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Composition for producing a long-lasting satiation effect

The present invention relates to a composition for oral ingestion, comprising a material which is insoluble or poorly soluble in water and gastrointestinal fluids, in the form of a sponge-like structure, a process for its preparation and its use for the preparation of compositions for producing a satiation effect and for the preparation of orally administrable medicaments, food supplements or foodstuffs having a time-delayed and gentle release of active compound.

Numerous experiments have been undertaken to break down, medicinally, superfluous concentrations of fat in the human article or to prevent their formation. There are, for example, so-called appetite suppressants which attempt to suggest to the article biochemically a reluctance to assimilate food. In some cases, these agents have considerable harmful side effects.

In addition to the numerous known diet proposals, there are also mechanical and electromechanical means with which a specific breakdown of fat or build-up of muscle is supposed to take place. The action of such means, however, is very doubtful.

German Patent Specification DE 4025912 discloses a composition for oral ingestion, which consists of a container which can be dissolved in the stomach where it releases its contents. This is filled with a substance which, after its release in the stomach, increases its volume and thereby suggests to the article a feeling of satiation.

The disadvantage with this system is that the preparation of a special coating is necessary. Before the composition can display its action in the stomach, some time accordingly elapses. Moreover, the preparation of the coating and the compressed form of the composition is associated with considerable outlay.

It is accordingly the object of the present invention to make available a composition having a satiation effect for oral ingestion, which does not have the described disadvantages of the previous compositions. In particular, the outlay for the preparation of the compressed form is intended to be decreased and a foodstuff-like consumption made possible.

This object is achieved by the composition consisting of an elastic material

- which consists of an elastic material [sic]
- which is deformable, shape-reducible and compressible by chewing and palatine swallowing motion so that it can pass through the oesophagus
- which, after leaving the oesophagus, is decompressible in drink fluids and in gastrointestinal fluids in the stomach in a volume-building manner,
- which during the gastric residence produces a physiological satiation effect, and releases bound active compounds and ingredients in a delayed manner, and
- which, after residence in the stomach for a number of hours, leaves the article again unabsorbed or poorly absorbable through the intestine.

In other words, the material is compressed with a simple chewing and swallowing motion and assistance by ingestion of fluid on passage through the human oesophagus and, after leaving the oesophagus, decompresses in water and gastrointestinal fluids in the stomach, where it largely regains its original spatial volume.

Sponge-like structures are understood according to the invention as meaning foams which consist of gas-filled, sphere/polyhedron-like cells, which are delineated by highly viscous or solid cell webs. Both naturally occurring sponges and synthetically prepared sponge-like structures can be employed according to the invention.

The sponge-like or spongiform structures are prepared by methods known per se according to the prior art. Depending on the starting material employed, in the simplest case a foam can be obtained by blowing, beating, shaking, spraying or stirring in the gas atmosphere concerned. In the case of the polymers, the foam structure results on account of chemical reactions. Thus in [sic] the polyurethanes are foamed by addition of blowing agents, which decompose at a certain temperature during the processing with gas formation, or by addition of fluid solvents during the polymerization. Foaming takes place either on leaving the extrusion tool, i.e. following the extrusion or injection moulding or in open moulds. Curing is carried out under the conditions characteristic for the respective chemical combination of the material.

An indispensable prerequisite for the employability of the material according to the invention and of the sponge structure is that the material is compressible without the cell webs breaking. In order to be able to employ the material according to the invention specifically for oral ingestion, the foamy or foam-like material must be able to be compressed on passage through the oesophagus without problems. In particular, symptoms must not occur on passing through the oesophagus.

It is furthermore essential for the choice of the material and the type of foam formation that it remains swellable without the cell webs being destroyed. After the passage through the oesophagus, the sponge-like structure should at least again assume the size which it had before entry into the oesophagus. If appropriate, the material can also swell to a size which exceeds the original volume.

The volume of the decompressed, sponge-like structure is 2, preferably 40, cm^3. The volume in the compressed state is 0.5, preferably 3, cm^3.

The sponge-like structure can have any desired shape in the decompressed state. However, square or

rectangular or round embodiments are preferred. The surface areas in this case are 6 to 60 cm^2.

Preferably, the material is designed such that the sponge-like structure is compressible to 1/2 to 1/20th, preferably 1/4 to 1/10th of its volume or its size. Under physiological conditions, the material, which is reduced in shape and compressed by chewing and swallowing motion, should preferably be able to expand to two- to twenty-fold, particularly preferably to four- to ten-fold its volume, in the stomach after exit from the oesophagus.

