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(71) Applicant (*for all designated States except US*):
DANISCO A/S [DK/DK]; Intellectual Capital, Langebro-
gade 1, P.O. Box 17, DK-1001 Copenhagen K (DK).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **RAUTONEN, Nina**
[FI/FI]; Säynäväkuja 4B8, FIN-023710 Espoo (FI). **APA-
JALAHTI, Juha** [FI/FI]; Kytöniityntie 24 C, FIN-00670
Helsinki (FI). **SIKANEN, Osmo** [FI/FI]; Tarhurinkuja 5-7
C 11, FIN-08700 Virkkala (FI).

(74) Agents: **DENHOLM, Anna** et al.; D Young & Co, 21 New
Fetter Lane, London, EC4A 1DA (GB).

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(54) Title: NOVEL USE AND COMPOSITIONS

(57) Abstract: The use of a hydrocolloid as a prebiotic in the preparation of a product for consumption is described. The hydrocol-
loid has the advantage of reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said
product. Compositions containing the hydrocolloid, methods for using the compositions in methods of treatment are also provided.



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NOVEL USE AND COMPOSITIONS

Field of Invention

- 5 The present invention relates to a novel use, compositions, methods of making same and to methods of treatment using same.

Introduction

- 10 Dietary fibre is defined as:

“all the polysaccharides and lignin in the diet that are not digested by the endogenous secretion of the human digestive tract” (Trowell et al., 1976, Lancet, 1; 967).

15

According to the so-called dietary fibre hypothesis:

- 20 *“A diet that is rich in foods that contain plant cell walls is protective against a range of diseases, in particular those prevalent in affluent Western Communities” (Gordon, 1988, Dietary fiber, Plenum Press, New York: 105-128).*

- The range of health effects include for example enhanced mineral absorption, increased vitamin bioavailability, positive changes in the plasma lipid profiles, improved colonic function and improved health. These are mediated primarily indirectly by altering the intestinal microflora and its metabolic end products – such as an increased production of volatile fatty acids (especially that of butyrate), a reduced pH, a favourable metabolism of biogenic amines, a reduced production of carcinogenic compounds, a local immunostimulation, and a reduced oxidative stress.
- 25
- 30

Several recent studies on colorectal cancer (Faivre and Bonithon-Kopp, 1999, *Recent Results Cancer, Res.* **151**: 122-133), some of which are still ongoing, state that vitamins and antioxidants do not protect against colorectal cancer – and that the effects of fibre, calcium supplementation, aspirin therapy and dietary intervention are yet to be proven.

Despite some controversy, a general consensus on the positive effects of fibre in preventing cancer seems to exist.

By way of example, the production of volatile fatty acids (VFA) by microbes in the digesta, especially butyrate, is said to improve the well-being of the intestinal mucosal cells and inhibits the growth of colonic carcinomas *in vitro* (Abrahamse *et al.* 1999, *Carcinogenesis*, **20**: 629-634).

A high activity of intraluminal β -glucuronidase enzyme (mostly of microbial origin) is considered harmful since it potentially liberates carcinogenic compounds which were conjugated with glucuronic acid in the liver. This enzyme activity is therefore used as one of the biomarkers for an increased risk for colorectal cancer.

However, a great deal of discrepancy exists on the effect of dietary fibre on that activity. Dietary fibre supplemented with 10% pectin or with 10% guar gum was shown to suppress colon cancer to a significant extent in dimethylhydrazine-induced colon carcinogenesis in rat (Heitman *et al.*, 1992). Similarly, azoxymethane-induced aberrant crypt foci (ACF) were significantly reduced when 10% pectin was given to rats (Rao *et al.*, 1998, *Carcinogenesis*, **13**: 815-818). In that experiment, pectin also reduced the beta-glucuronidase enzyme activity in the caecum while increasing the production of volatile fatty acids.

It is known that gel-forming fibres can slow the absorption of cholesterol and sugar from the intestinal contents therefore reducing hypercholesterolemia and hyperglycaemia. Seal and Mathers, report that guar gum and sodium alginate exhibit strong hypocholesterolaemic effects in experimental animals which may be due to the interruption in the entero-hepatic circulation of bile acids and not

through increased hepatic supply of propionate from fermentation of NSP (non-starch polysaccharides) in the large bowel (Seal CJ and Mathers JC, 2001, *Br. J Nutr.* **85**: 317-324). Yamaguchi *et al.* report that a low-molecular weight pectin with low viscosity had no effect on the plasma cholesterol whereas a high-molecular weight pectin was hypocholesterolemic (Yamaguchi *et al.* 1995, *Biosci. Biotechnol. Biochem.*, **59**: 2130-2131). The viscosity patterns of fibres can change in the process of digestion. In the trials of Brenelli *et al.*, guar gum, pectin and carboxymethylcellulose (CMC) with a similar initial viscosity behaved differently in *in vitro* digestion simulations (Brenelli *et al.*, 1997, *Braz. J. Med. Biol. Rev.*, **30**: 1437-1440). Guar gum showed the highest viscosity in the simulation, and was also the most efficient in lower plasma glucose levels in human trials. Pectin showed a marked reduction of viscosity at 37°C, and lacked any effect on blood glucose levels. The performance of viscosity and the glycemia response to CMC were at intermediate level between guar gum and pectin (Brenelli *et al.*, 1997, *Braz. J. Med. Biol. Rev.*, **30**: 1437-1440).

The aforementioned effects of fibre are largely based on their physical (gelling) action in the intestinal lumen, whereas the so called 'bifidogenic effect' involves the presence of prebiotic fibre. Prebiotic dietary fibres are resistant to gastric digestion allowing them to enter the colon for microbial fermentation. Here, a prebiotic is:

"a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or the activity of one or a limited number of bacteria in the colon." (*Am Clin Nutrit*, 2001; **73**:406S-409S.).

According to the latest consensus report (van Loo *et al.*, 1999, *Br. J. Nutr.*, **81**: 121-132) the definition for prebiotic activity is an increase in the number and/or activity of mainly bifidobacteria or lactic acid bacteria.

Prebiotic effects of pectins, inulin, guar gum, lactosucrose, soybean oligosaccharides, palatinose, isomalto-oligosaccharides, gluco-oligosaccharides, and xylo-oligosaccharides have been reported.

However, since the source and their molecular structure differ somewhat, it is not known how the different molecules affect its prebiotic characteristics (Gibson, G., 2002, *Microbiology Today*, **29**: 4-6).

Other prebiotics, in particular fructo-oligosaccharides (FOS), are increasingly used as foodstuff supplements and can have a more long-lasting effect as they encourage the growth of *Bifidobacteria* already present in the gut. But, here, it is reported that at least 10g FOS is needed daily.

Although beneficial for health, the prebiotics that are currently available on the market frequently cause discomfort to many consumers as they induce flatulence.

Flatulence is caused by excessive amounts of gas released by the rapid fermentation of the prebiotics in the alimentary canal. Flatus produced in a person's intestinal tract not only leads to the potential for social embarrassment, but also may cause personal discomfort, accompanied with abdominal rumblings, cramps, pain and in extreme case diarrhea. As food is digested in humans, flatus is typically generated in the stomach and the intestines. For most people, flatus generation rates are typically between 16 and 24 milliliters per hour. Factors that are known to impact flatus generation rates include diet, age, physiological status, and medical status. It is well documented that the majority of commercially used prebiotics exhibit high gas production when fermented by microorganisms (Rycroft *et al.*, 2001, *J Appl Microbiol*, **91**: 878-887).

Thus, there is a pressing need to identify prebiotic food ingredients, which can lead to reduced gastrointestinal gas production.

Broad Aspects of the Present Invention

Intriguingly, we have found that certain hydrocolloids can have a beneficial prebiotic effect in the gastrointestinal tract.

Aspects of the present invention are presented in the accompanying claims and in the following description and drawings. These aspects are presented under separate section headings. However, it is to be understood that the teachings under each section are not necessarily limited to that particular section heading.

5

Aspects of the Present Invention

Aspects of the present invention are presented in the following commentary and in the accompanying claims.

10

In one aspect, the present invention provides the use of hydrocolloids as prebiotic food ingredients wherein the hydrocolloids are characterised by having a reduced gas release when fermented by bacteria in the gastrointestinal tract.

15 Preferably the hydrocolloid is alginate and/or xanthan or derivatives thereof.

Preferably the hydrocolloid alginate constitutes an ingredient of or is a functional/nutraceutical food product.

20 Preferably the present invention provides the use of hydrocolloids wherein the hydrocolloid is further capable of acting as a fibre supplement in foodstuffs.

In a preferred aspect, the invention comprises the use of slow release hydrocolloids according to the invention in combination with a fast release prebiotic. Preferably the fast release prebiotic is pectin or functional derivatives thereof, inulin or
25 functional derivatives thereof, or locust bean gum (LBG) or functional derivatives thereof.

The present invention also provides a method of producing food ingredients containing prebiotic hydrocolloids comprising admixing said prebiotic
30 hydrocolloids with other food ingredients.

The present invention also provides a method of producing food stuffs containing prebiotic hydrocolloids as ingredients , comprising admixing said prebiotic

hydrocolloids with food components before, during or after the preparation process. Preferably the foodstuff is a fibre beverage or fibre bar or a tablet, pill, capsule or ovule. The method further provides packaging the foodstuff and the provision of a label.

5

In a further aspect the present invention provides a composition comprising a slow release hydrocolloid and a fast release hydrocolloid. Preferably the fast release hydrocolloid is pectin or derivatives thereof. Preferably the slow release hydrocolloid is alginate or derivatives thereof or xanthan or derivatives thereof.

10

The present invention also provides the use of a hydrocolloid in the preparation of a product, wherein said hydrocolloid reduces gas release when fermented by bacteria in the gastrointestinal tract.

15

The present invention also provides a combination comprising a mixture of a slow release hydrocolloid and a fast release hydrocolloid for the preparation of composition – such as a food or a food ingredient or a pharmaceutical or a pharmaceutical ingredient.

20

Advantages of the Present Invention

The hydrocolloids of the present invention have a beneficial prebiotic effect in the gastrointestinal tract. This is advantageous as the hydrocolloids can be used as beneficial food supplements or food ingredients.

