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(54) Title: AQUEOUS GELS PREPARED FROM PEA STARCH DERIVATIVES

(57) Abstract: Aqueous gels of starch based products wherein said starch based products are enzymatic hydrolysed, preferably with thermo-stable alpha amylase, and said gels have a bland taste. The current invention relates to a foodstuff selected from the group consisting of pudding, yoghurt, milk dessert, ice cream, imitation cheese, processed cheese preparation, processed meat preparation and beverages and wherein said foodstuff is comprising said aqueous gel. Furthermore, their use in food, feed, pharmaceutical compositions, or cosmetic products is described. The aqueous gels can be applied especially for replacing gelatin, skim milk powder, casein, caseinate, emulsifying protein, xanthan gum and/or carragenan.



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Aqueous gels prepared from pea starch derivatives

Technical Field

The present invention relates to aqueous gels of pea starch derivatives and their application in products especially for replacing gelatine, skim milk powder, caseine, caseinate, emulsifying protein, xanthan gum and/or carragenan.

Background of the invention

Currently potato starch based maltodextrins are known which have special thermoreversible gelling properties. Draw-back of common potato based products is that the odour is not neutral, which prevents the use of these products in sensitive applications. Alternatively elimination of this adverse odour demands for an additional and complicated process.

EP 0554 818 describes a steam stripping process for removal of undesirable flavors and odors from polysaccharides.

EP 0 499 306 relates to a method for improving the flavour of starch comprising incubating the starch with an enzymatically active peptidase containing cell preparation under such conditions that enzymatic peptidolysis of a substantial amount of oligopeptides in the starch is the result, which incubation is, optionally, preceded or followed by a non-enzymatic purification step such as steam stripping or solvent extraction.

Consequently there is a need for having gelling starch based products which do have a bland odour and taste.

The current invention provides such a product.

Summary of invention

The current invention relates to aqueous gels of pea starch based products wherein said starch based products are enzymatic hydrolysed, preferably with thermostable alpha-

amylases and said gels have a bland taste. Gels containing 25% of dry solids of starch based products have a hardness from 40 to 3500 g, preferably from 100 to 3500 g, more preferably from 400 to 2500 g. Furthermore, the starch based products have a DE up to 10, preferably a DE up to 7.

The current invention further relates to a foodstuff selected from the group consisting of pudding, yoghurt, milk dessert, ice cream, imitation cheese, processed cheese preparation, processed meat preparation and beverages wherein said foodstuff is comprising previously mentioned aqueous gels.

The current invention relates to a process for preparing said foodstuff and said process is comprising the following steps:

- a) Taking enzymatic hydrolysed pea starch based product,
- b) Adding liquid and ingredients of foodstuff,
- c) Allowing formation of aqueous gel of pea based starch products.

The current invention further relates to the use of said aqueous gels in foodstuffs for totally or partially replacing gelatine, skim milk powder, casein, caseinate, emulsifying protein, xanthan gum and/or carragenan gum.

In preferred embodiments either gelatine can be replaced in foodstuff selected from pudding, yoghurt and milk dessert, caseine and/or caseinate is replaced in imitation cheese or processed cheese preparation from 25% to 60%, emulsifying protein is replaced in processed meat preparation, and xanthan gum and/or carragenan gum is replaced in beverages.

Furthermore, the current invention relates to the use of these aqueous gels of pea starch based products in feed, pharmaceutical compositions, or cosmetic products.

Additionally, the current invention describes ice cream containing ice cream ingredients and said aqueous gel of pea starch based products.

The current invention further relates to yoghurt containing yoghurt ingredients and earlier mentioned aqueous gel of pea starch based products.

Detailed description

The current invention relates to aqueous gels of pea starch based products wherein said starch based products are enzymatic hydrolysed, preferably with thermostable alpha-amylases and said gels have a bland taste. Gels containing 25% of dry solids of said pea starch based products have a hardness from 40 to 3500 g, preferably from 100 to 3500 g, more preferably from 400 to 2500 g. Furthermore, the starch based products have a DE up to 10, preferably a DE up to 7.

Pea starch is quite different from corn, wheat, tapioca or potato starches and applying the process conditions used on one starch does not give the same functionality when applied on pea starch.

The products dealt with in this invention are low DE maltodextrins. In applying enzymatic hydrolysis to a low or moderate extent, a range of products can be obtained with a functionality leading to versatile applications. Hard gels and/or soft gels can be obtained and either short or longer time periods are required for the formation of the gels.

