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HIGH PROTEIN FOOD PRODUCT AND PROCESS FOR ITS PREPARATION

Robert A. Boyer, Cincinnati, Ohio

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This invention relates to a food product, and is a continuation-in-part of my copending application, Serial No. 118,445, filed September 28, 1949. In particular it relates to synthetic meat and to methods of producing synthetically foodstuffs which will have the flavor, coloring, taste and "chewiness" of meat. By the term meat I mean to include not only the meat of mammals, but also the meat of fish, fowl, shell fish and crustaceans.

It is well known that proteins are essential to the human diet and that proteins in the form of meat are the most attractive of all protein foods to the average human taste. It is unfortunate however that meats are one of the most expensive classes of foods there are, and it has therefore long has been the goal of food scientists to develop a low cost but satisfactory substitute for meat. Some progress has been made in this direction. Various meat flavors have been produced synthetically and are available commercially. As an example, may be cited bouillon cubes having chicken, beef and other meat flavors. Furthermore, various food dyes have been perfected so that it is possible synthetically to reproduce the coloring of various meats. It has also been demonstrated that some vegetable proteins, although much lower in cost, have nutritive values approximately equal to many meat proteins. The stumbling block up to this point has been in the reproduction of the texture and appearance of natural meat, the texture of course involving the factor of "chewiness." Vegetable chops using wheat gluten as a base have a certain amount of "chewiness," but they do not duplicate the fibrous character of meat; and they fail to give that satisfaction that comes from the breakdown in the mouth during the mastication of a piece of meat.

With the above considerations in mind, it is an object of my invention to produce synthetically a proteinaceous food product.

It is another object of my invention to produce synthetically from vegetable protein or animal protein or combinations thereof, a product which closely resembles natural meat as to its appearance, as to its fibrous qualities, as to its flavor, as to its nutritive value, and as to its chewiness.

It is another object of my invention to produce synthetical meat as above outlined which will closely simulate the white meat of chicken or turkey, which will simulate a filet mignon or a pork chop or other specific types and cuts of meat available in butcher shops.

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It is another object of my invention to provide a process for the production of synthetic meats which process is relatively simple and which can be carried out on a continuous basis.

It is still another object of my invention to provide a process for the production of synthetic meat as above outlined which can be carried out very cheaply, so that the synthetic meat produced according to my invention will be very inexpensive on the market.

Artificial textile fibers have been made synthetically from vegetable protein such as soy beans, corn or peanut protein, as well as from animal proteins such as casein and keratin. Generally speaking, such fibers are made by preparing a quantity of filaments of such protein material, coagulating them in a coagulating bath and then stretching them by means of a series of rolls revolving at increasing speeds. Such filaments are then usually placed in a salt solution (such as sodium chloride) of sufficient concentration to prevent the filaments from re-dissolving. About one-half per cent is sufficient for some proteins although higher salt concentrations may be necessary. These filaments in the production of textile fibers are then insolubilized by treatment in a formaldehyde bath.

The filaments according to the prior art are generally produced by dispersing the proteins which are the starting material in a suitable dispersing medium such as an alkaline aqueous solution. Actually, depending upon the material dispersed, and the dispersing agent used, the dispersion may amount to a collodial solution, and it will be understood that the use of either term in the claims is inclusive of the other. This dispersion is then forced through a porous membrane such as a spinneret used in the production of rayon, and passes into a coagulating bath which is generally an acid salt solution. The streamlets coming through the spinneret are thus precipitated into the form of filaments. Alternatively, coarser filaments can be produced by starting with the proteins in the form of powdered material and plasticizing them with about 25 per cent of alkaline water and then extruding the plasticized protein material through dies. The filaments produced by this process may be of much greater thickness than those produced by a spinneret. These coarser filaments may be of a thickness on the order of paint brush bristles and even though they are stretched afterwards, as outlined above, the final filament will be relatively coarse. On the other hand the filaments as they emerge from a spinneret, which neret, the groups being normally about one-quarter inch in diameter. Each of these groups would then be passed individually through lard or shortening or other melted fats and given about a one-sixteenth inch coating of fat. After the fat coating, the coated groups would be assembled together to give the final tow having a diameter of three to four inches. Before the final assembly the groups may be passed through the binder, and flavoring, coloring, vitamins and the like can be added as desired.