25

The hydrocolloids of the present invention have the advantage that they can induce the proliferation of probiotic microorganisms in the colon.

30

In addition, the hydrocolloids of the present invention – in particular the slowly fermented hydrocolloids of the present invention - result in a reduced gastrointestinal gas production/flatulence.

In addition, the hydrocolloids of the present invention – in particular the slowly fermented hydrocolloids of the present invention - cause less discomfort to the consumers while delivering health benefits.

- 5 In a preferred aspect, the hydrocolloids of the present invention: a) induce the proliferation of probiotic microorganisms in the colon; b) result in low levels of gastrointestinal gas production/flatulence; c) cause less discomfort to consumers; and d) impart health benefits.
- 10 Thus a primary advantage of the present invention is the use of hydrocolloids as food ingredients to stimulate beneficial intestinal microbe proliferation and importantly reduce discomfort to consumers by limiting the rate of flatus generation when digested.
- 15 Although it is preferred to use the hydrocolloids of the present invention to stimulate beneficial intestinal microbes - and also to reduce discomfort to consumers by limiting flatulence – the present invention also covers using these hydrocolloids to deliver a medical or physiological benefit in the gastrointestinal tract.
- 20 These – and other – advantages are mentioned in the following text.

Hydrocolloid

- 25 The definition for a hydrocolloid is “a substance with particles of colloidal size that is greatly attracted to water and absorbs it readily”.
- Hydrocolloids include colloidal materials such as vegetable gums that bind water and have thickening and/or gelling properties, and large molecules, such as those
- 30 that make up vegetable gums. Their main applications in the food industry are as emulsifiers and textural ingredients.

The hydrocolloid of the present invention may be obtained from natural sources and/or it may be prepared by chemical and/or enzymatic techniques. The hydrocolloid of the present invention may be obtained from treating other chemicals (natural or synthetic).

5

For some aspects, preferably the hydrocolloid of the present invention is obtained from natural sources and optionally wherein the hydrocolloid is then treated by chemical and/or enzymatic techniques.

10 In accordance with the present invention, the hydrocolloid according to the present invention may be a single component or it may be a combination of components – each of which is a hydrocolloid according to the present invention.

Preferably the hydrocolloid according to the present invention is a slowly
15 fermented hydrocolloid.

In accordance with the present invention, preferably the hydrocolloid according to the present invention is a hydrocolloid selected from a group consisting of alginate, locus bean gum (LBG), xanthan, inulin, pectin or combinations and/or
20 derivatives thereof.

More preferably the hydrocolloid according to the present invention is a hydrocolloid selected from alginate and xanthan or combinations and/or derivatives thereof.

25

In a preferred aspect, the hydrocolloid according to the present invention is alginate or a derivative thereof.

Prebiotic

30

The hydrocolloid of the present invention may be referred to as a prebiotic hydrocolloid.

As used herein, the term “prebiotic” encompasses compounds that escape or resist upper intestine digestion by the host digestive system and beneficially affect the host by selectively stimulating the growth and/or activity of one of a limited number of bacteria in the colon, and thus improve the host's health. Thus the prebiotic hydrocolloids as described herein are able to be utilised by the intestinal bacteria, further promote the growth of beneficial bacteria (traditionally lactibacilli or bifidobacteria) and concomitantly suppress the growth of harmful bacteria (enteropathogens).

As used herein the term “escape or resist upper intestine digestion” describes part of the gastrointestinal tract which includes the stomach with acidity of below pH 3.0 and the gastric enzyme pepsin, as well as small intestine with pancreatic enzyme activities are not able to break down said hydrocolloids.

Derivative

Examples of derivatives of the hydrocolloid of the present invention include chemically treated hydrocolloids and/or physically treated hydrocolloids and/or enzymatically treated hydrocolloids.

For some embodiments, the derivative may be a functional derivative (otherwise called a mimetic) – i.e. an entity having a chemical composition different to - but having at least a substantially similar characteristic functional effect as – the non-treated hydrocolloid.

For some instances, the derivative may exhibit improved properties.

For some instances, the prebiotic hydrocolloid of the present invention is a functional derivative of one or more of: alginate, locus bean gum (LBG), xanthan, inulin and pectin. In this instance, the functional derivatives may be prepared by modification techniques - such as chemical or physical – and wherein the modified alginate, locus bean gum (LBG), xanthan, inulin or pectin still exhibit at least

substantially the same characteristic features as the alginate, LBG, xanthan, inulin or pectin respectively as described in the present application.

Slow-release

5

The term "slow-release" as used herein refers to hydrocolloids which are not readily utilised by the microorganisms of the gastrointestinal tract. The slow-release hydrocolloids are particularly relevant to the present invention as they are characterised by reduced flatulence. Slow-release hydrocolloids are also considered to be beneficial to health.

10

Here, the hydrocolloids when used as food ingredients (e.g. as ingredients in food supplements and/or functional foods) they result in a reduced gastrointestinal gas production/flatulence and they cause less discomfort to the consumers while delivering health benefits.

15

In one preferred aspect the present invention, the hydrocolloids alginate and xanthan are used as slow-release prebiotics.

Fast-release

20

The present invention also includes the use of fast-release hydrocolloids. These are hydrocolloids that are rapidly utilised by the microorganisms in the gastrointestinal tract. Examples of "fast-release" prebiotic hydrocolloids include pectin, inulin, locust bean gum and/or guar gum.

25

Combination of slow-release and fast-release

The present invention also provides a combination of slow-release hydrocolloid(s) and fast-release hydrocolloid(s). This combination has the advantage of prolonging the fermentation but being accompanied with less discomfort of rapid gas formation in the bowel.

30

By way of example, mixing a slow release hydrocolloid with a fast release hydrocolloid can be used to achieve ultimately prolonged fermentation accompanied with less discomfort of rapid gas formation in the bowel.

- 5 In particular, by mixing a slow release alginate with a fast release inulin ultimately results in prolonged fermentation accompanied with less discomfort, reduction in bloating and avoidance of social embarrassment resulting from the consequence of rapid gas formation in the bowel.

10 **Combination with other components**

In accordance with the present invention, the hydrocolloid according to the present invention may be used in combination with other components – which need not be hydrocolloids.

15

Examples of other components include one or more of: thickener, gelling agents, emulsifiers, binders, crystal modifiers, sweeteners (including artificial sweeteners), rheology modifiers, stabilisers, anti-oxidants, dyes, enzymes, carriers, vehicles, excipients, diluents, lubricating agents, flavouring agents, colouring matter, suspending agents, disintegrants, granulation binders etc. These other components may be natural. These other components may be prepared by use of chemical and/or enzymatic techniques.

20

The other components may be used simultaneously (e.g. when they are in admixture together or even when they are delivered by different routes) or sequentially (e.g. they may be delivered by different routes).

25

Food

30 The hydrocolloids of the present invention may be used as – or in the preparation of - a food. Here, the term “food” is used in a broad sense – and covers food for humans as well as food for animals (i.e. a feed). In a preferred aspect, the food is for human consumption.

The food may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

- 5 When used as – or in the preparation of - a food – such as functional food - the hydrocolloids of the present invention may be used in conjunction with one or more of: a nutritionally acceptable carrier, a nutritionally acceptable diluent, a nutritionally acceptable excipient, a nutritionally acceptable adjuvant, a nutritionally active ingredient.

10

Food ingredient

The hydrocolloids of the present invention may be used as food ingredients.

- 15 As used herein the term “food ingredient” includes a formulation which is or can be added to functional foods or foodstuffs as a nutritional supplement and/or fibre supplement. The term food ingredient as used here also refers to formulations which can be used at low levels in a wide variety of products that require gelling, texturizing, stabilizing, suspending, film-forming and structuring, retention of
20 juiciness and improved mouthfeel, without adding viscosity.

The food ingredient may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

25 **Food Supplements**

The hydrocolloids of the present invention may be – or may be added to - food supplements.

30 **Functional foods**

The hydrocolloids of the present invention may be – or may be added to - functional foods.

As used herein, the term “functional food” means food which is capable of providing not only a nutritional effect and/or a taste satisfaction, but is also capable of delivering a further beneficial effect to consumer.

5

Accordingly, functional foods are ordinary foods that have components or ingredients (such as those described herein) incorporated into them that impart to the food a specific functional – e.g. medical or physiological benefit - other than a purely nutritional effect.

10

Although there is no legal definition of a functional food, most of the parties with an interest in this area agree that they are foods marketed as having specific health effects.

15 Some functional foods are nutraceuticals. Here, the term “nutraceutical” means a food which is capable of providing not only a nutritional effect and/or a taste satisfaction, but is also capable of delivering a therapeutic (or other beneficial) effect to the consumer. Nutraceuticals cross the traditional dividing lines between foods and medicine.

20

Surveys have suggested that consumers place the most emphasis on functional food claims relating to heart disease. Preventing cancer is another aspect of nutrition which interests consumers a great deal, but interestingly this is the area that consumers feel they can exert least control over. In fact, according to the
25 World Health Organization, at least 35% of cancer cases are diet-related. Furthermore claims relating to osteoporosis, gut health and obesity effects are also key factors that are likely to incite functional food purchase and drive market development.

30 **Fibre Supplement**

In another aspect, the hydrocolloid of the present invention may be used as – or in the preparation of – a fibre supplement.

Initially, the success of a food product virtually hinged on the word "fibre" or, subsequently, "bran". Despite conflicting studies on fibre's specific health attributes, the overall consensus among experts and consumers is that most people
5 need more fibre in their diet. Fibre has further proven to be useful for its functional properties, such as water absorption and bulk-building in reduced-fat foods.

Fibre has gone by a number of names over the years, including "roughage," "bulk,"
10 "bran", "fibre", "plant residue", "plantix" and "unavailable carbohydrates". Even today, devising a concise, yet complete, definition for dietary fibre is no simple task because dietary fibre is a complex matrix of various components defined differently among various scientific disciplines.

15 Here, the term fibre is used in the context of food and as such it is referred to as non-digestible material. Specifically, fibre consists of cellulose, hemicellulose, pectins, gums, mucilages and lignin.

Not every fibre source contains all of these components. Actually, it is the sheer
20 number of potential combinations that results in the wide variety of different physiological and functional effects observed in different fibre ingredients. By the same token, not every fibre source is 100% dietary fibre.

