starch is suspended in this water, stirred over a boiling water bath for five minutes, and then covered for the remainder of the cooking cycle. After cooking is complete, the sample is readjusted to a weight of 100 grams and transferred, quantitatively, into graduated 100 ml. centrifuge cups. The sample is then centrifuged at 2000 r.p.m. for exactly 20 minutes and the starch dispersion is removed as a clear supernate and a compacted swollen paste. The percent solids in the supernate is determined by evaporation of an aliquot. The wet weight of the swollen paste is determined directly after the decantation of the supernate and the amount of dry solids in the paste is determined by evaporation. The granule swelling power is then calculated by the formula:

$$GSP=\frac{\text{Wet weight of swollen paste}}{\text{Weight of dry starch in swollen paste}}$$

Although this procedure was used to determine the GSP values in the examples given below, it is to be noted that the technique for determining GSP need not necessarily be limited to the above described cooking conditions. Rather, the precise method of GSP determination will depend upon the nature of the inhibited starch and the manner in which it is to be used. This may involve cold water dispersion, or, it may involve cooking under pressure as in the case of high amylose starches, heat resistant starches as well as with some regular starches.

Unconverted starch will ordinarily exhibit higher granule swelling power than crosslinked, i.e. inhibited, starches. Thus, raw corn starches have a GSP of 33–35. However, in order to function effectively as texture producing starches, these mildly inhibited starches should have a GSP value in the range of from about 8 to 32 since within this range they appear to provide food products with an optimum degree of pulpy texture. Therefore, the quantity of crosslinking reagent to be used in the inhibition process may be defined as that amount required to obtain a product having a GSP of between 8 and 32. As these reagents all differ in their reactivity with starch, the optimum proportions will be different for each reagent. It should be noted, however, that only inhibited high amylose-containing starches and inhibited amylose provide satisfactory products displaying a pulpy texture at the lower GSP values, i.e. 8 to 10; whereas the other applicable inhibited starch bases provide optimum pulpy textured products when they have a GSP value in excess of about 10.

Excessive inhibition, which lowers the GSP values appreciably under 8, results in starch products which are incapable of providing stable pulpy textures, since the particles of such starches will not swell sufficiently during subsequent processing operations.

The method ordinarily used for producing cold water swelling starch products involves gelatinizing the starch, i.e. swelling and ultimately bursting the starch granules, and thereby enabling the resulting starch product to swell in water and eventually to produce discrete bulky particles. The gelatinization process preferably used, for purposes of this invention, is drum drying. In the latter procedure, an aqueous slurry of the crosslinked, amylose-containing starch is passed over heated rollers which raise the temperature of the slurry above the gelatinization point of the starch present therein while also evaporating the water therefrom so as to ultimately yield dry, solid particles of pregelatinized starch.

The drum drying conditions, e.g. temperature and drum speeds, under which the starch product is gelatinized and dried will, of course, vary according to the particular formulation, the degree of crosslinking therein, the degree and density of the desired granule swelling and the ultimate end-use application. In addition, it should be noted that the above described procedure may be varied by precooking the starch product, as by the use of a boiling water bath, a swept-surface heat exchanger, or a jet cooker apparatus, prior to drum drying. The use of any of the latter procedures thus enables the practitioner to utilize lower drum temperatures and rotating speeds as well as to reduce the overall time required for the drum drying operation.

The starch products resulting from the drum drying process are in the form of thin, solid sheets which are then pulverized in order to provide particles of which no more than about 25%, by weight, will be retained on a #12 U.S. Standard Sieve, while no more than about 60%, by weight, will pass through a #100 U.S. Standard Sieve. Thus, the use of starch products which contain more than about 25%, by weight, of +12 material, i.e. particles which will be retained on a #12 mesh screen, will result in the formation of undesirably thick, unnatural textures in the final food products as opposed to imparting the desirable optimum grain-like pulpy texture. On the other hand, starch products which contain more than about 60%, by weight, of −100 material, i.e. particles which will pass through a #100 mesh screen, cannot provide the particles whose large size is the basis of the resulting pulpy textured effect.

Other mechanical means of accomplishing the latter gelatinization step, e.g. spray drying, flash drying and extrusion, etc., may also be utilized if so desired by the practitioner. It should be noted, however, that the drum drying procedure is most economical and efficient for purposes of this invention.

The resulting crosslinked, pregelatinized, amylose-containing starch products should now exhibit the properties which are required in order to enable them to provide the grainy, pulpy texture desired in the food products resulting from the novel process of this invention. Thus, being gelatinized, they are able to provide sufficient cold water swelling ability to produce discrete bulky particles during atmospheric cooking. In addition, they exhibit a proper mesh size and are sufficiently inhibited to permit their individual particles to withstand the heat, acidity, and agitation that may be encountered in subsequent food processing procedures.

Among the food products which can profit from the presence of the crosslinked, pregelatinized starch products produced according to the above procedure are: soups, tomato sauce, meat sauces, gravies, baby foods, puddings, cereals, fruit sauces such as apple sauce, fruit drinks such as pineapple drink, dry powdered mixes which may be reconstituted with water into fruit drinks, soups, etc., confections such as textured orange gum drops, and grainy textured baked goods such as cookies, crackers, pastries, and cakes. Thus, in tomato sauce, for example, the presence of such starch products enables the resulting sauce to exhibit the rich, natural texture of the fresh, raw tomato.

In order to incorporate these starches into a food product, they may merely be put into the form of an aqueous slurry which should contain at least about 10% of water, as based on the total weight of components in the final food product. As an optional component, these slurries may also contain a conventional starch thickener, such as inhibited tapioca or a waxy maize starch; the resulting slurry, either with or without the conventional thickener, thereupon being added to the various non-starch, food base ingredients. It should be noted that when reference is made to "water" or "moisture" in the process of this invention, we contemplate the use of water either in its pure state or as the liquid vehicle of a fruit juice or milk, etc. Furthermore, when reference is made to the "non-starch" ingredients of our products, we contemplate such ingredients as fruits, meats, fish, seafood, vegetables, flours, cereals, spices, flavors, sweeteners, colorings, and preservatives, etc.

In either instance, the resulting mixture is then heated at a temperature of at least about 160° F., thereby causing the crosslinked, pregelatinized starch product to swell and thus form the desired discrete bulky particles. In all