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WATER-IN-OIL DISPERSION CONTAINING AGAR, PROTEIN AND A VISCOSITY ENHANCER

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(56) Prior Art Documents
AU 503174 19347/76 A23D 3/00 3/02
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(57) Claim

1. An edible plastic dispersion containing from 5-65 wt.% of a continuous fat phase, which may comprise non-toxic, indigestible fatty materials and from 95-35 wt.% of an agar containing dispersed aqueous phase, which is present in a concentration exceeding the critical gelling concentration and which aqueous phase further contains from 0.01 to 10.0 wt.% of protein and a viscosity enhancer other than protein selected from thickening agents, gelling agents and mixtures thereof below the critical gelling concentration thereof.

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STANDARD PATENT

Invention Title:

WATER-IN-OIL DISPERSION CONTAINING AGAR, PROTEIN AND A VISCOSITY ENHANCER

The following statement is a full description of this invention, including the best method of performing it known to me:-

AUSTRALIAN PATENT OFFICE

WATER-IN-OIL DISPERSION CONTAINING AGAR, PROTEIN AND A VISCOSITY ENHANCER.

The present invention relates to a plastic dispersion containing from 5-65 wt.% of a continuous fat phase and from 95-35 wt.% of a gelling polysaccharide containing dispersed aqueous phase.

Dispersions of the above type, such as fat spreads, are well known in the art. Examples of gelling polysaccharides used in such dispersions are: carrageenan, modified starches, alginate. It is also known in the art to use gelatin to gel the aqueous phase rather than a gelling polysaccharide. Gelatin, as compared to gelling polysaccharides, generally offers the advantage that it melts at mouth temperature and that dispersions containing said gelling agent readily release salt as well as water soluble flavour components. The use of high melting gelling polysaccharides, such as agar, at above critical concentration level on the contrary produces a dispersion with a bad mouthfeel on account of the high melting point and because it breaks down in the mouth relatively slowly, i.e. does not quickly release salt and flavour compounds. Therefore agar has not become acceptable as replacer for gelatin in fat spreads with a gelled aqueous phase.

Research Disclosure 217, (May 1982), p. 133, 21709 discloses a 40% fat calorie spread containing milk protein which is usually stabilized by incorporating e.g. 2.5% of gelatin and was found to be stabilized by incorporating high methoxylated pectin. The spreads so obtained had a satisfactory water dispersion and shelf life. Because this type of pectin in the used concentrations does not form a gelled water phase, the above problem does not arise.

AU 19347/76 (503 174) discloses low fat spreads of the oil-in-water type prepared from two aqueous media, the first of which is neutral and proteinaceous but free from undissolved protein particles above 5 microns and the second of which is substantially protein free and contains a gelling agent. The type of gelling agent is said to be "extremely critical" (column 1, lines 46-51) and gelatin and Danish agar were found to suitable for this invention. The content of gelling agent is 0.2 - 6%, but for Danish agar the content is somewhat lower and 0.2 -3 % is preferred. These two aqueous media are then combined and subsequently dispersed in a fatty phase.

AU 78 524 (489 792) discloses a low-fat spread of the water-in-oil type containing 38-59% of fat, partial glycerides and an aqueous phase containing dairy proteins and non-dairy high molecular substances, especially hydrocolloids in a concentration from 0.2-3wt.%, most suitable are hydrocolloids that interact with proteins and increase the viscosity. Mixtures of two or more hydrocolloids are particularly preferred and comprise mixtures of pectin and one or more hydrocolloids of natural origin, e.g. carageenan, agar-agar, guar gum, locust bean gum etc. or their salts. Mixtures of pectin and carageenan are preferred since they are very effective in stabilizing the spreads.

AU 44 739/89 (equi to EP 369 550) discloses a fat continuous spread with an aqueous phase containing denatured colloidal protein particles, one or more gelling agents at a concentration which is at least 30%, preferably at least 60%, of the critical gelling concentration. The gelling agent or gelling agents are selected from: gelatin, kappa carrageenan, iota carrageenan, agar, alginate and furcelleran. To improve the inherent bad properties of the high-melting polysaccharide gelling agents a relatively large amount of denatured heat-settable protein was added. Spreads with such an aqueous phase have the advantage that they do not give a thick mouthfeel and destabilize rapidly in the mouth and are stable at low fat concentrations.