"Total dietary fibre (TDF) is defined as non-digestible carbohydrates," says Diane
25 Lardiere, national sales and marketing manager, Canadian Harvest, Cambridge, MN. "Wheat bran is only 40% TDF, but is considered a fibre ingredient".

Thus, the hydrocolloids of the present invention may be – or may be added to -
fibre supplements.

30 It is within the scope of the present invention that hydrocolloids may be used as a fibre supplement to the diet in combination with other conventional fibre sources as detailed above. The amount of hydrocolloid added to the foodstuffs is more

than 0.1%, preferably more than 0.5% and more preferably 5%. The recommended dose of fibre intake for adults is between 20 and 35 grams per day or 10-13 grams per every 1000 calories consumed and for children, generally, the intake is based on their age or weight 0.5 grams of fibre per kilogram of body weight (or 0.23 grams per pound of body weight) with an upper limit of 35 grams of fibre per day.

It is also within the scope of the invention to provide a means ensuring that the recommended daily fibre intake (20-35 grams per day or 10-13 grams per every 1000 calories consumed) is achievable. Such tablets, pills, capsules, ovules, solutions or suspensions, can be formulated to substitute for meals and snacks, especially during the beginning of a weight-loss program.

Importantly from a health point of view, when fibre pills are taken with meals, the fibre helps reduce the consequent rise in blood glucose after eating and enhances satiety.

The fibre pills of the present invention may be prepared by techniques known in the art – such as those described in, for example, Remington's Pharmaceutical Sciences, Mack Publishing Co. (A. R. Gennaro edit. 1985). The choice of carrier, excipient or diluent can be selected with regard to the intended route of administration and standard administering practice.

It is also within the scope of this application that the hydrocolloids of the present invention be incorporated in a fibre beverage. Research has indicated that soluble fibre, may help support digestive health and that a diet high in soluble fibre (at least 25 grams per day) may help maintain normal cholesterol levels.

Food Products

The hydrocolloids of the present invention can be used in the preparation of food products such as one or more of: fruit products, vegetable products, dairy products

(such as milk or cheese), meat products, poultry products, fish products, and dough products such as bakery products.

Alginate and functional derivatives thereof can be used as ingredients in food products such as American cheese sauce, anti-caking agent for grated & shredded cheese, chip dip, cream cheese, dry blended whip topping fat free sour cream, freeze/thaw dairy whipping cream, freeze/thaw stable whipped tipping, low fat & lite natural cheddar cheese, low fat Swiss style yoghurt, aerated frozen desserts, and novelty bars, hard pack ice cream, label friendly, improved economics & indulgence of hard pack ice cream, low fat ice cream: soft serve, barbecue sauce, cheese dip sauce, cottage cheese dressing, dry mix Alfredo sauce, mix cheese sauce, dry mix tomato sauce and others.

For certain aspects, preferably the foodstuff is a beverage, such as a fibre drink.

For certain aspects, preferably the foodstuff is a bakery product - such as bread or a fibre bar.

The present invention also provides a method of preparing a food or a food ingredient, the method comprising admixing a hydrocolloid according to the present invention with another food ingredient.

The present invention also provides a combination comprising prebiotic hydrocolloids which comprise slow release prebiotic hydrocolloids for the preparation of a food ingredient.

Furthermore, the combination of the present invention can be a mixture of a slow release hydrocolloid and a fast release hydrocolloid for the preparation of a food ingredient.

Pharmaceutical

The hydrocolloids of the present invention may be used as – or in the preparation of - a pharmaceutical. Here, the term “pharmaceutical” is used in a broad sense –

and covers pharmaceuticals for humans as well as pharmaceuticals for animals (i.e. veterinary applications). In a preferred aspect, the pharmaceutical is for human use and/or for animal husbandry.

- 5 The pharmaceutical can be for therapeutic purposes – which may be curative or palliative or preventative in nature. The pharmaceutical may even be for diagnostic purposes.

10 When used as – or in the preparation of - a pharmaceutical, the hydrocolloids of the present invention may be used in conjunction with one or more of: a pharmaceutically acceptable carrier, a pharmaceutically acceptable diluent, a pharmaceutically acceptable excipient, a pharmaceutically acceptable adjuvant, a pharmaceutically active ingredient.

- 15 The pharmaceutical may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

Pharmaceutical ingredient

- 20 The hydrocolloids of the present invention may be used as pharmaceutical ingredients. Here, the hydrocolloid may be the sole active component or it may be at least one of a number (i.e. 2 or more) active components.

25 The pharmaceutical ingredient may be in the form of a solution or as a solid – depending on the use and/or the mode of application and/or the mode of administration.

Forms

- 30 The hydrocolloids of the present invention may be used in any suitable form – whether when alone or when present in a composition. Likewise, hydrocolloid ingredients of the present invention (i.e. ingredients – such as food ingredients,

functional food ingredients or pharmaceutical ingredients) may be used in any suitable form.

Suitable examples of forms include one or more of: tablets, pills, capsules, ovules, solutions or suspensions, which may contain flavouring or colouring agents, for immediate-, delayed-, modified-, sustained-, pulsed- or controlled-release applications.

By way of example, if the hydrocolloid is used in a tablet form – such for use as a functional ingredient – the tablets may also contain one or more of: excipients such as microcrystalline cellulose, lactose, sodium citrate, calcium carbonate, dibasic calcium phosphate and glycine; disintegrants such as starch (preferably corn, potato or tapioca starch), sodium starch glycollate, croscarmellose sodium and certain complex silicates; granulation binders such as polyvinylpyrrolidone, hydroxypropylmethylcellulose (HPMC), hydroxypropylcellulose (HPC), sucrose, gelatin and acacia; lubricating agents such as magnesium stearate, stearic acid, glyceryl behenate and talc may be included.

Examples of nutritionally acceptable carriers for use in preparing the forms include, for example, water, salt solutions, alcohol, silicone, waxes, petroleum jelly, vegetable oils, polyethylene glycols, propylene glycol, liposomes, sugars, gelatin, lactose, amylose, magnesium stearate, talc, surfactants, silicic acid, viscous paraffin, perfume oil, fatty acid monoglycerides and diglycerides, petroethral fatty acid esters, hydroxymethyl-cellulose, polyvinylpyrrolidone, and the like.

Preferred excipients for the forms include lactose, starch, a cellulose, milk sugar or high molecular weight polyethylene glycols.

For aqueous suspensions and/or elixirs, the hydrocolloids of the present invention and functional derivatives thereof may be combined with various sweetening or flavouring agents, colouring matter or dyes, with emulsifying and/or suspending agents and with diluents such as water, ethanol, propylene glycol and glycerin, and combinations thereof.

The forms may also include gelatin capsules; fibre capsules, fibre tablets etc.; or even fibre beverages .

5 Alginate

In one aspect, the present invention provides the use of alginate - and derivatives thereof - as a slow-release, prebiotic hydrocolloid.

10 Alginates are linear unbranched polymers naturally found in brown seaweeds (*Phaeophyceae*, mainly *Laminaria*) containing β -(1 $\rightarrow$ 4)-linked D-mannuronic acid (**M**) and α -(1 $\rightarrow$ 4)-linked L-guluronic acid (**G**) residues. Although these residues are epimers (D-mannuronic acid residues being enzymatically converted to L-guluronic after polymerization) and only differ at C5, they possess very different
15 conformations; D-mannuronic acid being 4C_1 with diequatorial links between them and L-guluronic acid being 1C_4 with diaxial links between them. Bacterial alginates are additionally O-acetylated on the 2 and/or 3 positions of the D-mannuronic acid residues. The bacterial O-acetylase may be used to O-acetylate the algal alginates, so increasing their water-binding.

20

Alginates are not random copolymers but, according to the source algae, consist of blocks of similar and strictly alternating residues (i.e. **MMMMMM**, **GGGGGG** and **GMGMGMGM**), each of which have different conformational preferences and behaviour. They may be prepared with a wide range of average molecular
25 weights (50 - 100000 residues) to suit the application.

'Designer' alginates can be generated by 5-epimerization of β -(1 $\rightarrow$ 4)-linked D-mannuronic acid residues to α -(1 $\rightarrow$ 4)-linked L-guluronic acid residues in algal alginates using bacterial epimerases. An available natural alternative is to harvest
30 the seaweed from exposed seaboards (more **G** giving the kelp strength) or sheltered bays (more **M**).

The primary function of the alginates are as thermally stable cold setting gelling agents in the presence of calcium ions; which gel at far lower concentrations than gelatin. Such gels can be heat treated without melting, although they may eventually degrade. Gelling depends on the ion binding ($\text{Mg}^{2+} \ll \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$) with the control of the di-cation addition being important for the production of homogeneous gels (e.g. by ionic diffusion or controlled acidification of CaCO_3). High **G** content produces strong brittle gels with good heat stability (except if present in low molecular weight molecules) but prone to water weepage (syneresis) on freeze-thaw, whereas high **M** content produces weaker more-elastic gels with good freeze-thaw behaviour. However, at low or very high Ca^{2+} concentrations high **M** alginates produce the stronger gels. So long as the average chain lengths are not particularly short, the gelling properties correlate with average **G** block length and not necessarily with the **M/G** ratio which may be primarily due to alternating **MGMG** chains. The future prospects are excellent as recombinant epimerases with different specificities may be used to produce novel designer alginates. The use of these in the context of the present invention is also contemplated.

In the context of the present invention, alginate or functional derivatives thereof can be used as an ingredient in a variety of products that require gelling, texturising, stabilising, suspending, film-forming, structuring, retention of juiciness, improve mouth-feel without adding viscosity and flavour release.

We have surprisingly found that advantageously the alginate is fermented by human faecal bacteria at much slower rate than the fermentation of comparable amounts of market leading prebiotics such as for example galacto-oligosaccharide (GOS), fructo-oligosaccharide (FOS), inulin or pectin. Thus, despite the fact that alginate is fermented to some degree by human faecal bacteria to some amounts of volatile fatty acids and gas – those fermentation products are produced at much slower rate than the fermentation of comparable amounts of the market leading prebiotics. This is a particularly advantageous result.