In simulating a filet mignon, the procedure would be similar to that for a pork chop except that the groups of filaments coming from the spinneret would first be assembled into approximately four groups before the fat coating procedure. In other words, individual groups would not be fat coated but plural groups containing three or four spinneret groups would be treated simultaneously with the fat coating. The assembly thereafter would be the same as disclosed above.

In simulating the white meat of chicken or turkey, all the filament groups would be assembled together after being treated with the binder and before being passed to the fat bath.

It has been shown in the prior art of producing man-made textile fibers that physical properties such as strength and elasticity are greatly influenced by the degree of molecular orientation, and similarly I have found that the toughness or tenderness of the synthetic meat product is also affected by an orientation of the protein molecules.

A degree of orientation is brought about by an alignment of the protein molecules as the solution or dispersion passes through the extrusion orifice. It is intended in the present invention therefore that the term "oriented protein fibers" will include those fibers which have been produced by extrusion through an orifice, whether or not they have been subjected to stretching.

Further orientation of the molecules is obtained by stretching the freshly formed and relatively plastic filaments; and a stretching procedure involving no more than leading the fibers away from the extrusion orifice at a rate of speed sufficiently great to prevent the fibers from being formed in a kinky condition enhances the orientation, and consequently the strength.

For instance if the filaments emerging from the spinneret or die are not stretched at all, they will tend to be weak, tender, inelastic and kinky. Usually they will be as large or larger than the opening from which they emerged. On the other hand if the filaments are pulled away from the spinneret or die at a speed sufficiently great to keep them straight and prevent kinking, a further orientation of the molecules occurs and the filaments become stronger, attain elasticity, and usually will be smaller in diameter than the orifice from which they emerged.

The synthetic product made from the kinky or unstretched fibers will lack chewiness, whereas the product made from more highly oriented fibers will have improved chewiness and a more meat-like texture.

The extrusion rate of the fibers through the die or spinneret can be calculated, as is well known. If the take-away reel, or godet wheel as it is sometimes called, is driven at such a rate that its peripheral speed is exactly equal to the extrusion rate, we have zero stretching. If the godet wheel has a peripheral speed twice the extrusion rate, we produce 100% stretching.

It will be obvious that, as the speed at which the filaments are led away from the spinneret or die is increased, the stretching effect will be increased, resulting in a greater degree of orientation. There is an optimum amount of orientation for each type of protein fiber which results in maximum strength and elasticity. I have found however, that it is not necessary to use fibers having maximum strength and elasticity in preparing meat-like products, and in fact have obtained satisfactory results by employing fibers produced over a wide range of stretching tensions.

In practicing my invention, I may employ stretching tensions which are so great that they cause breakage of the filaments before they are completely converted from the solution phase to the solid phase, at which time the filaments are very weak. In these cases, I find it advantageous to apply the stretching forces to the filaments after they have been led out of the precipitating bath and in such a manner that the stretching tensions are not transmitted back to the filaments in the precipitating bath. In these cases, I usually lead the filaments away from the spinneret at a speed just sufficient to keep them in a straight condition, and then after leading them out of the precipitating bath I stretch them by any suitable means such as passing the fibers in the form of a continuous tow over rolls or series of rolls revolving at increasing speeds.

In this manner I can apply varying amounts of stretching tensions in a practical and continuous manner. For instance I can increase the length of a one foot section of tow as it leaves the precipitating bath to two feet as it leaves the last stretching roll. This would be applying a stretch of 100%.

