

THIS SHEET HAS BEEN
REPLACED**Cereals with added vegetables**

The subject of the present invention is instant cereals with added vegetables and a process for preparing such cereals.

5 Various processes of preparation, by cooking-extrusion, of instant cereals, especially for baby foods, are known.

WO 93/17592 (SCHAAF TECHNOLOGIE GMBH) describes a process for the preparation of instant cereals, especially instant cereals with added vegetables, in which there is cooked-extruded at 130-160°C a mixture of cereals to which dry vegetables and vegetable purée, for example, may be added, and which has a water content of 19-22 %, the cooked-extruded mixture is allowed to expand in an expansion chamber immediately after coming out of the extruder die, and the cooked-extruded mixture is cut upon coming out of the expansion chamber into pieces having an open porosity over the slice, it being possible for these pieces to be used in mixtures for instant babies' cereal for example.

The aim of the present invention is to provide instant cereals with added vegetables which do not disintegrate on coming into contact with a liquid but remain on the contrary crispy during a relatively long time.

To this end, the instant cereals with added vegetables according to the present invention comprise, in % by weight of dry matter, 2-90 %, preferably 2-50 % of vegetable, 8-96 %, preferably 48-96 % of cereal, 2-15 % of added fat, 0-1 % of a calcium salt, 0-1 % of sodium chloride, 0-5 % of added protein material and 0-1.5 % of a colouring agent, and they have an apparent density of 100-500 g/l, preferably 200-500 g/l and a water content of 1.5-15 %.

35 Likewise, in the process for the preparation of instant cereal flakes with added vegetables according to the present invention, a mixture having a water content between more than 23 and 70 % by weight and comprising,

in parts by weight, 9-110 parts, preferably 50-110 parts of cereal, 7-300 parts, preferably 7-170 parts of a vegetable purée, 0-20 parts of vegetable powder, 2-15 parts of added fat, 0-1 % of a calcium salt, 0-1 % of sodium chloride, 0-5 % of added protein material and 0-1.5 % of a colouring agent is cooked-extruded in an extruder, a quantity of steam is aspirated and/or allowed to escape before coming out of the extruder such that the cooked-extruded mixture has after coming out of the extruder a water content of 15-23 %, the cooked-extruded mixture is cut up upon coming out of the extruder and it is dried.

It was observed that the present cereals with added vegetables having these characteristics, and the present process which makes it possible to produce such cereals with added vegetables, meet surprisingly the objective set.

These cereals with added vegetables can indeed be consumed as such or as essential ingredient in the preparation of a dessert containing milk or yogurt, a muesli, a porridge or an instant soup, they have in each case a remarkable crispness even after a few min in a cold, hot, or even boiling liquid for example.

This is due to the fact that they have a relatively low porosity and are not open at the surface, a relatively high apparent density and a relatively solid texture which softens only slowly on coming into contact with a liquid, due in particular to their oil content.

Preferably, in the present cereals with added vegetables, the starch has a degree of gelatinization of 50-92 %, more particularly of 70-90 %. Such a degree of gelatinization of the starch in fact favours some resistance of the present cereals to softening during the absorption of a liquid in which they are immersed while being sufficient to confer the instant characteristic upon them.

The said vegetable may be any leaf vegetable, fruit vegetable, root vegetable, seed vegetable or tuber vegetable which has a substantial content of vegetable

fibre, such as spinach, beans, peas, lentils, carrots or yam for example, these vegetable fibres contributing to the firmness of the texture of the present cereals with added vegetables.

5 The said cereal may be any cereal, especially any cereal which is relatively low in gluten such as maize, or rice for example.

10 The said added fat is intended, on the one hand, to facilitate the cutting of the cooked-extruded mixture and, on the other hand, to reinforce and stabilize the texture of the present cereals with added vegetables by reducing water regain, namely by preventing water from reaching the starch matrix too rapidly. To this end, the said added fat is preferably a vegetable or animal oil
15 having a melting point greater than about 35°C as well as a good resistance to oxidation, such as hydrogenated palm oil for example.