As indicated above, mixing slow release alginate with fast release can be used to achieve ultimately prolonged fermentation accompanied with less discomfort of rapid gas formation in the bowel. By way of a further example, it may be mixed with fast release inulin to achieve ultimately prolonged fermentation accompanied with less discomfort, reduction in bloating and avoidance of social embarrassment resulting from the consequence of rapid gas formation in the bowel.

Xanthan

- 10 In one aspect, the present invention provides the use of xanthan - and functional derivatives thereof - as a slow-release, prebiotic hydrocolloid.

Xanthan is an anionic bacterial polysaccharide composed of a $\hat{U}$ -(1->4)-D-Glc (1->4)-beta-D-Glc (cellulosic) backbone with a trisaccharide side chain linked to C3 of every second glucose residue. The side chain is $\hat{U}$ -D-Man-(1->4)- $\hat{U}$ -D-GlcA-(1->2)-6-O-acetyl-alpha-D-Man-(1->beta-D-Man-(1->4)-beta-D-GlcA-(1->2)-alpha-D-Man-(1->) with approximately 60% of the terminal mannose units being pyruvylated. 90% of the proximal mannose units are substituted at C6 with O-acetyl groups. There are side chains having 2 mannose and 1 gluconic glucuronic acid group.

Xanthan gum is an exocellular polysaccharide produced by fermentation of the bacteria *Xanthomonas campestris*, originally isolated from the rutabaga plant. It is a cream-coloured powder that dissolves in water to produce a thick viscous solution at low concentrations. Xanthan remains stable over a wide temperature range and forms a strong film on drying. Xanthan is used as a binder, an extender and a stabiliser in foods and cosmetics.

Fennema, O.R., Food Chemistry, Marcel Dekker, New York (1996) lists xanthan as emulsion stabiliser; which holds water; enhances freeze-thaw stability; inhibits starch retrogradation; improves shelf life and serves to bring about stabilisation of dispersions in foods and cosmetics, suspensions, and as an emulsions thickener, binder, extender and crystal modifier.

Xanthan is characterised with the following features: it provides visibly clear solutions even at high concentrations, it is soluble in both hot and cold water, it imparts high solution viscosity at low polysaccharide concentrations, its viscosity change is minimal over wide temperature range, it is soluble and stable in both acidic and alkaline solutions, it is compatible and stable in solutions with high salt concentrations, it is highly resistant to enzymatic degradation, it is a good lubricant, it imparts freeze/thaw stability, it is an effective emulsion stabiliser, it has an excellent mouth-feel, it can have synergistic properties with guar and locust bean gum.

In one preferred aspect, the present invention also provides xanthan as a prebiotic hydrocolloid for use as a food ingredient in combination with alginate.

Other preferred combinations include using xanthan as a food ingredient in combination with one or more of: pectin, locust bean gum (LBG) or inulin and/or functional derivatives thereof.

In this respect, we found that xanthan, alginate and LBG were shown to stimulate the growth of most beneficial bacteria tested, but especially the proliferation of the beneficial *Bifidobacterium* and *Lactobacillus*. The importance of these bacteria is manifested in that:

Bifidobacteria may help fight a wide range of harmful and food-poisoning bacteria, including enteropathogenic *E coli*.

Lactobacillus GG can be helpful in treating antibiotic-associated diarrhoea.

Lactobacillus GG has also been shown effective at treating some cases of travellers' diarrhoea and rotavirus infection, the most common cause of diarrhoea in adolescents and the immunocompromised.

We also found that xanthan is capable of strongly suppressing the growth of the enteropathogenic *E coli*. The ability of xanthan to suppress the growth of said

enteropathogenic bacteria is of particular relevance to pig husbandry as piglets infected by this bacterium suffer from weight loss which in extreme cases can lead to death.

- 5 Supplementing the diet with hydrocolloids which are capable of stimulating the proliferation of beneficial microorganisms and concomitantly reducing the growth of enteropathogenic microorganisms may also help reduce certain food allergies. This may be due to the fact that the proliferation of beneficial bacteria can reinforce the barrier properties of the gut so that improperly digested compounds
10 cannot leak through.

Pectin

- In one aspect, the slow-release hydrocolloid of the present invention may be used
15 in combination with a pectin - or a functional derivative thereof.

- The pectin may be used simultaneously (e.g. when they are in admixture together or even when they are delivered by different routes) or sequentially (e.g. they may be delivered by different routes).

20

Preferably, the pectin is delivered at the same time and/or by the same route and/or in admixture with the slow-release hydrocolloid of the present invention.

- More preferably, the pectin is delivered in admixture with the slow-release
25 hydrocolloid of the present invention.

Pectin is an important commodity in today's industry and can be used in the food industry as a thickening or gelling agent, such as in the preparation of jams.

- 30 Pectin is a structural polysaccharide commonly found in the form of protopectin in plant cell walls. The backbone of pectin comprises α -1,4 linked galacturonic acid residues which are interrupted with a small number of 1,2 linked α -L-rhamnose units. In addition, pectin comprises highly branched regions with an almost

alternating rhamno-galacturonan chain. These highly branched regions also contain other sugar units (such as D-galactose, L-arabinose and xylose) attached by glycosidic linkages to the C3 or C4 atoms of the rhamnose units or the C2 or C3 atoms of the galacturonic acid units. The long chains of α -1,4 linked galacturonic acid residues are commonly referred to as "smooth" regions, whereas the highly branched regions are commonly referred to as the "hairy regions".

Some of the carboxyl groups of the galacturonic residues are esterified (e.g. the carboxyl groups are methylated). Typically esterification of the carboxyl groups occurs after polymerisation of the galacturonic acid residues. However, it is extremely rare for all of the carboxyl groups to be esterified (e.g. methylated). Usually, the degree of esterification will vary from 0-90%. If 50% or more of the carboxyl groups are esterified then the resultant pectin is referred to as a "high ester pectin" ("HE pectin" for short) or a "high methoxyl pectin". If less than 50% of the carboxyl groups are esterified then the resultant pectin is referred to as a "low ester pectin" ("LE pectin" for short) or a "low methoxyl pectin". If 50% of the carboxyl groups are esterified then the resultant pectin is referred to as a "medium ester pectin" ("ME pectin" for short) or a "medium methoxyl pectin". If the pectin does not contain any - or only a few - esterified groups it is usually referred to as pectic acid.

The structure of the pectin, in particular the degree of esterification (e.g. methylation), dictates many of the resultant physical and/or chemical properties of the pectin. For example, pectin gelation depends on the chemical nature of the pectin, especially the degree of esterification. In addition, however, pectin gelation also depends on the soluble-solids content, the pH and calcium ion concentration. With respect to the latter, it is believed that the calcium ions form complexes with free carboxyl groups, particularly those on a LE pectin.

Locust Bean Gum

In one aspect, the slow-release hydrocolloid of the present invention may be used in combination with Locust Bean Gum (LBG) - or a functional derivative thereof.

The LBG may be used simultaneously (e.g when they are in admixture together or even when they are delivered by different routes) or sequentially (e.g they may be delivered by different routes).

- 5 Preferably, the LBG is delivered at the same time and/or by the same route and/or in admixture with the slow-release hydrocolloid of the present invention.

More preferably, the LBG is delivered in admixture with the slow-release hydrocolloid of the present invention.

10

LBG is a soluble fibre of plant material derived from the endosperm of beans of exotic trees grown mostly in Africa and the Mediterranean (*Ceratonia siliqua*). Locust bean gum is a synonym for carob bean gum, the beans of which were used centuries ago for weighing precious metals, a system still in use today, the word
15 carob and Karat having similar derivation.

15

In the food industry, LBG is used in ice cream, sauces, bakery products, processed cheese and different dairy or non-dairy beverages. The presence of LBG in foodstuffs can improve smoothness in body and texture, reduce the ice crystal
20 formation during storage and re-crystallisation, provide uniformity, aid in suspension of flavouring particles, improve stability of foam, improve cutting procedure, and reduction in crumb production, prevent shrinkage in the frozen foodstuff, and slow down moisture migration out of the frozen product.

20

- 25 LBG hydrates when heated, it has high viscosity after cooking and excellent milk reactivity. The term "reactivity" as used here refers to the ability of LBG to homogeneously mix with milk and without having any adverse or other wise detrimental effect on milk or milk products thereof. LBG also provides excellent heat shock resistance, smooth meltdown, and desirable texture and chewiness in
30 ice cream and other frozen dessert products.

30

Inulin

In one aspect, the slow-release hydrocolloid of the present invention may be used in combination with inulin - or a functional derivative thereof.

5

The inulin may be used simultaneously (e.g when they are in admixture together or even when they are delivered by different routes) or sequentially (e.g they may be delivered by different routes).

10 Preferably, the inulin is delivered at the same time and/or by the same route and/or in admixture with the slow-release hydrocolloid of the present invention.

More preferably, the inulin is delivered in admixture with the slow-release hydrocolloid of the present invention.

15

Inulin is a fructan and storage carbohydrate and belongs to a group of naturally-occurring carbohydrates containing non-digestible fructooligosaccharides. The nutrition industry refers to them as FOS. Inulin is found naturally in more than 36,000 types of plants worldwide. It is estimated that approximately one-third of the earth's vegetation contain this substance. Inulin is a major constituent of some of the most famous of the "old-standby" herbs, such as burdock root, dandelion root, elecampane root, chicory root, and the Chinese herb codonopsis. Inulin is also a natural dietary fibre present in common fruits and vegetables like artichokes, asparagus, onions, garlic, raisins and bananas. Botanically, inulin is a storage food in the plants of the Composite family. It is not digested or absorbed, however, (except perhaps in mico-amounts) and such effects are not observed with oral use. Inulin is recommended sometimes for diabetics; it has a mildly sweet taste, and is filling like starchy foods, but because it is not absorbed, it does not affect blood sugar levels. Inulin is soluble in hot water, but only slightly soluble in cold water or alcohol, so is not present to any significant extent in tinctures (Spiller, GA. Dietary Fiber in Health and Nutrition, Boca Raton, Florida: CRC Press, 1994).

20
25
30

Inulin has also been proven to be a good source of soluble dietary fibre and is well suited for diabetics because it does not increase the glucose level or insulin level in the blood. Importantly, recent research has shown that inulin significantly increases the absorption of calcium.