Suitable enzymes for the enzymatic hydrolysis are thermostable alpha-amylases, for example Termamyl 120L Type L from Novozymes or Spezyme AA from Genencor. In the enzymatic conversion, the starch slurry is preferably continuously prepared and in-line supplemented with the enzyme. The enzyme dosage is a crucial variable parameter for obtaining the target hydrolysis and corresponding gelling properties. The slurry can be fed continuously under pressure to a jet cooker device where it is contacted with steam which instantaneously increases the temperature of the starch/steam mix. The starch is converted by the enzyme to a low or higher degree of hydrolysis. The conversion level is determined by the product Dextrose Equivalent (DE), which is the reducing power of the starch hydrolysate expressed as D-glucose on the dry basis whereby DE for dextrose is 100. The lower the DE value the higher the molecular weight of the hydrolysate and the less the extent of degradation.

The products are further characterised by measurement of the gel strength of the aqueous gels containing 25% dry solids of pea starch based derivatives. A penetrometer (PNR 10 Sommer & Runge KG) is applied and the cone of set equipment is positioned on the surface of the gel and allowed to penetrate in the gel. The reading gives the penetration distance in mm.

Furthermore, the aqueous gels containing 25% dry solids of pea starch based derivatives are characterised by measuring the hardness of the gels. Aqueous gels of 25% dry solids are prepared and a Texture analyser (SMS TAXT2I) is applied. A Perspex cylindrical plunger of 20mm diameter (type P20) is forced into the gel which – after the gel formation in the refrigerator – is equilibrated at 20°C. The measurement itself is done also at 20°C. The Texture Profile Analysis consists of penetrating the gel twice in a reciprocating motion, with 5 seconds interval, and extracting from the resulting force-time curve a number of textural properties. The first penetration gives the hardness (expressed in g (Force)) and the second penetration gives the cohesiveness. In-between the two penetrations a value for the adhesiveness is obtained.

Furthermore, in a preferred embodiment, the aqueous gels of the current invention have special thermo reversible gelling properties.

The current invention further relates to a foodstuff selected from the group consisting of pudding, yoghurt, milk dessert, ice cream, imitation cheese, processed cheese preparation, processed meat preparation and beverages wherein said foodstuff is comprising previously mentioned aqueous gel of pea starch derivatives obtainable by enzymatic hydrolysis.

The aqueous gels of the current invention have a bland taste and are free of any odour. Consequently these pea starch based aqueous gels can be applied in plenty of foodstuffs including the sensitive applications where taste and odour are critical.

The current invention relates to a process for preparing said foodstuff and said process is comprising the following steps:

- a) Taking enzymatic hydrolysed pea starch based product,
- b) Adding liquid and ingredients of foodstuff,
- c) Allowing formation of aqueous gel of pea based starch products.

The enzymatic hydrolysed pea starch based product is preferably hydrolysed with thermo stable alpha-amylase.

The liquid can be any aqueous based liquid, such as water, and/or milk.

Although the aqueous gels are characterized by their hardness of gels of 25% dry solids, the final foodstuff may comprise aqueous gels of different dry substances, depending on the gelling properties required, such as its gels strength, its hardness etc.

The wide range of hardness, the bland taste and the odour-free aqueous gels allows the use of these products in versatile applications, going from food, feed, pharma products and cosmetic products.

In particular, the aqueous gels are suitable for the use as total or partial replacer of gelatin, skim milk powder, casein, caseinate, emulsifying protein, xanthan gum and/or carragenan gum.

In particular, said aqueous gels of enzymatic hydrolysed pea starch derivatives are used for totally or partially replacing gelatin, preferably in foodstuff selected from pudding, yoghurt and milk dessert.

Furthermore, the current invention relates to the use wherein casein and/or caseinate is replaced in imitation cheese or processed cheese preparation from 25% to 60%. The replacement with products of current invention stands for 25-60% of total weight of casein and/or caseinate normally present in the imitation cheese or processed cheese preparation, whereby the replacement by the products of the current invention can be equi-weight or not.

The current invention relates to the use of emulsifying protein up to 100% in processed meat preparation.

The current invention relates to the use of aqueous gels of enzymatic hydrolysed pea starch derivatives for total or partial replacement of xanthan gum and/or carragenan gum in beverages.

Additionally, the current invention describes ice cream containing ice cream ingredients and said aqueous gel of pea starch based products. The ice cream ingredients can be but are not limited to fat, sugar, carbohydrate derivatives, water, milk powder and the like. The hardness measurement of the corresponding ice cream are slightly higher for the products of the current invention in comparison with the standard formulation.

The current invention further relates to yoghurt containing yoghurt ingredients and earlier mentioned aqueous gel of pea starch based products. These yoghurt ingredients can be but are not limited to sugar, milk, water, milk powder, and the like. The yoghurt made with pea starch based products of current invention is somewhat shorter, less sticky, less slimy compared to the gelatin-type yoghurt.

