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SPRAY DRYING PROCESS

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This invention relates to spray drying. It is particularly useful in making an improved infant food powder and will be first illustrated by description in connection therewith.

Infant foods of the class to which the present invention relates include ordinarily large amounts of lactose, edible fat, and milk protein. A representative composition contains somewhat over half its total weight of lactose and approximately a fourth fat and an eighth protein in addition to various mineral, vitamin, and other enriching materials. The composition may be made by mixing the components with water, homogenizing, and then spray drying, some of the more sensitive components being added to advantage after the homogenization of the others and just before drying of the whole composition.

The present invention provides a process and apparatus for creating and drying crossed sprays of solutions of different viscosities.

Briefly stated, the invention comprises the herein described process and apparatus for codrying two solutions in the special manner described and the resulting product. More specifically, the invention comprises causing impingement of two merging or crossed streams of sprayed droplets in a current of drying gas such as warm air, the spraying being from nozzles in close proximity to each other so that the sprayed droplets from one of the plurality of streams impinge upon those of another stream before the exterior surfaces become dry. The invention comprises also the use of two solutions (true solutions or dispersions) or different viscosities in the plurality of nozzles so that the liquid of lower viscosity, when it impinges under conditions that are comparable except for viscosity differences upon a particle of higher viscosity, spreads preferentially over the particle of the higher viscosity and leaves finally its non-volatile material in higher proportion in the exterior coating in the finished dried particle than in the interior thereof. Other factors, if variable between the merging sprays, also affect the proportion of a given material at the outside and within the finished dried particle.

The invention will be further illustrated by description in connection with the attached drawings in which

FIG. 1 is a side view partly in section of the spray drying equipment in the part thereof that is considered new.

FIGS. 2, 3, and 4 are similar views of modified forms of assemblies.

There are shown a duct 10 in which there is disposed approximately centrally the arrangement of the supply lines 12 and 14 for the dispersions to be sprayed through the plurality of nozzles 16, 18, 20, which together cause impingement of the sprayed droplets as illustrated at 22.

The assembly of nozzles 24 and 26, 28, 30, 32, and 34, with their supply lines 12 and 14, may be substituted in turn in place of the assembly inside the duct 10, in FIG. 1.

The figures are in part diagrammatic and parts of the spray drying equipment not shown are conventional. Such conventional parts not shown include (1) two systems including each a pump delivering under pressure the different dispersions that enter through the lines 12 and 14, (2) a drying chamber in which warm air contacts the sprays and causes drying, and (3) scraper and conveyor means for removing the spray dried product that settles in the drying chamber.

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The materials of construction of the various parts of the equipment shown are those that are usual for parts of the same class in other spray drying equipment. Stainless steel is particularly satisfactory and is recommended when the product is to be used as a human food. We may use tinned iron or Monel metal, the tinned iron being not recommended because of shortness of life under the conditions of use and the Monel because of unnecessary expense.

The materials to be spray dried in making the infant food are, first, a dispersion of skim milk solids and edible fat supplied through one of the lines of the apparatus of the drawings as, for instance, through line 12. This dispersion may and ordinarily does include also considerable lactose as, for instance, about 160 parts of lactose to 100 of protein. This, however, may be varied widely and the added lactose may be omitted entirely from that line. The lactose solution supplied through line 14 ordinarily contains lactose in amount approximately 0.3-3 times the amount of protein in the whole composition. In this manner there is made a finished product in which there is some layering, with the quickly wettable lactose in higher concentration on the outside of the particle than within and with a ratio of total lactose to protein and fat ordinarily above that in a milk powder as, for example 45%-60% of the total.

The medium in which the dispersions are made is volatile and inert, i.e., non-reactive chemically with the materials dispersed therein. Water is the usual medium. When desired or necessary, other volatile liquid solvents may be used, as for example ethanol, isopropanol, acetone, ether, or ethyl acetate, in accordance with solubility of the materials to be dried to powder form.

In a modification of the invention, the dispersion supplied through line 12 is a dispersion of milk solids, either skim or whole and ordinarily skim milk solids as in a skim concentrate. It is advantageous here also to omit, from the milk solids, some of the normal content of lactose that is to appear in the finished product and to introduce the omitted portion separately through line 14. The several materials are supplied in total amounts to give a finished spray dried product of the approximate analysis of skim milk powder.

In place of the lactose, we may use other sugars, examples of which are sucrose, dextrose, maltose, and corn syrup solids, as may be most in demand in the various classes of products of this invention.

The fat introduced, as through line 12, may be butter fat, palm oil, cottonseed oil, soyabean oil, peanut oil, or mixtures thereof.

When it is desired to promote spreading of one of the sprayed liquids over the sprayed droplets of the other, rather than integral blending throughout coalesced droplets, the viscosity of one of the liquids sprayed is made substantially lower than the other, as by concentration, variation of its nature, or temperature of spraying, so that the said one liquid spreads faster, as, for instance, of viscosity in centipoises not more than 25%-75% of the liquid over which the less viscous droplets are to spread.

The operation of the process and apparatus is largely evident from the description that has been given. The sprayed plurality of materials impinge upon each other at a position sufficiently close to the orifices of the several nozzles, such as 1-15 inches, that the impingement occurs while the droplets of the one spray at least are moving at high velocity, each of the materials is in flowable condition as in dispersion or solution in water, and the exterior surfaces of the droplets are not dried to solid form. The high velocity of impingement causes spreading or filming of the most easily spreadable liquid over the other.

Thus we find that the solution of lactose, of lower viscosity than the dispersion of the other components of the