5

EXAMPLES

The present invention will now be described by way of examples, and with reference to the accompanying figures and tables:

10 **FIGURES AND TABLES.**

Figure 1. *In vitro* degradation of hydrocolloids.

Figure 2. Gas production as function of time in a batch fermentation with faecal inoculum.

15

Figure 3. Net molar production of gas from hydrocolloids from the batch experiment with faecal inocula. Initial gas production between 0-4 hours and Delayed gas production between 3-24 hours.

20 Figure 4. pH changes in the 24 hour batch fermentation in the presence of a selection of hydrocolloids.

Figure 5. Total microbial count in the batch fermentation with faecal inoculum.

25 Figure 6. Gas production as function of time in the batch fermentation experiment with faecal inoculum with a selection of hydrocolloids

Figure 7. pH after 24 hours batch fermentation with or without (control) hydrocolloids.

30

Figure 8. VFA production (mmol/l after 24 hours) in the presence of a selection of hydrocolloids.

Table 1 Net molar production of gas and total VFA's from hydrocolloids and VFA/gas-ratio in an experiment including faecal inocula.

Table 2. Relative composition of VFA's.

5

METHODS

In vitro digestion of hydrocolloids

Digestion of hydrocolloids in the stomach was simulated by pepsin-HCl treatment at pH 3.0. After the stomach simulation, the pH was raised to 6.5 by adding NaOH. Pancreatin was added to simulate digestion in the small intestine. Degradation of hydrocolloids was analysed by size exclusion chromatography (SEC) by comparing peak areas before and after simulation.

"Stomach" at pH3

0.3g of hydrocolloid was weighed and dissolved overnight at +37°C in 0.1 M Na-phosphate buffer, pH 6. The pH was adjusted to 3 with 1 M HCl. 1.7ml pepsin was added (Sigma P7000, from porcine, 13 mg/ml in 0.01 M HCl) and mixed. The sample was incubated for 120 minutes at +37°C.

"Small intestine" at pH 6.5

The pH was adjusted to 6.5 with 1 M NaOH. 5ml of pancreatin solution was added (Merck 107133, from porcine, 4 mg/ml). The volume was adjusted to 100 ml with water and mixed. The sample was incubated for 180 minutes at +37°C and stored at -20°C until analysed. The blank sample was prepared in the same way but without the enzymes.

Batch fermentation of hydrocolloids with faecal bacteria

Faeces from 4-5 donors were pooled and diluted with 5 parts of phosphate buffer at pH 7 with reducing agent. The mixture was stirred anaerobically at 37°C for 1h and filtered through metal grid to remove solid particles. 25ml of filtrate was mixed with 0.25 g of hydrocolloid and incubated anaerobically at 37°C with stirring (120 rpm) for 24h. Gas production was measured 1, 2, 3, 4 and 24h after inoculation and volatile fatty acids (VFA), pH and microbes were measured at 24h

after inoculation. In calculations both initial and delayed gas production were determined. Initial production was calculated from the four first hours, and delayed production from three hours onwards.

5 **Growth responses of probiotic and indicator microbes**

50 mg of tested hydrocolloid was sterilized with 0.5 ml of ethanol in an anaerobic bottle. The ethanol was allowed to evaporate after which the bottle was closed and the gas atmosphere changed to anaerobic in an anaerobic chamber through a sterile filter.

10

10ml of tryptone soy broth (LABM) enriched with diluted pig ileal digesta (pH 7.3) served as the growth medium for the tested microbes (*Bifidobacterium* , *Lactobacillus plantarum* , *L.acidophilus* , *L. casei* , *Eschericia coli* K88, and *Salmonella enteritidis*). A 10% inoculum was used for the probiotic microbes and
15 a 1% inoculum for the fast growing indicator microbes.

The microbes were grown in the presence and absence of carbon sources. The carbon sources were locust bean gum, guar, xanthan, lime pectin, alginate, and kappa carrageenan. pH and gas production was measured at certain time intervals
20 during a 48-h growing period. Samples for microbial counting were also taken.

Total microbial counts

The total number of microbes was analysed by flow cytometry. Samples collected from the simulator were appropriately diluted and the cells stained with a
25 fluorescent, nucleic acid binding dye(Molecular Probes) having absorption at wavelength of 490 nm and emission at 515 nm. After staining, the amount of events per fixed time internal was determined by running the sample into FACS Calibur (Becton Dickinson) flow cytometer with parameters adjusted suitable for counting of microbes. The cells were quantified by using BD TrueCount™ Tubes
30 including a certain amount of fixed sized fluorescent beads. During analysis, the absolute number of cells in the sample could be determined by comparing cellular events to bead events.

PH

The pH was measured with a glass electrode.

Gas measurement

- 5 The produced gas volume was measured with a syringe.

VFA – analysis

- 100 µl of sample solution, 100 µl of ISTD-solution (20 mM pivalic acid), 300 µl of water and 250 µl of saturated oxalic acid solution were mixed and allowed to stand
10 for 60 min at 4 °C. The samples were then centrifuged for 5 min at maximum speed and injected (1 µl) of the supernatant into the gas chromatograph.

Example 1. *In vitro* digestion of hydrocolloids

- The results of *in vitro* stomach and small intestine simulation with endogenous
15 enzymes are shown in Figure 1. Wheat starch was used as a control and it was degraded during 30 min after the simulation. The hydrocolloids were not digested in 120-min simulation. No significant digestion was detected.

Example 2. Batch fermentation of hydrocolloids with faecal bacteria

- 20 The gas production as function of time from hydrocolloids in the batch fermentation with faecal inocula is shown in Figure 2. The net rate of molar gas production is shown in Figure 3. The molar gas production was calculated using the ideal gas equation where the volume of one mole of gas is 22.414 L. The VFA/gas-ratio is shown in Table 1, and the percent composition of produced
25 VFA's in Table 2.

- The alginates produced 80-84% acetic acid and 9-13% butyric acid. Carob germ flour produced also minor amounts of iso-acids. (Table 1) Starch was used as a control. After incubation the samples were also analysed by SEC to get
30 approximate values how well the hydrocolloids were fermented. The method measures concentration of the hydrocolloid in its original form. Completeness of digestion or digestion of the side chains could not be measured. No pectin or

xanthan was detected in the samples at the end of the test. Trace amounts (1-2 %) of alginates, LBG and guar gum were also detected.

The reduction in pH by different hydrocolloids (Figure 4) grossly followed their fermentability pattern: high fermentation usually reduced the pH more than a less efficient fermentation. Sometimes, as in the case of carob germ flour, the high protein concentration in the hydrocolloid may produce ammonia which may compensate the pH reduction.

Total microbial counts are shown in Figure 5. High G-high viscosity alginate, alginate, and guar gum increased the total microbial amounts compared to the control.

Example 3. Batch fermentation with faecal bacteria

The gas production as a function of time from hydrocolloids in the batch fermentation with faecal inoculum is shown in Figure 6. The highest initial gas production rates were seen in those groups that contained pectin. In comparison with the previous trial described above, the initial gas production of high ester lime pectin was slower. This could reflect a lot-to-lot difference. All other hydrocolloids gave more consistent results between the trials.

The combination of pectin with xanthan resulted in a slower initial gas production. Similarly, the addition of xanthan to alginate resulted in slower initial gas production than that with alginate alone. This latter one was actually equally low as that without any carbon source (control) (Figure 6). The initial speed of gas production rate without control carbon source, starch (Maizena), was close to the level of those with pectin.

The delayed gas production rates with carbon sources were greater than that without a carbon source (Control), but the different types of hydrocolloids did not seem to differ from each other considerably (Figure 6).

The reduction in pH after the 24h batch fermentation was close to one pH unit (Figure 7). When compared to the no-carbon source control, the production of VFA was increased in the presence of extra carbon source (Figure 8). The pectins seemed to be somewhat better in that respect than the others. As was seen in the gas production, replacing half of pectin with xanthan slightly reduced VFA production suggesting that pectin may stimulate gas production better than xanthan. The smallest VFA production was in the combination of xanthan + alginate. These values for Maizena and Lime pectin were slightly smaller than reported above. The control, however, produced very similar values in both trials.

SUMMATION

Some summary aspects of the present invention are now presented by way of numbered paragraphs:

1. Use of a hydrocolloid in the preparation of a product for consumption, wherein said hydrocolloid has a reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid.
2. A hydrocolloid for use as a product having a beneficial therapeutic effect, wherein said hydrocolloid is a slowly fermentable hydrocolloid.
3. A process comprising forming a product for consumption, wherein said product comprises a hydrocolloid that has a reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid .
4. A method of preparing a product, the method comprising admixing a hydrocolloid with another component so as to form said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid .
5. A product for consumption, wherein said product comprises a hydrocolloid that has a reduced gas release when fermented by bacteria in the gastrointestinal tract after the

consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid.

6. A container comprising a product for consumption, wherein said product comprises a hydrocolloid that has a reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid.

7. A container comprising a product for consumption, wherein said product comprises a hydrocolloid that has a reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid and/or a slow-release hydrocolloid; and wherein said container has thereon a label indicating use and/or approval wherein the hydrocolloid has reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product.

8. A product comprising a mixture of a slow release hydrocolloid and a fast release hydrocolloid for use in causing a beneficial therapeutic effect.

9. The invention according to any one of the preceding paragraphs wherein the hydrocolloid is alginate and/or xanthan or derivatives thereof.

10. The invention according to any one of the preceding paragraphs wherein the hydrocolloid is used in combination with one or more other hydrocolloids.

11. The invention according to any one of the preceding paragraphs wherein the hydrocolloid is used in combination with one or more fast-release hydrocolloid, such as one or more of: locus bean gum (LBG), inulin, pectin or combinations and/or derivatives thereof.

12. The invention according to any one of the preceding paragraphs wherein the product is a functional food.

13. Use of hydrocolloids as prebiotic food ingredients substantially as described herein.

14. A prebiotic food composition substantially as described herein.

5

All publications mentioned in the above specification are herein incorporated by reference. Various modifications and variations of the described methods and system of the present invention may be apparent to those skilled in the art without departing from the scope and spirit of the present invention. Although the present
10 invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in chemistry and biochemistry or related fields are intended to be within the scope of the following
15 claims.