20 The said calcium salt may be any edible calcium salt capable of contributing to the relative firmness of the texture of the flakes, especially calcium carbonate or phosphate for example.

25 The said added protein material is intended to reinforce the texture of the present cereals with added vegetables and to reduce the water regain. To this end, the said added protein material may be a caseinate or gluten, for example. It is preferably a mixture of sodium caseinate and of calcium caseinate, the former being more soluble than the latter, but the latter conferring more hardness on the present cereals with added vegetables
30 than the former.

 The said colouring agent may be any colouring agent authorized for food use, especially for use in baby foods, in particular as oleoresin from a spice such as paprika for example.

35 In order to implement the process according to the present invention, it is possible to use a single- or twin-screw extruder turning at 200-500 revolutions/min, whose casing has one or more feed openings upstream, at least one steam release or aspiration opening downstream

and a jacket for the circulation of a heating liquid for example. This extruder may be equipped with a die having one or more outlets, of circular cross-section or having the shape of an easily recognizable motif such as a star,
5 a rabbit or a carrot, of about 1-10 mm in diameter, as well as a rotating knife whose blades slide against the said outlets for example.

The mixture which it is possible to cook-extrude with such an extruder therefore has a water content of
10 between more than 23 and 70 %, preferably of between more than 23 and 60 % by weight. This relatively high water content is intended to prevent the expansion of the mixture upon coming out of the extruder, in cooperation with the said 2-10 % of added fat and the said fibres.

15 This water content of the mixture to be cooked-extruded is provided mainly by the said vegetable in the form of a purée, in other words in the form of a fresh or frozen vegetable which is reduced to a purée by grinding for example. But the vegetable dry matter
20 content of the present cereals can therefore be adjusted by providing the said vegetable in powdered form, in other words in the form of a vegetable reduced to a powder by dehydration and grinding for example.

A quantity of steam should be allowed to escape
25 before coming out of the extruder such that the cooked-extruded mixture has after coming out a water content of 15-23 %, preferably 17-23 %. Indeed, if the cooked-extruded mixture has a water content greater than 23 %, there is a risk of not being able to cut it upon coming
30 out of the extruder because it sticks to the blades of the rotating knife. And if the cooked-extruded mixture has a water content of less than 15 %, or even 17 %, there is a risk of causing it to expand excessively upon coming out of the extruder and to weaken and destabilize
35 the texture of the present cereals with added vegetables.

It is possible to cook-extrude the said mixture at 140-250°C, preferably at a temperature of between more than 160°C and 200°C, for 20-60 s at 10-100 bar. This relatively high temperature region can be recommended in

order to obtain good aspiration and/or good release of steam before coming out of the extruder. This region of relatively short durations can be recommended in order to remain below a degree of gelatinization of 100 % of the starch contained in the mixture, especially in order to
5 obtain the said preferred degree of gelatinization of 50-92 %, more particularly of 70-90 %.

By cutting the cooked-extruded mixture upon coming out of the extruder, it is possible to obtain
10 pellets whose general shape is conferred by the shape of the cross-section of the die outlets. It is thus possible to obtain pellets which are spherical or which have the general shape of easily recognizable motifs such as stars, rabbits or carrots for example.

15 In a specific embodiment of the present process, such pellets are rolled into flakes. To do this, it is possible to use a rolling mill having several rollers with adjustable interstices and exerted pressure. Preferably, the said pellets are rolled into flakes 0.5 to 2 mm
20 thick.

The present cereals with added vegetables, in the form of pellets or flakes, can finally be dried to a residual water content of 1.5-15 %, preferably 3-10 %, in a hot air dryer at atmospheric pressure or reduced
25 pressure for example.