In practicing my invention with soy bean protein I have applied stretching tensions satisfactorily as high as 400%. Higher stretches with this material frequently cause excessive breakage of the filaments. In general, with soy bean protein I prefer to employ stretching tensions from about 50% to about 400%. Appropriate stretching tensions for other protein materials can readily be determined.

It will be understood that the stretching range set forth herein applies to total stretch produced, whether the stretch be produced in its entirety in the coagulating bath, or after emergence from the coagulating bath, or partly in the bath and partly after emergence from the bath.

Another method for controlling toughness is by the use of hardening, tanning, or insolubilizing chemicals. For instance, soaking the fiber in a brine of sodium chloride of any concentration up to a saturated solution will have a toughening effect. Brine has a similar effect on many meats. Other chemicals, such as aluminum sulphate, formaldehyde, and tannic acid will insolubilize the filaments although care must be taken to guard against toxic or other undesirable effects.

If it is desired to tenderize the filaments, proteolytic enzymes (e. g. papain, bromelin, pepsin, trypsin, etc.) may be used as in the known procedures for tenderizing meats. Partial hydrolysis for the same purpose may be effected by the use of such agents as hydrochloric acid, sodium sulphide, alkaline hydroxides, etc., as is well known in the field of protein chemistry.

I have outlined above by way of example how certain specific meats can be simulated. It will be clear that almost any kind of meats can be simulated simply by varying one or more of the and passing said tow through a bath of melted fat of the fowl whose meat is being simulated.

11. The process of preparing simulated pork which includes the steps of preparing a number of groups of filaments of soy bean protein material, stretching said filaments at least to a degree sufficient to produce an orientation of the molecules but not exceeding about 400 per cent, applying to said groups of filaments an edible binder chosen from the group consisting of cereal binders and edible protein binders, passing said groups of filaments individually through a bath of melted pork fat, and assembling said groups of filaments into a tow.

12. The process of preparing simulated beef steak which includes the steps of preparing a number of groups of filaments of soy bean protein material, stretching said filaments at least to a degree sufficient to produce an orientation of the molecules but not exceeding about 400 per cent, applying to said groups of filaments an edible binder chosen from the group consisting of cereal binders and edible protein binders, assembling a number of said groups of filaments and passing said assembled groups individually through a bath of melted beef fat, and further assembling said assembled groups of filaments into a tow.

13. A food product consisting of oriented man-made fibers of natural protein held together by means of an edible binder chosen from the group consisting of cereal binders and edible protein binders.

14. A food product consisting of oriented man-made fibers of natural protein held together by means of an edible binder chosen from the group consisting of cereal binders and edible protein binders with inclusions of fats.

15. A food product comprising oriented edible fibers, extruded from a mass of natural protein.

16. A meat-like product comprising oriented edible fibers, extruded from a mass of natural protein.

17. A food product comprising oriented man-made fibers of natural protein held together by means of an edible binder.

18. A food product comprising oriented man-

made fibers of natural protein, with inclusions of fats.

19. A food product comprising oriented man-made fibers of natural protein held together by means of an edible binder, with inclusions of fats.

20. A food product comprising oriented edible fibers, extruded from a mass of natural protein, and an edible flavoring material.

21. The process of preparing a synthetic food product, which includes the steps of preparing edible filaments by mechanically extruding them from a mass of natural protein, and assembling said filaments into a food product.

22. The process of preparing a synthetic food product, which includes the steps of preparing edible filaments by mechanically extruding them from a mass of natural protein, assembling said filaments into a food product, and adding a flavoring material thereto.

23. In a process of preparing a synthetic food product from edible filaments mechanically extruded from a mass of natural protein, the step of assembling said filaments into groups.

24. In a process of preparing a synthetic food product from edible filaments mechanically extruded from a mass of natural protein, the step of adding an edible flavoring material to said filaments.

25. In a process of preparing synthetic food product from a mass of natural protein, the step of extruding said protein in the form of filaments.

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