CLAIMS

- 5 1. Use of hydrocolloids as prebiotic food ingredients wherein the hydrocolloids are characterised by having a reduced gas release when fermented by bacteria in the gastrointestinal tract.
2. Use of hydrocolloids according to claim 1 wherein the hydrocolloid is
10 alginate and/or xanthan or derivatives thereof.
3. Use of hydrocolloids according to claim 2 wherein the hydrocolloid alginate constitutes an ingredient of or is a functional/nutraceutical food product.
- 15 4. Use of hydrocolloids according to any preceding claim wherein the hydrocolloid is further capable of acting as a fibre supplement in foodstuffs.
5. Use of slow release hydrocolloids according to any preceding claim in combination with a fast release prebiotic.
20
6. Use of a combination according to claim 5 wherein the fast release prebiotic is pectin or functional derivatives thereof.
7. Use of a combination according to claim 5 wherein the fast release prebiotic
25 is inulin or functional derivatives thereof.
8. Use of a combination according to claim 5 wherein the fast release prebiotic is locust bean gum (LBG) or functional derivatives thereof.
- 30 9. A method of producing food ingredients containing prebiotic hydrocolloids according to any one of the preceding paragraphs comprising admixing said prebiotic hydrocolloids with other food ingredients.

10. A method of producing food stuffs containing prebiotic hydrocolloids as ingredients according to claim 9, comprising admixing said prebiotic hydrocolloids with food components before, during or after the preparation process.

5 11. A method of producing foodstuffs according to claim 9 or 10 wherein the foodstuff is a fibre beverage or fibre bakery product.

12. A method of producing a foodstuff according to claim 9 or 10 wherein the foodstuff is a tablet, pill, capsule or ovule.

10

13. A method according to any of claim 9 to 12 further comprising packaging the foodstuff.

14. A method according to claim 13 comprising the provision of a label.

15

15. A product for consumption, wherein said product comprises a hydrocolloid that has reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid.

20

16. A container comprising a product for consumption, wherein said product comprises a hydrocolloid that has reduced gas release when fermented by bacteria in the gastrointestinal tract after the consumption of said product; wherein said hydrocolloid is a slowly fermentable hydrocolloid.

25

17. A product comprising a mixture of a slow release hydrocolloid and a fast release hydrocolloid for use in causing a therapeutic effect.

18. A product according to claim 17 which is a functional food.

30

19. Use of hydrocolloids as prebiotic food ingredients substantially as described herein.

20. A composition comprising a slow release hydrocolloid as defined in any preceding paragraph and a fast release hydrocolloid.

21. A composition according to claim 20 wherein the fast release hydrocolloid
5 is pectin or derivatives thereof.

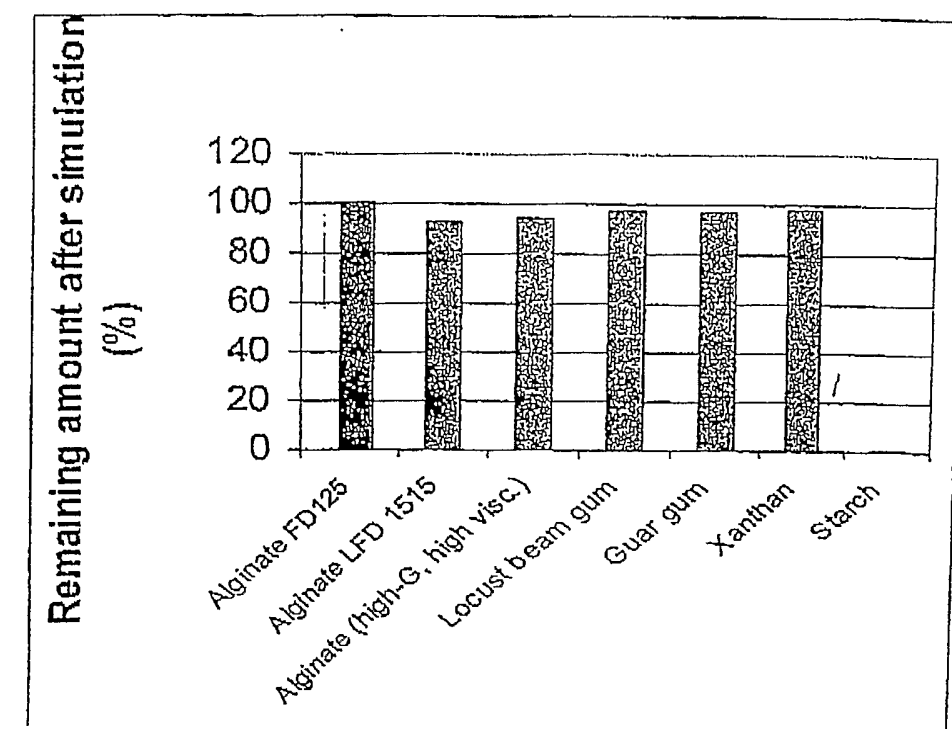
22. A composition according to claim 20 wherein the slow release hydrocolloid is alginate or derivatives.

10 23. A composition according to claim 20 wherein the slow release hydrocolloid is xanthan or derivatives.

24. Use of a hydrocolloid in the preparation of a product, wherein said hydrocolloid reduces gas release when fermented by bacteria in the gastrointestinal tract.

15

In vitro stomach and small intestine simulation of hydrocolloids

Figure 1. Degradation of hydrocolloids in the *in vitro* simulation.

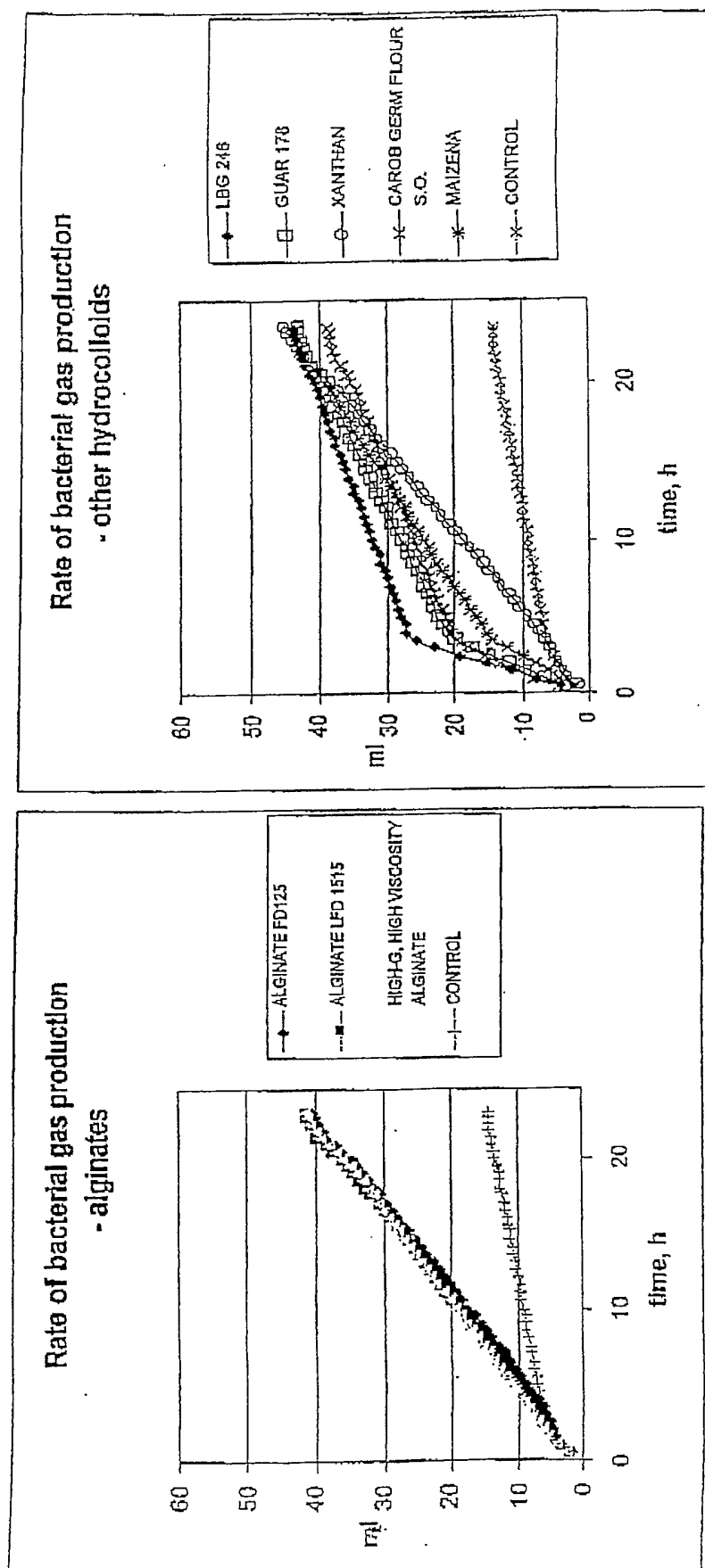


Figure 2. Gas production as function of time in the batch fermentation with faecal inocula.