The current invention has the following advantages:

- Aqueous gels of bland taste can be prepared
- Broad range of hardness allows application in versatile application fields, such as pharma products, cosmetics, feed and food products.
- Gels can be applied to substitute gelatin, skim milk powder, casein, caseinate, emulsifying protein, xanthan gum and/or carragenan.

The current invention is illustrated by way of the following examples.

Example 1

Continuous enzyme conversion

Pea starch was re-slurried in tap water at 40-45°C for obtaining a suspension of 30% d.s. pH was adjusted with caustic soda (1 N NaOH) to 5.9-6.1. Termamyl 120L Type L from Novozymes (amount specified in table 1) was added to the slurry. The slurry was then continuously fed under 10 bar pressure to a jet cooker device where it was contacted with live steam at 7.5 bar which instantaneously increased the temperature of the starch/steam mix to 105-106°C. A back-pressure of 1 bar was applied to keep this temperature. The liquefied starch was passed through a set of narrow pipes, which allowed a holding time of 20 minutes at said temperature. After said holding time, the liquefact left the holding pipes and was flashed at atmospheric pressure. The temperature decreased to slightly below 100°C and the maltodextrin was passed to a tank for adjusting pH to 2.8-3.2 by using hydrochloric acid (1 N HCl) and the residence time was about 5 minutes. Subsequently the pH was re-adjusted to 4.5-5.0 with caustic soda (1 N NaOH). The product was then fed to a continuous spray-drying tower to dry the product.

Gel strength

Hundred grams of spray dried maltodextrin was added to 400g of boiling demineralised water in a beaker and the mix was agitated for 30 seconds. The beaker was then placed in a water bath at 85°C and agitated for 10 minutes. The preparation is poured into beakers

(150ml content, 80 mm diameter) and allowed to cool to 30-40°C. Afterwards the beakers were covered with a glass and were put in the refrigerator at 4°C for 20 hours. The beaker was then placed in the PNR 10 Sommer & Runge KG penetrometer and a cone was positioned on the surface of the gel and allowed to penetrate in the gel. The reading gave the penetration distance in mm. Prepare 2-3 gels each time and repeat the measurement. The gel strength is the mean value of said measurements.

Hardness – Cohesiveness

For these measurements gels were prepared under the following conditions :

- 100 g of the product was dispersed into 400 g of cold tap water while mixing (Braun household mixer high speed) for 1 minute in a glass beaker of 1000 ml.
- The beaker was transferred to a water bath at 85°C and kept for 15 min while agitating with standard laboratory magnetic stirrer at 150 rpm. The beaker remained open. At the end, the temperature of the solution should be 75°C.
- The hot solution was poured into plastic cups of 75 mm diameter (44 mm height), and allowed to cool to room temperature and stored in refrigerator overnight.

The SMS TAXT2I Texture Analyser was used to measure the parameters.

A perspex cylindrical plunger of 20mm diameter (type P20) was forced into the gel equilibrated at 20°C, and the measurement itself was done at 20°C as well. The Texture Profile Analysis consisted of penetrating the gel twice in a reciprocating motion, with 5 seconds interval, and extracting from the resulting force-time curve a number of textural properties. The first penetration gave the hardness. The second penetration gives the cohesiveness.

Test Conditions:

Pre-speed, test speed and post speed: 1 mm/sec

Penetration depth: 20 mm

Trigger force: 5 grams

Time in between the cycles: 5 seconds

Plunger: P20 (20 mm diameter)

Table 1

Product Label	enzyme % ds	DE	Gel strength penetration (mm)	Hardness (grams F)	Cohesiveness
Pea Mdx 7	0.07	4.2	5.0	840	0.49
Pea Mdx 4	0.10	5.8	6.5	496	0.54
Pea Mdx 5	0.14	6.8	15.3	186	0.53
Pea Mdx 8	0.02	2.0	-	3481	0.24
Pea Mdx 9	0.045	2.2	-	2369	0.14
Pea Mdx 6	0.20	10.1	27.9	43	0.49

Example 2: Gelatin replacement in yoghurt

Pea Mdx 4, Pea Mdx 7 were evaluated as gelling agent. The following recipe's were used for preparing yoghurt.