Materials employed according to the invention for the sponge-like structure can be natural, semi-synthetic or synthetic polymers. Examples of suitable synthetic polymers are polyurethanes, polyacrylates, poly(meth)acrylic acid esters, homo- and copolymers of vinyl acetate. The natural and semi-synthetic polymers include, inter alia, cellulose, ethers, diethyl-cellulose or cellulose esters, such as cellulose diacetate, cellulose triacetate, cellulose acetate propionate and cellulose acetate butyrate. Those suitable according to the invention are, for example, cellulose derivatives, in particular appropriate ethers, e.g. methylcellulose, hydroxypropylcellulose, hydroxypropyl methylcellulose, or sodium carboxymethyl-cellulose (preferably those compounds having higher viscosity); certain polymers, such as polyacrylic acid and salts thereof; natural (anionic) mucilaginous substances, e.g. xanthan gum, guar gum, tragacanth or alginic acid and salts thereof and the like. Moreover, the employment of insoluble polysaccharides, such as chitin or chitin derivatives or microcrystalline cellulose is conceivable. Linear high molecular weight polymers are particularly preferred according to the invention. According to the invention, those polymers can especially be employed which have a fibre structure. Examples of such substances are the scleroproteins, such as keratins, conchagens, fibrin, elastins, chitin and collagen. The latter is parti-

cularly preferred according to the invention. It is possible for the composition according to the invention, inter alia, also to contain pharmaceutically active substances, foodstuffs or food supplements-minerals, e.g. vitamins, bulk materials, proteins and other foodstuffs or flavourings.

Besides the substances mentioned, further auxiliaries can also be added to the carrier material. Inter alia, in the case of the employment of pharmaceutically active substances, delaying substances are additionally possible.

Moreover, the compositions according to the present invention can additionally contain fillers, disintegrants, binders and lubricants and also excipients.

The present invention also relates to a process for the preparation of the composition described above. In this process, in principle, a suspension of the material for the sponge-like structure is initially prepared and then freeze-dried. If desired, the material for the sponge-like structure is comminuted beforehand and/or subjected to an alkaline and/or an acidic pretreatment. The freeze-drying is preferably carried out at -50 to -150°C, in particular at -80 to -120°C.

Before, during or after the preparation of the sponge-like structure, the material can be loaded with the abovementioned pharmaceutically active substances, foodstuffs or food supplements minerals, e.g. vitamins, bulk materials, proteins and other foodstuffs or flavourings. All customary methods are suitable for this. In the simplest case, this can be carried out during the preparation phase of the sponge material by mixing carrier material and active compound. Likewise, pharmaceuticals, flavourings or luxury foods such as chocolate, icing sugar or similar substances can be applied to the surface.

The purpose of the process according to the invention is to obtain a material which on passage

through the oesophagus is sufficiently compressible and moreover is not decomposed in the case of a relatively long residence time in the stomach. This aim is achieved using the process steps mentioned. Unlike other foodstuff/food supplement/diet or pharmaceutical products, which are decomposed in the short term by gastric juice or even pass into the stomach in comminuted form and thus again pass through (leave) the stomach in a short time, the sponge or foam article consisting of natural or synthetic fibres and prepared in the manner described retains its original form for several hours as a result of special fibre crosslinking sites, such that it passes through the stomach only after several hours. The fibre sponge is not absorbed in the stomach but excreted unabsorbed.

In a variant of the process according to the invention, soluble collagen from the hides of young cattle or pigs (animals) can be employed. The soluble collagen components in the hide of animals specifically become smaller and smaller with increasing age of the article, since the collagen forms an insoluble three-dimensional network as a result of intermolecular crosslinking. The crosslinking sites are solid chemical bonds between individual collagen molecules.

During the preparation of the necessary collagen suspensions for foam preparation, the hides must therefore come from 1 to 2 year-old animals (bulls). Here too, the collagen forms an insoluble network. As a result of strongly alkaline and acidic pretreatment of the hide and mechanical forces during preparation of the sponge suspension, it can result that individual chemical and physical crosslinking sites in the collagen are dissolved.

During the drying of the sponge by freeze-drying, preferably at up to -120°C, new crosslinking sites are again introduced as a result of the relatively high temperatures in the sponge material. This brings about the long-lasting insolubility of the sponge article in the gastric juice. This relative

gastric juice insolubility is a prerequisite for the satiation effect lasting due to the long residence of the sponge in the stomach.

The invention is not restricted to the process described, but also applies to all other processes in which sponges or sponge-like structures are prepared which should or can achieve a long-term satiation effect due to the relative water and gastric juice insolubility and the long residence time in the stomach thereby resulting.