AU 45 906/89 (equi to EP-372 625) discloses a spread with 5-35% w.w. of a continuous fat phase and an aqueous phase containing less than 200 ppm of protein, a gelling hydrocolloid or combination of hydrocolloids at a concentration level of at least three times the critical concentration level of gelling. The gelling hydrocolloids are selected from the group of kappa-carrageenan, iota-carrageenan, agar, alginate, pectin, gellan, furcelleran and mixtures thereof. The volume weighted mean droplet size of the aqueous phase should be less than 25 microns. The spreads so obtained are easy spreadable, do not lose water and have a strong butter impression.

EP 52 890 discloses a water-in-oil dispersion containing 25-65 wt% of fat and an aqueous phase containing at least one hydrocolloid forming a linear gel structure (e.g. pectins and alginates) and at least one hydrocollod forming a spherical gel structure (e.g. guar gum, locust bean gum and iota carrageenan). Claim 4 discloses the combination of pectin and guar gum (one of the present viscosity enhancers), pectins and dextrins are used in 0.01 - 0.3% w.w. and guar gum in 0.1 to 1.0% w.w. of the aqueous phase. The present invention prefers in general 0.5-5% of agar and generally 0.08-13.0 % of viscosity enhancer. According to the citation proteins may also be present e.g. milk proteins, vegetable proteins and microbial proteins) in amounts of 0.01-8%, preferably 1-5% by weight (column 2, lines 3-7 and claim 6).

Summarizing the prior art on spreads with an aqueous phase containing protein and gelling agent is rather crowded. The problems encountered and had to do inter alia with stability of the dispersion, brittleness, thick mouthfeel, loss of water etc. What should be noted is that AU 19347/76 (503 174) states explicitly on page 3, lines 3 - 7 that the type of gelling agent is "extremely critical" in low fat spreads also containing protein.

We have found now that an improved high-melting gelling polysaccharide can be obtained which contains from 5-65 wt.% of a continuous fat phase, which may comprise non-toxic, indigestible fatty materials and from 95-35 wt.% of an agar containing dispersed aqueous phase, which is present in a concentration exceeding the critical gelling concentration and which aqueous phase further contains from 0.01 to 10.0 wt.% of protein and a viscosity enhancer other than protein selected from thickening agents, gelling agents and mixtures thereof below the critical gelling concentration thereof.

Accordingly, the present invention is specifically concerned with such a plastic dispersion containing from 0.01 to 10.0 wt.% of protein, preferably other than gelatin. Even protein concentrations lower than 0.01 wt.%, until 0.004 wt.% may be used.

The replacement of gelatin by the present system offers several advantages. Agar and protein can both be obtained from natural non-animal sources, as contrasted to gelatin which is extracted from pig skin. The latter explains why food products containing gelatin are unacceptable to large consumer groups such as vegetarians and people who only eat 'kosher' food.

The present gelling system offers the additional advantage that although agar and pectin are both relatively insensitive to the ionic environment, agar is even preferred over pectin which is sensitive to Ca^{2+} (with the exception of Ca-pectin). This offers the advantage that the ionic composition of the aqueous phase and the saliva do not seriously influence the properties of the product.

The improved oral release observed for the present dispersion can suitably be demonstrated by recording the conductivity of the dispersion as a function of time in the mouth. The latter measurement can suitably be carried out by means of a dental plate provided with two electrodes. The test person is requested to masticate the product in order to mimic the in-mouth shear forces normally observed during consumption. When measuring the conductivity as a function of time in the mouth, generally a sigmoid curve is obtained, indicating that the conductivity rises with time. A product displaying a good oral response generally produces a relatively steep curve which arrives at its maximum quickly. Dispersions producing an adequate oral release generally reach 50% of the total conductivity increase within 30 seconds.

The synergistic interaction of the gelling polysaccharide and protein can suitably be illustrated by measuring the conductivity as a function of time for the product containing gelling polysaccharide and the product containing gelling polysaccharide and protein. The introduction of protein at a concentration level in accordance with the present invention results in a substantially more rapid conductivity increase. The latter conductivity increase is believed to be closely correlated to, for instance, the increase in salt and flavour release. It is interesting to notice that the inclusion of protein in gelatin-based dispersions does not substantially improve the break-down characteristics thereof.

The beneficial effect of the inclusion of protein is obtained already at surprisingly low concentration levels of protein. Therefore, in a preferred embodiment the aqueous phase contains less than 1.0 wt.% protein, more preferably less than 0.30 wt.% and most preferably less than 0.15 wt.%. According to another preferred embodiment the protein concentration exceeds 0.03% by weight of the aqueous phase.
It is beneficial for the storage stability as well as for the spreading behaviour of the present type of dispersions that the effective amount of protein is found to be so low, because proteins are known for their destabilizing

action.