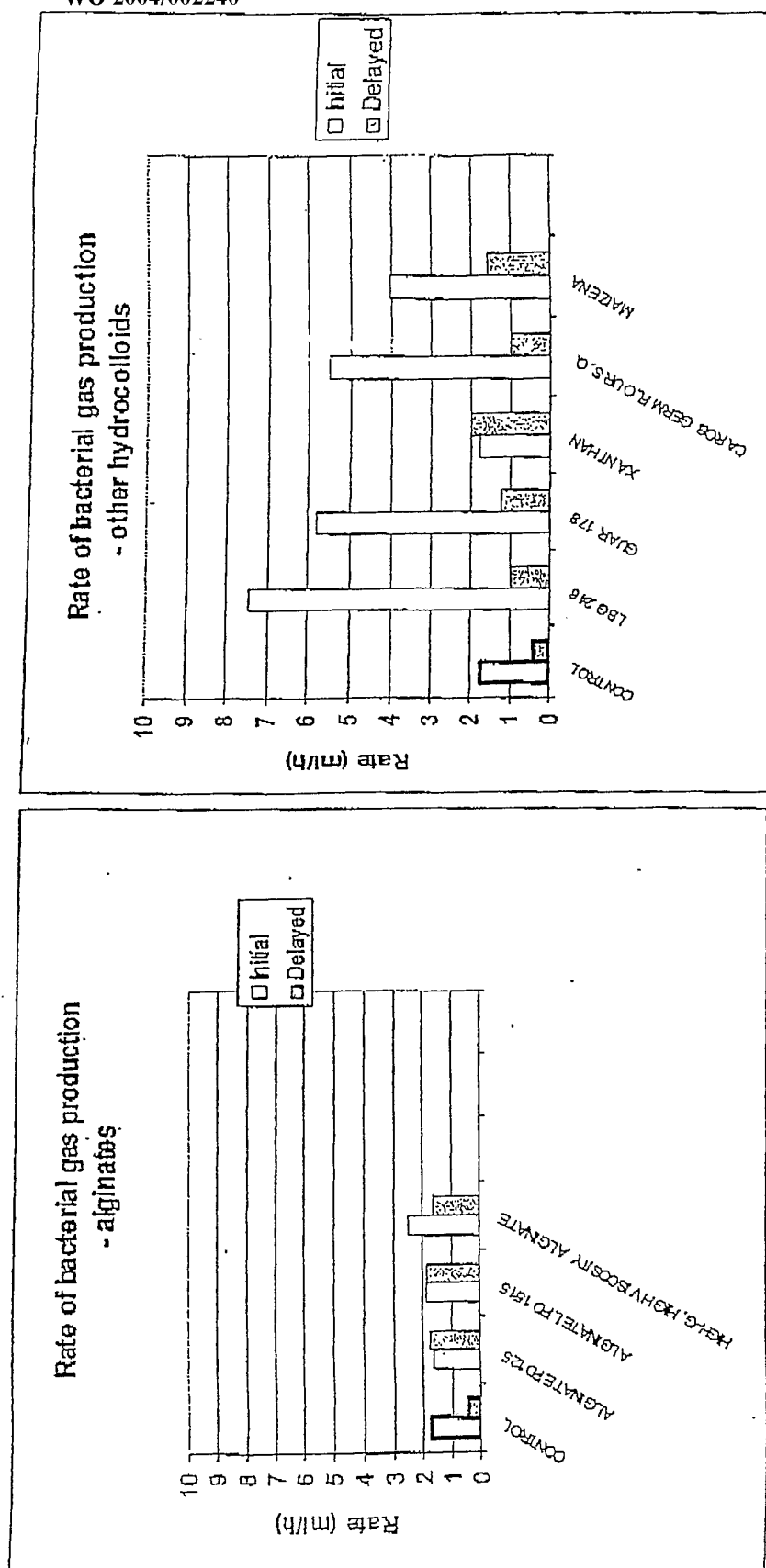


Figure 3. Net molar production of gas from hydrocolloids in the batch experiment with faecal inocula. Initial = gas production between 0 – 4 h; Delayed = gas production between 3 – 24 h.

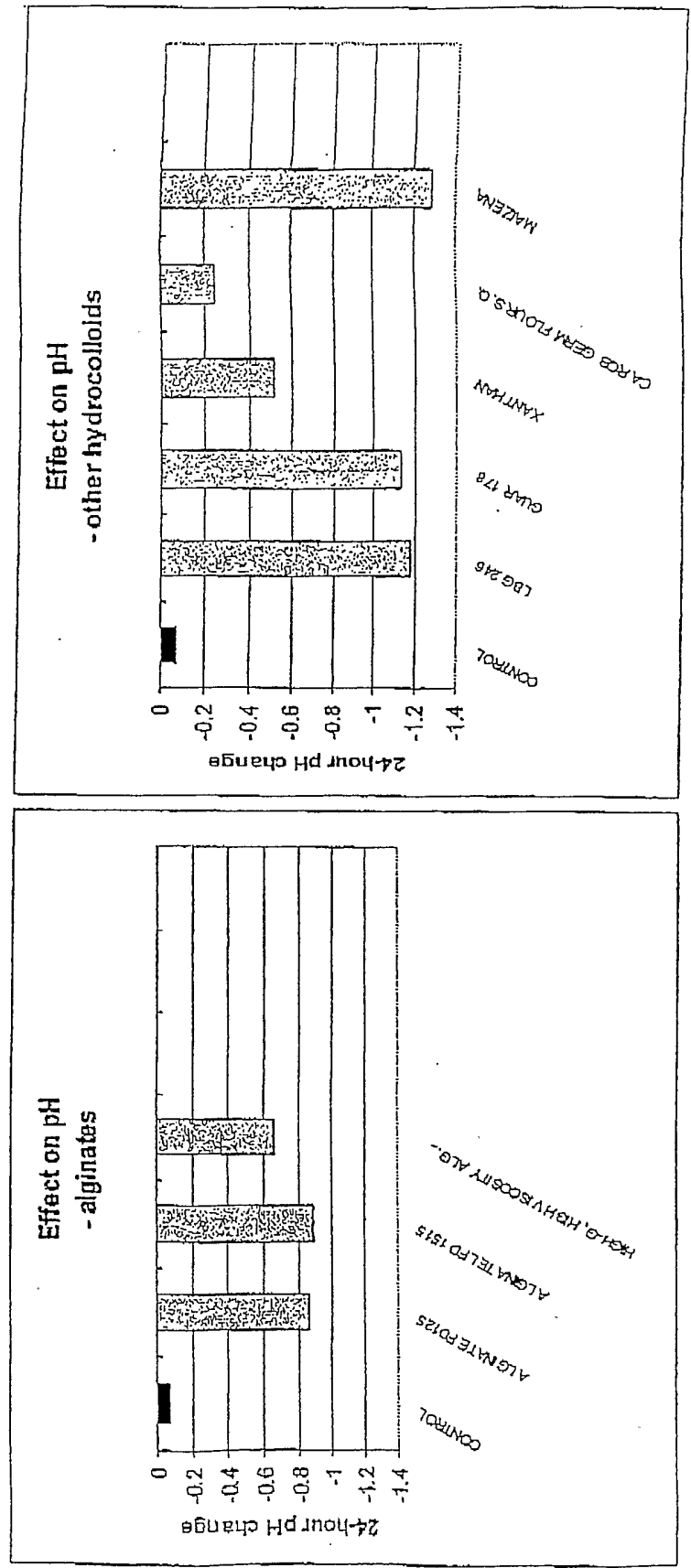


Figure 4. pH changes in the 24-h batch fermentation in the presence of different hydrocolloids.

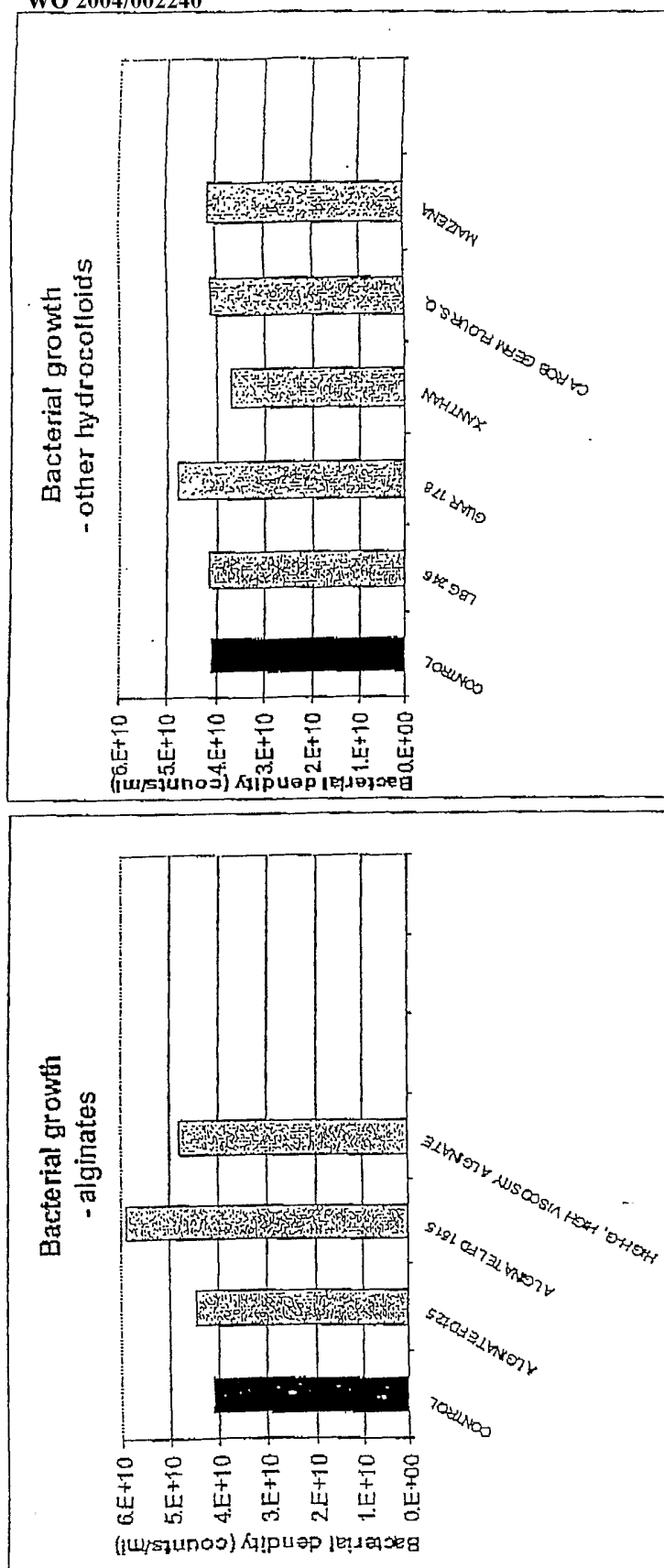


Figure 5. Total microbial counts in the batch fermentation with faecal inocula.