Table 2

Thickener is = (expressed in w%)	Gelatine 250 Bloom (PB Gelatine)	Pea Mdx 4	Pea Mdx 7
Sugar S2 (Beghin Say) (w%)	4	4	4
Skim milk powder (w%)	4	4	4
Thickener (w%)	0.3	14	1
Water (w%)	2.7	0	0
Skim milk (w%)	89	91	91

The mixes were handled according to the state of the art for yoghurt preparation. Maltodextrin dry powders were mixed in the milk, while the gelatin was made up in warm water. The yoghurt containing Pea Mdx 7 with the highest gelling power, showed slight syneresis on top of the yoghurt surface. The yoghurt made with Pea Mdx 4 is somewhat shorter, less sticky, less slimy compared to the gelatin-type yoghurt. In none of the preparations any off-taste was detected. The hardness and cohesiveness are displayed in Table 3.

Table 3

Thickener is =	Gelatin Bloom	250 Pea Mdx 4	Pea Mdx 7
Hardness	61	63.9	68.5
Cohesiveness	0.62	0.66	0.68

The measurements of hardness and cohesiveness show that Pea Mdx 4 is most preferred for gelatin replacement in yoghurt.

Example 3 - skim milk powder replacement in ice cream.

The following recipe's were applied :

Table 4

Ingredient (w%)	Standard	Recipe 1	Recipe 2
Anhydrous butter Fat	10	5	10
Fructose containing syrup (%ds)	9	9	
Sucrose	10	10	10
Skim milk powder	10	10	5
Spray dried Glucose 22 DE (Cerestar)		2.5	
Pea Mdx 4		2.5	
Pea Mdx 5			5
Water up to 100%			

Sensorial evaluation showed that no off-taste was observed for none of the recipe's. The hardness of the ice cream was measured according to the method describe in example 1. The results are displayed in Table 5.

Table 5

	Standard	Pea Mdx 4	Pea Mdx 5
Hardness	13.74 kg	> 35 kg	20.00 kg

Hardness measurements of the ice cream indicated that the Pea Mdx 5 was more preferable for this application.

Claims

1. Aqueous gels of pea starch based products characterised in that said starch based products are obtainable by enzymatic hydrolysis of pea starch and said gels have a bland taste.
2. Aqueous gels according to claim 1 characterised in that enzymatic hydrolysis is performed with thermostable alpha-amylases.
3. Gels according to claim 1 or 2 characterised in that said gels containing 25% of dry solids of starch based products have a hardness from 40 to 3500 g, preferably from 100 to 3500 g, more preferably from 400 to 2500 g.
4. Gels according to anyone of claims 1 to 3 characterised in that said starch based products have a DE up to 10, preferably a DE up to 7.
5. A foodstuff selected from the group consisting of pudding, yoghurt, milk dessert, ice cream, imitation cheese, processed cheese preparation, processed meat preparation and beverages and characterised in that said foodstuff is comprising an aqueous gel according to anyone of claims 1 to 4.
6. A process for preparing a foodstuff according to claim 5 and said process is comprising the following step:
 - a) Taking enzymatic hydrolysed pea starch based product,
 - b) Adding liquid and ingredients of foodstuff,
 - c) Allowing formation of aqueous gel of pea based starch products.
7. Use of aqueous gels according to anyone of claims 1 to 4 in foodstuffs for totally or partially replacing gelatin, skim milk powder, casein, caseinate, emulsifying protein, xanthan gum and/or carragenan gum.

8. Use according to claim 7 characterised in that gelatin is replaced in foodstuff selected from pudding, yoghurt and milk dessert.
9. Use according to claim 7 characterised in that casein and/or caseinate is replaced in imitation cheese or processed cheese preparation from 25% to 60%.
10. Use according to claim 7 characterised in that emulsifying protein is replaced in processed meat preparation.
11. Use according to claim 7 characterised in that xanthan gum and/or carragenan gum is replaced in beverages.
12. Use of aqueous gels of starch based products according to anyone of claims 1 to 4 in feed, pharmaceutical compositions, or cosmetic products.
13. Ice cream containing ice cream ingredients and aqueous gel of pea starch based products according to anyone of claims 1 to 4.
14. Yoghurt containing yoghurt ingredients and aqueous gel of pea starch based products according to anyone of claims 1 to 4.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 A23L1/09 C08B30/18		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 A23L C08B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ, FSTA		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SLOMINSKA L ET AL: "Low conversion starch hydrolysates." ZYWNOSC (SUPPLEMENT), vol. 4, no. 33, 2002, pages 31-39, XP008030317 POLAND the whole document	1-14
X	WO 01/21011 A (AVEBE COOP VERKOOP PROD ; BERGSMA JACOB (NL); ATEN JAN (NL); BLEEKER I) 29 March 2001 (2001-03-29) page 3, line 18 - page 4, line 26 page 8, line 3 - page 10, line 18 example 5 ----- -/-	1-14
☒ Further documents are listed in the continuation of box C. ☒ Patent family members are listed in annex.		
* Special categories of cited documents : *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *G* document member of the same patent family		
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Vuillamy, V

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