The composition according to the invention is ingested orally. The solid sponge article or solid foam article passes through the oropharyngeal and oesophageal passage by means of addition of drinking fluid and slight chewing or swallowing motions and, due to the gastric fluid, swells again in the stomach, preferably to its original volume. If appropriate, the volume can also be larger or smaller than the original.

By means of the oral ingestion of the composition according to the invention, the residence of the solid sponge article or solid foam article in the stomach for several hours is achieved by means of the poor solubility in the stomach. As a result, a long-term feeling of satiation or fullness can be achieved, which results in reduced assimilation of food.

Depending on the desired degree of satiation, one to fifteen foam articles can be ingested daily at different time intervals. The "satiation sensors" responding due to the foam volume in the stomach produce a satiation effect via the midbrain, which only decreases again on emptying of the stomach. Thus the satiation period can be controlled by the length of residence and the magnitude of the volumes of the sponges.

In the following, the invention is explained in greater detail with reference to the figure:

1. Gastric juice- and water-resistant cube of foam

2. As a result of addition of some fluid, the dry cube of foam loses its solid form and can be swallowed without problems in its aqueous-slippery form like other foodstuffs.
3. The slippery deformed cube of foam passes through the oesophagus.
4. Having reached the stomach, the foam absorbs the gastric and drinking fluid there, and resumes its old spatial volume again.
5. The cube of foam, which is non-digestible due to its particular fibre structure, resides in the stomach for 2-20 hours by retaining its volume. As a result of its volume, it does not pass through the pylorus.
6. The sponge loses its cube shape again (without being absorbed) only due to the continuous stomach movement (peristaltic, 1-20 hours) and the action of the gastric acid and as a result only has the possibility after 1-20 hours of passing through the pylorus in order to be removed through the intestine. Normal foodstuffs, such as meat or vegetables, are reduced to small pieces and dissolved by the gastric acid even after only a short time in order also to pass through the pylorus after a few minutes. As a result of the special fibre structure described, the composition according to the invention, however, retains its original volume in the stomach due to the resistance to gastric acid so that the gastric residence which is hours long and thus satiating is caused biologically (physiologically).

Claims:

1. Composition for oral ingestion, comprising a material which is insoluble or poorly soluble in water and gastrointestinal fluids, in the form of a sponge-like structure, characterized in that it consists of an elastic material,

- which is deformable, shape-reducible and compressible by chewing and palatine swallowing motion so that it can pass through the oesophagus

and

- which, after leaving the oesophagus, is decompressible in water and in gastrointestinal fluids in the stomach in a volume-building manner.

2. Composition according to Claim 1, characterized in that after leaving the oesophagus it is decompressible to approximately the size which it had before entry into the oesophagus by oral ingestion.

3. Composition according to one of Claims 1 or 2, characterized in that the sponge-like structure is compressible to 1/2 to 1/20th, preferably 1/4 to 1/10th, its size.

4. Composition according to one of Claims 1 to 3, characterized in that the sponge-like structure is decompressible after leaving the oesophagus to two- to twenty-fold, preferably four- to ten-fold, its size in the compressed state.

5. Composition according to one of Claims 1 to 4, characterized in that the materials for the sponge-like structures are viscose sponges.

6. Composition according to one of Claims 1 to 5, characterized in that the material for the sponge-like structure consists of natural, semi-synthetic or synthetic polymers.

7. Composition according to one of Claims 1 to 6, characterized in that the material for the sponge-like structure consists of long-fibre, linear colloidal, high molecular weight polymers.

8. Composition according to Claim 7, characterized in that the material for the sponge-like structure consists of polymers with fibre structure, preferably of proteins.

9. Composition according to Claim 8, characterized in that the material for the sponge-like structure consists of scleroproteins, preferably collagens.

10. Composition according to one of Claims 1 to 9, characterized in that the sponge-like structure contains foodstuffs and/or medicaments or active compounds or flavourings and/or is coated or covered externally with pharmaceuticals, lacquers or foodstuffs (luxury foods) such as chocolate, icing sugar, fruit material, etc.

11. Process for the preparation of the composition according to one of Claims 1 to 10, characterized in that a collagen-containing suspension of the material for the sponge-like structure is prepared and then freeze-dried.

12. Process for the preparation of the composition according to one of Claims 1 to 11, characterized in that the material for the sponge-like structure is comminuted and/or subjected to an alkaline and/or an acidic pretreatment.

13. Process for the preparation of the composition according to one of Claims 1 to 12, characterized in that the heating during the freeze-drying is carried out at -50°C to -150°C, preferably at -80 to -120°C.

14. Use of the composition according to one of Claims 1 to 13 for the preparation of compositions for producing a satiation effect and for the preparation of orally administrable medicaments, food supplements, foodstuffs or luxury foods having a time-delayed and gentle release of active compound and contents.