that meet the criteria set out above and are classified as a prebiotic that is needed as feed for good bacteria (probiotics) in a person's large intestine.

[0038] Inulin and Nutriose may be used alone or in combination. If inulin (or the fructose-based polymer) is used alone, a higher ratio of inulin may be needed to produce the stable honey powder due to the lower glass transition temperature of inulin compared to Nutriose. Inulin has lower solubility and glass transition temperature compared to Nutriose. The combination of inulin and Nutriose would complement each other. Inulin may be perceived as more natural than Nutriose by a consumer, but inulin has a lower glass transition temperature and lower solubility than Nutriose. Hence, a mixture of inulin and Nutriose provides a balance of properties. In an embodiment, inulin and Nutriose may be used in a weight ratio of 1:4 to 4:1, or 3:7 to 7:3.

[0039] A small amount of protein (0.5% to 1.5% by weight of total solid in the honey powder) may be optionally added to prevent the honey mixture from attaching to the surface of the drying chamber during the spray drying process. This results in the high recovery and yield of the honey powder obtained from the spray drying process. Examples of the protein that may be used include whey protein concentrate (WPC) and/or soy protein concentrate (SPC).

[0040] Prebiotic Honey powder is produced with the use of a low glycemic index glass former (prebiotic). The process is done in several steps and the amount of the various components are expressed in terms of the weight of honey used (100 part) and is schematically illustrated in FIG. 1.

[0041] Water is needed in the initial mixture prior to spray drying to make the total solid content of the honey mixture (honey solid, glass former and protein if present) around 30 %. If water is not added, the mixture of honey liquid and the glass former is too viscous and thick to obtain a homogenous mixture and might block the spray dryer atomizer. Adding more water would mean that the spray drying will take longer as more water needs to be removed from the solution.

[0042] With honey (100 parts) having 80% solid content, the filler may be added in 30 to 120 parts, the amount of water added may be from 290 to 350 parts, and the protein if added may be from 1.3 to 1.6 parts or more specifically from 1.34 to 1.6 parts. Good quality honey generally contains 20% or less by weight of water and raw honey usually contains about 18% water. However, some honey may contain up to 25% of water depending on the honey source. The moisture content in the liquid honey used may be measured gravimetrically or by refractometry methods to measure the refractive index of the honey and comparing with a standard reference table to determine the water content.

[0043] The mixture of components is stirred until a homogenous solution is obtained. During mixing or stirring of the components, the temperature could be raised up to 40 °C to allow the homogenous solution to be obtained more quickly.

[0044] The solution is then dried using a spray dryer with an inlet temperature of 140 to 170 °C and an outlet temperature of 80 to 92 °C. The spray dryer may be prepped to the inlet temperature setting of 140 to 170 °C and the mixture is pumped into the atomizer of the spray dryer for spray drying. The feeding rate is set appropriately until the outlet temperature reaches 85 to 92 °C.

[0045] The temperature settings of the spray dryer produce honey powder with high diastase number (DN) value (13.40 – 23.11), while good quality of honey should have a minimum diastase number of 8 and is also a regulatory requirement in some countries. Diastase is the common name of alpha amylase which breaks up complex carbohydrates into simple sugars and the DN value describes the activity of enzyme in honey. A low diastase number means low activity of the diastase enzyme in the honey due to the inactivation of the enzyme due to the high temperature treatment. While a high diastase number means the diastase enzyme in the honey is not

damaged due to heating. The DN of the liquid honey and honey powder was measured before mixing and after spray drying. The DN of the powder honey is similar to the original liquid honey used with little loss of the DN value, and shows the loss of DN value is very low by the spray drying process.

- 5 [0046] The honey powder may be collected in a production room equipped with dehumidifier to maintain low relative humidity. The honey powder with the prebiotic is packaged in a container preferably with a low water vapor transmission rate (WVTR).

[0047] Table 1: Honey Powder Compositions

Component	Honey			Glass former		Protein	
	With water content (parts)	Solid honey content (parts)	(%)	(parts)	(%)	(parts)	(%)
Powder 1	100	80	72.7%	30	27.3%	0	0.0%
Powder 2	100	80	71.9%	30	27.0%	1.3	1.2%
Powder 3	100	80	71.7%	30	26.9%	1.6	1.4%
Powder 4	100	80	40.0%	120	60.0%	0	0.0%
Powder 5	100	80	39.7%	120	59.6%	1.3	0.6%
Powder 6	100	80	39.7%	120	59.5%	1.6	0.8%
Powder 7	100	85	73.9%	30	26.1%	0	0.0%
Powder 8	100	85	73.1%	30	25.8%	1.3	1.1%
Powder 9	100	85	72.9%	30	25.7%	1.6	1.4%
Powder 10	100	85	41.5%	120	58.5%	0	0.0%
Powder 11	100	85	41.2%	120	58.2%	1.3	0.6%
Powder 12	100	85	41.1%	120	58.1%	1.6	0.8%
Powder 13	100	75	71.4%	30	28.6%	0	0.0%
Powder 14	100	75	70.6%	30	28.2%	1.3	1.2%
Powder 15	100	75	70.4%	30	28.1%	1.6	1.5%
Powder 16	100	75	38.5%	120	61.5%	0	0.0%
Powder 17	100	75	38.2%	120	61.1%	1.3	0.7%
Powder 18	100	75	38.1%	120	61.0%	1.6	0.8%