The inclusion of a viscosity enhancer was found to be advantageous as a dispersion displaying a still better mouthfeel can thus be obtained. Examples of suitable viscosity enhancers are thickening agents, such as natural gums and non-gelling starches, and gelling agents applied below their critical concentration. According to a very preferred embodiment of the invention the viscosity enhancer is selected from guar gum, enzyme modified guar, maltodextrin, sodium alginate, xanthan gum, waxy starches (e.g. waxy rice starch), locust bean gum, tragacanth, cross-linked starches, and mixtures thereof.

The critical concentration of a gelling agent is the concentration level at which said gelling agent will start to form a gel. The critical concentration of the gelling polysaccharide(s) in the aqueous phase composition of the plastic dispersion is determined in an aqueous system which has exactly the same composition as the aqueous phase composition to be incorporated into the present dispersion, except that non-polysaccharide gelling agents are not included and on the understanding that the concentration of the gelling polysaccharide(s) has to be varied in order to establish the critical concentration thereof.

The critical concentration of a gelling polysaccharide or a mixture of gelling polysaccharides in a particular composition can be calculated from measurements of the shear modulus of a series of samples containing different concentrations of gelling polysaccharide or mixture of hydrogenated or modified otherwise, as well as non-toxic fatty materials having properties similar to triglycerides, which materials may be indigestible, such as for example waxes, e.g. jojoba oil and hydrogenated jojoba oil, and polyol fatty acid polyesters referred to hereinafter in more detail. The terms fat and oil are used interchangeably.

In this specification the term 'polyol' is intended to refer to any aliphatic or aromatic compound which comprises at least four free hydroxyl groups. Such polyols in particular include the group of sugar polyols, which comprises the sugars, i.e. the mono-, di-and oligosaccharides, the corresponding sugar alcohols and the derivatives thereof having at least four free hydroxyl groups. Examples of sugar polyols include glucose, mannose, galactose, xylose, fructose, sorbose, tagatose, ribulose, xylulose, maltose, lactose, cellobiose, raffinose, sucrose, erythritol, mannitol, lactitol, sorbitol, xylitol and alpha-methylglucoside. A generally used and preferred sugar polyol is sucrose.

In this specification the term 'polyol fatty acid polyester' is intended to refer to any such polyesters or mixtures thereof of which, on an average, more than 70 % of the polyol hydroxyl groups have been esterified with fatty acids. In this specification by 'indigestible' is meant that at least about 70 % by weight of the material concerned is not digested by the human body.

The fat phase of the present dispersion preferably contains a substantial amount of solid fat at 20°C, but only a very limited amount of solid fat at 35°C. The so called N-value of the fat phase is indicative of the solid fat content. The N-value for a fat at a certain temperature t is indicated as N_t and indicates the equilibrium solid fat content of the composition at that temperature t, expressed in % of the weight of that composition. It can conveniently be measured by means of NMR, as described in Fette, Seifen, Anstrichmittel 80 (1978), 180-186. Preferably the N_{20} of the present fat phase is in the range of 8-50%, whereas the N_{35} ranges from 0-5%.

The benefits of the present invention are particularly appreciated in low fat spreads, i.e. spreads containing substantially less than the about 80% fat normally found in butter and margarine. The lower the fat content of the dispersion, the bigger the influence of the aqueous phase system becomes. Preferably the present dispersion contains less than 65 wt.% fat. Such dispersions of low fat content can suitably be divided into two classes: the low fat spreads containing from 28-65 wt.% fat and the very low fat spread containing from 5-28 wt.% fat.

As observed hereinbefore the present dispersion offers the advantage that a good oral response is obtained which is at least partially ascribed to the fact that the combined utilization of gelling polysaccharide and protein results in a quick break down of the dispersion in the mouth. A measure for the quickness of break down is the time needed to achieve 50% of the total conductivity increase observed when measuring the conductivity as a function of time in the mouth, using the method described hereinbefore. A good performance is when 50% of the conductivity increase is observed in 10-25 seconds.