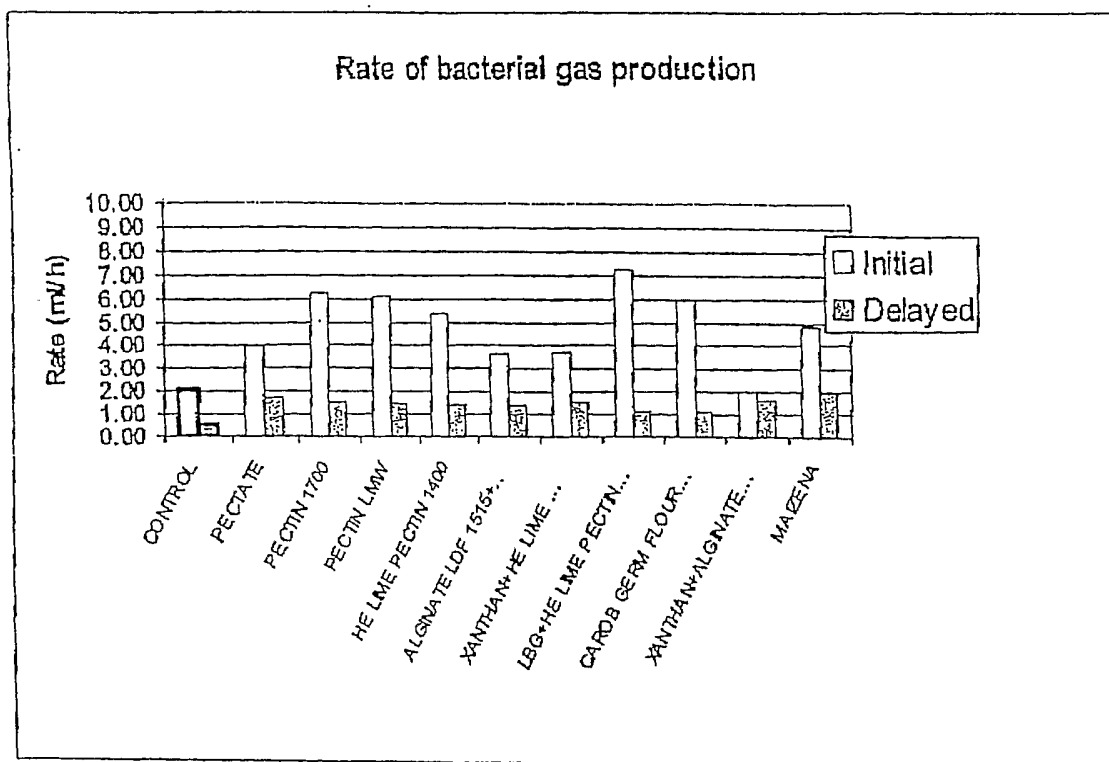


Figure 6. Gas production as function of time in the batch fermentation experiment with faecal inoculum with a selection hydrocolloids.

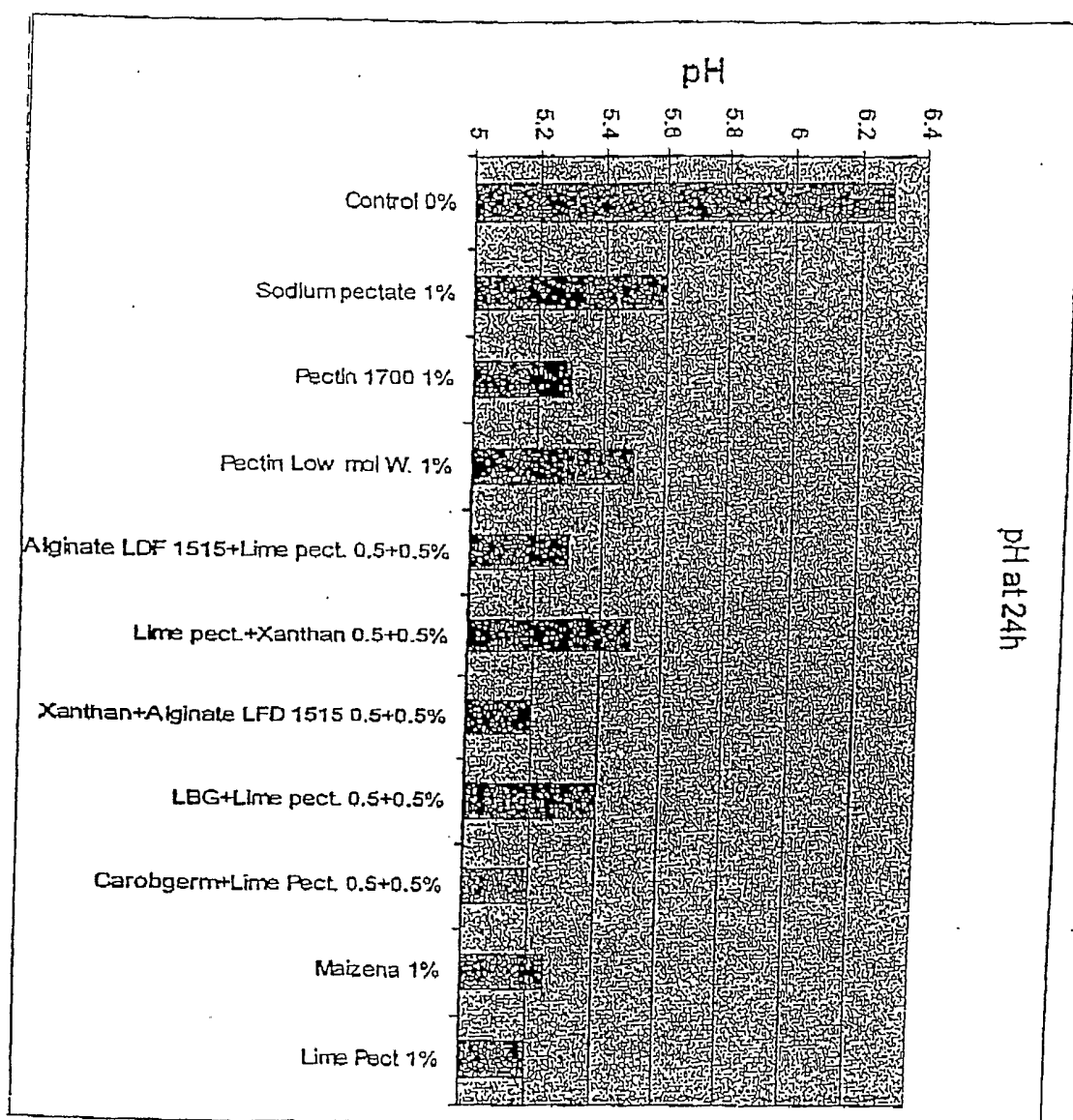


Figure 7. pH after 24h batch fermentation with or without (Control) hydrocolloids.

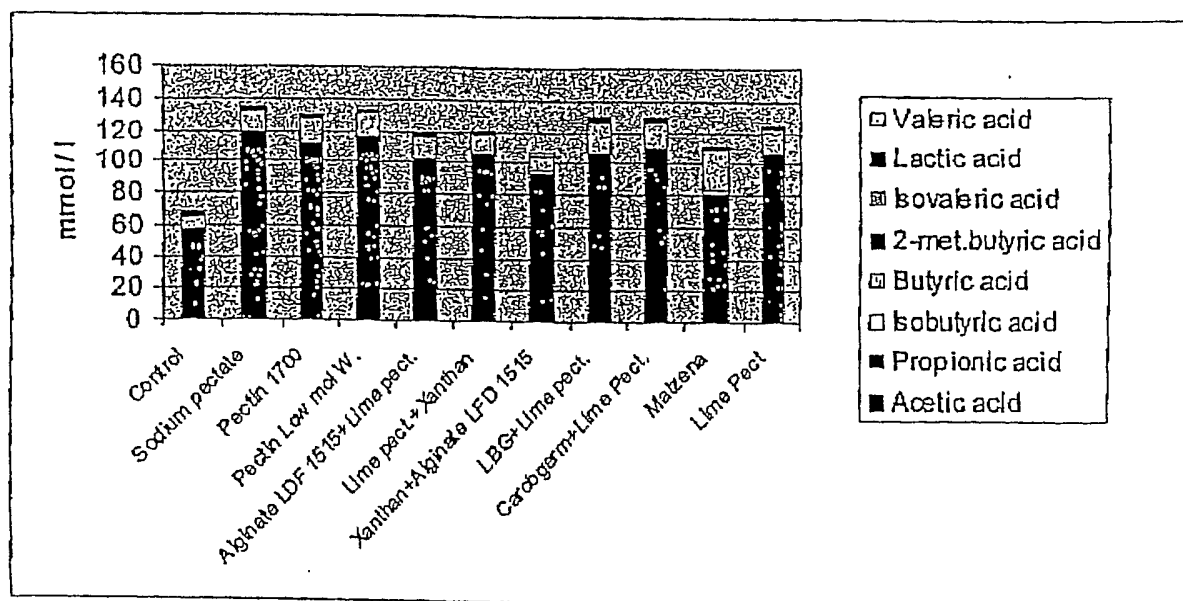


Figure 8. VFA production (mmol/l after 24 hours) in the presence of various hydrocolloids.

	Gas mmol	VFA mmol	Gas+VFA mmol	VFA/gas- ratio
Alginate FD125	1.00	1.56	2.57	1.56
Alginate LFD 1515	1.06	1.60	2.66	1.51
High-G, High vlsc. Algin.	1.04	1.45	2.49	1.39
LBG	1.14	1.34	2.48	1.18
Guar gum	1.12	1.16	2.28	1.03
Xanthan	1.18	1.33	2.51	1.13
Carob germ flour	0.94	1.51	2.45	1.60
Starch	1.16	1.43	2.59	1.23

Table 1. Net molar production of gas and total VFA's from hydrocolloids and VFA/gas-ratio in the batch experiment with faecal inocula.

Table 2. The relative composition of VFA's in the batch fermentation with faecal inocula. Control values were subtracted with yields the production of VFA from the added substrate alone.

	Acetic %	Propionic %	Butyric %	Isobutyric %	2-met.butyric %	Isovaleric %	Valeric %
ALGINATE FD125	83	7	9	0	0	0	0
ALGINATE LFD 1515	84	6	9	0	0	0	0
HIGH-G, HIGH VISC.	80	6	13	0	1	0	0
ALGINATE							
LBG 246	61	9	29	0	0	0	0
GUAR GUM 178	71	9	19	0	0	0	1
XANTHAN	96	0	2	0	0	0	1
CAROB GERM FLOUR	55	14	24	2	2	1	2
Starch	60	0	40	0	0	0	0