- 10 [0048] Table 1 shows the compositions of various honey powders prepared as described herein. The solid content in the liquid honey used depends on the moisture content. With a typical water content of approximately 20%, the liquid honey contains 80% of honey solids which is assumed to be completely used in the honey powder, and thus 100 parts of liquid honey used would contribute 80 parts of honey solid in the
- 15 honey powder produced (Powders 1 to 6). Similarly if the water content is lower at

15% or higher at 25% then the honey solid would contribute 85 parts and 75 parts of honey solid respectively as shown in Table 1 (Powders 7 to 12 and 13 to 18 respectively). Hence, the quantity of honey (in the form of honey solids) in the honey powder is from 35% to 75% by weight (or more accurately 38% to 74%) of the honey powder. The honey powder is presumed to contain only solids.

[0049] The glass former may be added in 30 to 120 parts and is similarly assumed to be completely used in the honey powder and would constitute 25% to 65% by weight of the honey powder. Examples of the glass former are described above. The glass former may possibly be used up to 70% by weight in the powder honey. For the glass former to be used less than 30% by weight, it will be preferable for the glass former to have a higher glass transition temperature like Nutriose or any other suitable glass former or sugar polymer.

[0050] The protein if present may be added in 1.3 to 1.6 parts and is similarly assumed to be completely used in the honey powder and would constitute 0.5% to 1.5% by weight of the honey powder. The components of the honey powder would total 100% by weight of the honey powder.

[0051] The honey powder (prebiotic honey powder) produced and described herein have similarities to normal commercial honey powder in term of its solubility and stability during storage. However, the described honey powder has a low glycaemic index product and the presence of the prebiotic means that it provides more benefits to the consumer's health.

CLAIMS

[Claim 1] A honey powder comprising 30% to 75% by weight of honey and 25% to 70% by weight of a sugar polymer, the sugar polymer having a glycaemic index of 50 or less and a glass transition temperature of at least 80 °C, wherein the sugar polymer comprises a fructose-based fibre.

[Claim 2] The honey powder according to claim 1 further comprising 0.5% to 1.5% by weight of a protein, preferably the protein comprises whey protein concentrate, soy protein concentrate, or combinations thereof.

[Claim 3] The honey powder according to claim 1 or claim 2 comprising 38% to 74% by weight of the honey and 25% to 62% by weight of the sugar polymer.

[Claim 4] The honey powder according to claim 3 comprising 38% to 70% by weight of the honey and 30% to 62% by weight of the sugar polymer.

[Claim 5] A honey powder comprising honey and a sugar polymer, the honey to the sugar polymer ratio is 75-85 to 30-120, the sugar polymer having a glycaemic index of 50 or less and a glass transition temperature of at least 80 °C.

[Claim 6] The honey powder according to any one of claims 1 to 5 further comprising a protein, the honey to the protein ratio is 75-85 to 1.3-1.6.

[Claim 7] The honey powder according to any one of claims 1 to 6, wherein the fructose-based fibre is inulin.

[Claim 8] The honey powder according to any one of claims 1 to 7, wherein the sugar polymer comprises a glucose-based fibre, gum Arabic, or a combination thereof.

[Claim 9] The honey powder according to claim 8, wherein the glucose-based fibre is a dextrin resistant to digestive enzymes or polydextrose.

[Claim 10] The honey powder according to claim 8 or claim 9, wherein the sugar polymer comprises the fructose-based fibre and the glucose-based fibre in a weight ratio of 4:1 to 1:4.

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[Claim 11] The honey powder according to any one of claims 1 to 10, wherein the glycaemic index of the sugar polymer is 35 or less.

10 [Claim 12] The honey powder according to any one of claims 1 to 11, wherein the glass transition temperature of the sugar polymer is at least 100 °C.

[Claim 13] The honey powder according to any one of claims 1 to 12 consisting essentially of the honey, the sugar polymer, and the protein if present.

15 [Claim 14] The honey powder according to claim 13 consisting of the honey, the sugar polymer, and the protein if present.

[Claim 15] The honey powder according to any one of claims 1 to 14 with a diastase value of at least 8.

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[Claim 16] A method of preparing a honey powder according to any one of claims 1 to 15, the method comprising providing a mixture comprising a liquid honey, the sugar polymer, and the protein if present; stirring the mixture to obtain a solution; and spray drying the solution.

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[Claim 17] The method according to claim 16, wherein spray drying is done with an inlet temperature of 140 °C to 170 °C and an outlet temperature of 82 °C to 90 °C.