The invention is illustrated by means of the following examples:

Example 1

A 40% fat spread was prepared from an aqueous phase and fat phase of the following composition (in wt.%):

Fat phase

Fat blend [1]	99.0
Monoglycerides (Hymono 8903 $^{\text{TM}}$)	0.5
Lecithin (Bolec ZTD $^{\text{TM}}$)	0.5
Beta carotene	trace
Flavour	trace

[1] Blend consisting of 80 wt.% sunflower oil and 20 wt.% soybean oil hardened to a slip melting point of 44°C

Aqueous phase

Agar (1254 Gelidium $^{\text{TM}}$)	0.8
Sodium caseinate	0.1
Sodium alginate (Mannucol DM $^{\text{TM}}$)	1.0
Sodium chloride	1.5
Potassium sorbate	0.15
Water	96.45

pH to 5.3 with lactic acid

The fat phase and aqueous phase were separately prepared and maintained at 60°C in separate vessels. From these vessels both phases were fed to a sequence of apparatus at a throughput of 50 g/minute and combined therein in a weight ratio of fat phase to aqueous phase of 40:60. The processing conditions applied were as follows:

Unit	Jacket temperature (°C)	Rotation speed (rpm)
C-unit	25	1000
A-unit	10	1000
C-unit	10	1400
A-unit	10	1000
C-unit	10	1000

As can be deduced from the above table both the C-units (crystallizers) and A-units (scraped surface heat exchangers) were provided with a cooling jacket.

The low fat spread obtained was found to have a good oral release and mouthfeel. The oral release and mouthfeel were very similar to those of a similar low fat spread containing 3% gelatin by weight of the aqueous phase. When the sodium caseinate is not included in the aqueous phase composition a low fat spread is obtained which displays a substantially worse oral response than the above product.

Also when the product containing sodium caseinate was compared with the protein free product after 30 seconds of mastication by viewing the masticated samples under a light microscope it was clear that the former product had broken down more completely than the protein free product.

Conductivity measurements and also the measurement of the average water droplet size by means of NMR unambiguously showed that the low fat spread was a water-in-oil dispersion.

Example 2

A 40% fat spread was prepared from an aqueous phase and fat phase having the same composition as given in Example 1, with the exception that instead of 1 wt.% sodium alginate 10.0 wt.% maltodextrin (Paselli SA2) was used.

The product obtained was in all respects very similar to the product described in Example 1.

Conductivity measurements and also the measurement of the average water droplet size by means of NMR unambiguously showed that the low fat spread was a water-in-oil dispersion.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An edible plastic dispersion containing from 5-65 wt.% of a continuous fat phase, which may comprise non-toxic, indigestible fatty materials and from 95-35 wt.% of an agar containing dispersed aqueous phase, which is present in a concentration exceeding the critical gelling concentration and which aqueous phase further contains from 0.01 to 10.0 wt.% of protein and a viscosity enhancer other than protein selected from thickening agents, gelling agents and mixtures thereof below the critical gelling concentration thereof.

2. A dispersion according to claim 1, wherein the agar is Gracaleria, Gelidium or agar/agar of food grade.

3. A dispersion according to claim 1 or 2, wherein the viscosity enhancer is present in a concentration level of 0.08 to 13.0 wt.% of the aqueous phase.

4. A dispersion according to claim 1, 2 or 3, wherein the protein in the aqueous phase is dairy protein present in a concentration level of 0.05 to 0.5 wt.%.

5. A dispersion according to any of the claims 1 to 4, wherein the dispersion contains a viscosity enhancer in an amount sufficient to raise the viscosity of the aqueous phase, in the absence of agar by at least 40 mPa.s at 35°C and 100 s^{-1}.

6. A dispersion according to any of the claims 1 to 5, wherein the viscosity enhancer is selected from guar gum, enzyme modified guar, non-gelling maltodextrin, sodium

alginate, xanthan gum, waxy starches (e.g. waxy rice starch), locust bean gum, tragacanth, cross-linked starches, and mixtures thereof.

7. A dispersion according to any of the claims 1 to 6, wherein the aqueous phase of the dispersion contains 0.5 - 5 wt.% of agar.

8. A dispersion according to any of the claims 1 to 7, wherein the dispersion comprises 28 - 65 wt.% of fat.

9. A dispersion according to any of the claims 1 to 7, wherein the dispersion comprises 5 - 28 wt.% of fat.

10. A dispersion according to any of the claims 1 to 9, wherein, when measuring the conductivity of the dispersion in the mouth as a function of time, 50% of the conductivity increase is observed within 10-25 seconds.

DATED THIS 30TH DAY OF JULY 1993
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ABSTRACT

The present invention is concerned with a plastic dispersion containing from 5-65 wt.% of a continuous fat phase and from 95-35 wt.% of a gelling polysaccharide containing dispersed aqueous phase, wherein the gelling polysaccharide is selected from the group consisting of agar, pectin and mixtures thereof and present in a concentration exceeding the critical concentration and which aqueous phase contains further 0.004 to 10.0 wt.% of protein.

We have found that the present dispersion displays essentially the same in-mouth break down behaviour as a gelatin based dispersion.