These cereals with added vegetables can therefore be consumed as such or as essential ingredient in the preparation of a dessert containing milk or yogurt, a muesli, porridge or an instant soup for example. But they
30 can also be provided in the form of whole cereals at the surface of which adhere other ingredients, added after the cooking-extrusion, such as seeds, especially sesame seeds, aromatic herbs, spices and/or basic traditional components of instant soups or broths for example.

35 The examples below illustrate various embodiments of cereals with added vegetables and of the process for the preparation of cereals with added vegetables according to the present invention. The percentages and parts are indicated therein by weight.

Example 1

A twin-screw extruder 1.2 m in length is fed continuously with the various components of a mixture having a water content of 28.7 %.

5 The extruder casing has several feed openings upstream, a steam release opening downstream and a jacket for the circulation of a heating liquid. The extruder die has two outlets of circular cross-section 3 mm in diameter. The mixing of the various components is carried
10 out in the extruder itself.

The various components, their water content, their feed rate and the percentage which their dry matter (DM) represents in the total dry matter (DM_{tot}) content of the mixture are presented in the table below:

15 Table 1

Component	Water content (%)	Rate (kg/h)	DM/DM _{tot} (%)
Maize flour	11	80	86.9
Carrot purée	92	27	2.7
Hydrogenated palm oil	-	8	9.8
20 Colouring (10% paprika oleoresin + 90% oil)	-	0.5	0.6

The extruder screws are rotated at 350 revolutions/min. The cooking-extrusion is carried out at 195°C for 30 s at 28 bar while allowing a quantity of steam to
25 escape such that the cooked-extruded mixture has a water content of 16 %.

The pudding of cooked-extruded mixture coming out of the die is cut into pellets of about 4 mm in diameter with a rotating knife whose blades slide against the
30 outlets.

The pellets are rolled between rollers 20 cm in diameter turning at 500 revolutions/min, while maintaining the surface temperature of the rollers at 20°C and while exerting on the rollers a pressure of 24 bar.

The rolled pellets are dried to a water content of 5 %.

Crisp flakes 1.0-1.4 mm thick are obtained which have a nice orange-carrot colour, a degree of gelatinization of 75 % and an apparent density of 330 g/l.

Their shape, their size and their crispness are maintained well even after being in a cold, hot, or even boiling liquid for a few min.

Example 2

A twin-screw extruder 1.2 m in length is fed continuously with the various components of a mixture having a water content of 29.8 %.

The extruder casing has several feed openings upstream, a steam release opening downstream and a jacket for the circulation of a heating liquid. The extruder die has two outlets of circular cross-section 3 mm in diameter. The mixing of the various components is carried out in the extruder itself.

The various components, their water content, their feed rate and the percentage which their dry matter (DM) represents in the total dry matter (DM_{tot}) content of the mixture are presented in Table 2 below:

Table 2

Component	Water content (%)	Rate (kg/h)	DM/DM _{tot} (%)
Maize flour	11	80	77.3
Red kidney bean purée	72	41.9	12.7
Hydrogenated palm oil	-	8	8.7
Colouring (10% paprika oleoresin + 90% oil)	-	1.2	1.3

The extruder screws are rotated at 350 revolutions/min. The cooking-extrusion is carried out at 190°C for 30 s at 28 bar while aspirating a quantity of steam such that the cooked-extruded mixture has a water content

of 20 %.

5 The pudding of cooked-extruded mixture coming out of the die is cut into pellets of about 4 mm in diameter with a rotating knife whose blades slide against the outlets.

The pellets are rolled between rollers 20 cm in diameter turning at 500 revolutions/min, while maintaining the surface temperature of the rollers at 20°C and while exerting on the rollers a pressure of 24 bar.

10 The rolled pellets are dried to a water content of 8 %.

Crisp flakes 1.0-1.5 mm thick are obtained which have a brown-red colour, a degree of gelatinization of 72 % and an apparent density of 300 g/l.

15 Their shape, their size and their crispness are maintained well even after being in a cold, hot, or even boiling liquid for a few min.

