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# IMPREGNATING EDIBLE PROTEIN FIBERS WITH THREE COMPONENT BINDER AND PRODUCT

Niles A. Kjelson, Minneapolis, Minn., assignor to General Mills, Inc., a corporation of Delaware

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The present invention relates to high protein food products and the process of preparing same. More particularly, it relates to such products prepared from edible protein fibers and a binder material consisting essentially of albumen, gluten and particulate defatted oilseed material.

This application is a continuation in part of my prior application Ser. No. 203,447, filed June 19, 1962.

Simulated food products, especially meat substitutes, have recently been prepared from fibers derived from edible protein materials. These protein fibers are prepared by the creation of a spinning dope of protein which is then forced through a porous membrane such as a spinneret to form fibers or filaments which are coagulated in an acid salt bath and oriented by suitable means, such as a series of rolls revolving at increasing speeds. The filaments are then placed in a salt solution (such as sodium chloride) of sufficient concentration to prevent the filaments from redissolving. Groups of these filaments are freed from excess liquid by squeezing or centrifuging and impregnated with flavoring agents, coloring agents, oils, fats and binder materials. The impregnated filaments are then allowed to set-up by heating. The flavoring agents and the like can be so selected and the fiber bundles so arranged as to simulate the meat of mammals, fish, fowl, and shell fish.

Many natural food products can theoretically be simulated using the above techniques. However, in order to enjoy much commercial success, such products must closely resemble the natural foods as to texture, flavor and appearance. In addition, the simulated products must be able to compete favorably as to price. Prior to the present invention, the only material enjoying much success as a binder in the preparation of the heat set-up products was albumen. While certain products can be closely simulated using such binder, others cannot. Thus, it has been found that ground meats, such as chopped beef, ham and the like can be prepared from spun protein fibers and albumen as the sole binder material but that such products, when dried and rehydrated, differ significantly from the natural meats which they are to simulate, in that they are fairly mealy and more loose textured than the natural meats. Additionally, albumen is fairly expensive and is used in amounts which materially affect the cost of the simulated food products. It would be highly desirable to be able to replace a substantial portion of the albumen with less expensive materials and, at the same time, produce simulated food products of excellent texture and/or appearance, such properties being retained even after dehydration and rehydration.

Therefore, it is an object of the invention to provide novel simulated food products.

Another object of the invention is to provide a method for preparing such products.

These and other objects will become apparent from the following detailed description.

I have now discovered that simulated food products having excellent texture and/or appearance can be prepared from spun edible protein fibers and a binder consisting essentially of a mixture of albumen, gluten and particulate defatted oilseed material. My process generally comprises the steps of impregnating spun edible protein fibers with a composition containing a binder consisting essentially of a mixture of albumen, gluten and particulate defatted oilseed material and allowing the impregnated filaments to set-up by applying heat thereto. After the setting-up step, the simulated food products can be cut into various size pieces, chopped or ground, fried, smoked and/or dried as will be more fully described hereinbelow. My invention is particularly designed for the production of products which can be chopped or ground, the chopped or ground products closely resembling natural foods such as hamburger, ground ham and the like even after dehydration and rehydration. It is understood that the impregnated spun protein fibers can be simultaneously set-up and chopped or ground as well as first set-up and then chopped or ground.



The spun protein filaments of fibers used in my process can be produced by any of the methods known in the art. Thus, a wide variety of protein materials which are edible can be used in preparing the dispersions. Representative of such materials are soybean, safflower, corn, peanut and pea proteins as well as various animal proteins such as casein. The edible protein is dispersed in an alkaline medium in varying amounts, such as from about 10–30% by weight. A suitable alkaline medium is water containing an alkali metal hydroxide, i.e., about 5–10% by weight NaOH. The pH of the spinning solution can vary within relatively wide limits but is generally in the range of 9 to 13.5. The viscosity and temperature of such dispersions will generally be within the range of about 10,000–20,000 centipoises and about 20–45° C., respectively. Obviously, the viscosity, pH, temperature and concentrations of alkali metal hydroxide and protein will vary somewhat with the particular protein being dispersed. Also, the dispersions may amount to a colloidal solution, and it is understood that the use of either dispersion or colloidal solution in the claims is inclusive of the other.

After formation of the dispersion or spinning dope, it is forced through a porous membrance, such as a spinneret used in the production of rayon, into a coagulating bath which is generally an acid salt solution. The streamlets coming through the spinneret are thus precipitated in the form of filaments. The filaments issuing from the spinneret, which is actually a small die having from perhaps 5,000 to 15,000 holes each on the order of 0.003–0.004 inch in diameter, will be of a diameter of about 0.003–0.004 inch. Alternatively, coarser filaments can be produced by starting with the protein in the form of powdered material and plasticizing them with about 25% alkaline water and then extruding the plasticized protein material through dies. Filaments produced by such a process may be of much greater thickness on the order of paint brush bristles. It is also possible to have a series of spinnerets producing filaments from the protein dispersion. Such spinnerets may have the same or different number of holes making it possible to directly produce tows of filaments having the same or different diameters.

The coagulating bath is preferably an aqueous solution of salt and an acid. The salt (i.e., NaCl, for example) can be used in widely varying concentrations, such as from about 0.5 to 12% by weight.The acid can be any of those normally used in the coagulating bath. Representative acidic compounds are acetic acid, lactic acid, citric acid, adipic acid, hydrochloric acid, phosphoric and the like. The concentration of said acid in the bath is not critical and may vary between about 0.5 to 10% by weight.

The filaments or bundles thereof (tows) are stretched by pulling them from the coagulating bath over a take-away reel. Preferably, stretching tensions of 50–400% are applied to the filaments or fibers. It is understood, however, that higher or lower tensions can be used and also that the stretching can be performed on a series of