Examples 3-5

20 Under operating conditions similar to those described in Example 1, with the exception of the fact that the extruder die has outlets with the shape of a star, a rabbit or a carrot, and that the pellets obtained are not rolled out by cutting the pudding of cooked-extruded mixture coming out of the die, cereals with
25 added vegetables are prepared having the respective compositions presented in Table 3 below. The figures indicated represent the percentage of dry matter (DM) of each component in the total dry matter content (DM_{tot}) of the pellets.

Table 3

	Component	Example 3	Example 4	Example 5
	Maize flour	77.46	86.5	80.45
5	Red kidney bean purée	13.3	-	-
	Carrot purée	-	3.25	-
	Green pea purée	-	-	10.0
	Hydrogenated palm oil	8.8	9.75	9.1
10	Calcium carbonate	0.44	-	0.45
	Calcium caseinate	-	0.25	-
	Sodium caseinate	-	0.25	-

All these crisp pellets, with the shape of a star, rabbit or carrot, have a colour which evokes that of the vegetable which they contain, a degree of gelatinization of 70-90 %, an apparent density of 200-450 g/l and a water content of 5-8 %.

Their shape, their size and their crispness are maintained well even after being in a cold, hot, or even boiling liquid for several min.

Example 6

A mixture of the crisp pellets with added carrots, and with added green peas prepared in Examples 4 and 5 is used at a content of 50 % by weight in a dry composition, the other half of which is itself composed of:

	acidified powdered milk	67.0 %
	guar gum	1.5 %
	sugar	10.0 %
30	salt and spices	1.0 %
	malt	9.5 %
	grated coconut	7.5 %
	citric acid	3.5 %

This composition is consumed as a dispersion in

milk, at a content of 38 g of composition per 100 g of milk, as a cold, nutritious and refreshing savoury milk-containing dessert.

**Claims**

1. Instant cereals with added vegetables, comprising, in % by weight of dry matter, 2-90 % of vegetable, 8-96 % of cereal, 2-15 % of added fat, 0-1 % of a calcium salt, 0-1 % of sodium chloride, 0-5 % of added protein material and 0-1.5 % of a colouring agent, and having an apparent density of 100-500 g/l and a water content of 1.5-15 %.
2. Cereals with added vegetables according to Claim 1, in which the starch has a degree of gelatinization of 50-92 %.
3. Cereals with added vegetables according to Claim 1, in which the said vegetable is beans, peas, lentils or carrots, the said cereal is maize or rice, the said calcium salt is calcium carbonate or phosphate and the said added protein is a mixture of sodium caseinate and calcium caseinate.
4. Cereals with added vegetables according to Claim 1, in the form of pellets or flakes.
5. Process for the preparation of instant cereals with added vegetables, in which a mixture having a water content between more than 23 and 70 % by weight and comprising, in parts by weight, 9-110 parts of cereal, 7-300 parts of a vegetable purée, 0-20 parts of vegetable powder, 2-10 parts of added fat, 0-1 % of a calcium salt, 0-1 % of sodium chloride, 0-5 % of added protein material and 0-1.5 % of a colouring agent is cooked-extruded in an extruder, a quantity of steam is aspirated and/or allowed to escape before coming out of the extruder such that the cooked-extruded mixture has after coming out of the extruder a water content of 15-23 %, the cooked-extruded mixture is cut up upon coming out of the extruder and it is dried.
6. Process according to Claim 5, in which the said mixture is cooked-extruded at 140-250°C for 20-60 s at 10-100 bar.
7. Process according to Claim 5, in which the cooked-extruded mixture is cut into pellets.
8. Process according to Claim 7, in which the said



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pellets are rolled into flakes 0.5 to 2 mm thick.

9. Process according to Claim 5; in which the said vegetable is beans, peas, lentils or carrots, the said cereal is maize or rice, the said calcium salt is calcium carbonate or phosphate and the said added protein is a mixture of sodium caseinate and calcium caseinate.
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