Treatment to Produce Phosphated Distarch Phosphate	*Residuals Limitation*
Sodium tripolyphosphate and sodium trimetaphosphate	Not more than 0.4% of residual phosphate (calculated as P)

Treatment to Produce Acetylated Distarch Phosphate	*Residuals Limitation*
Phosphorus oxychloride, not to exceed 0.1%, followed by either acetic anhydride, not to exceed 8%, or vinyl acetate, not to exceed 7.5%	Not more than 2.5% of acetyl groups introduced into finished product

Treatment to Produce Starch Sodium Succinate	*Residuals Limitation*
Succinic anhydride, not to exceed 4%	—

Monofunctional Etherification

Treatment to Produce Hydroxypropyl Starch	*Residuals Limitation*
Propylene oxide, not to exceed 25%	Not more than 1 mg/kg of residual propylene chlorohydrin

TESTS

Crude Fat Determine as directed under *Crude Fat*, Appendix X.

Lead Determine as directed in the *Flame Atomic Absorption Spectrophotometric Method* under *Lead Limit Test*, Appendix IIIB, using a 5-g sample.

Loss on Drying Determine as directed under *Loss on Drying*, Appendix IIC, drying a 5-g sample in a vacuum oven, not exceeding 100 mm Hg, at 120° for 4 h.

pH of Dispersions Determine as directed under *pH Determination*, Appendix IIB, using the following suspension: Mix 20 g of sample with 80 mL of water, and agitate continuously at a moderate rate for 5 min. (For pregelatinized starches, suspend 3 g of sample in 97 mL of water.)

> **Note**: The water used for sample dispersion should require not more than 0.05 mL of 0.1 *N* acid or alkali per 200 mL of sample to obtain the methyl red or phenolphthalein endpoint, respectively.

Protein Transfer about 10 g of sample, accurately weighed, into an 800-mL Kjeldahl flask, and add 10 g of anhydrous potassium sulfate or anhydrous sodium sulfate, 300 mg of copper selenite or mercuric oxide, and 60 mL of sulfuric acid. Gently heat the mixture, keeping the flask inclined at about a 45° angle, and after frothing has ceased, boil briskly until the solution remains clear for about 1 h. Cool, add 30 mL of water, mix, and cool again. Cautiously pour about 75 mL (or enough to make the mixture strongly alkaline) of a 2:5 aqueous solution of sodium hydroxide down the inside of the flask so that it forms a layer under the acid solution, and then add a few pieces of granular zinc. Immediately connect the flask to a distillation apparatus consisting of a Kjeldahl connecting bulb and a condenser, the delivery tube of which extends well beneath the surface of an accurately measured excess of 0.1 *N* sulfuric acid contained in a 50-mL flask. Gently rotate the contents of the Kjeldahl flask to mix, and distill until all ammonia has passed into the absorbing acid solution (about 250 mL of distillate). Titrate the excess acid with 0.1 *N* sodium hydroxide, using 0.25 mL of methyl red–methylene blue TS as the indicator. Perform a blank determination (see *General Provisions*), substituting pure sucrose or dextrose for the sample, and make any necessary correction. Each milliliter of 0.1 *N* sulfuric acid consumed is equivalent to 1.401 mg of nitrogen. Calculate the percent of nitrogen in the sample, and then calculate the percent of protein in starches obtained from corn by multiplying the percent of nitrogen by 6.25, or in starches obtained from wheat, by 5.7. Other factors may be applied as necessary for starches obtained from other sources.

Sulfur Dioxide Determine as directed under *Sulfur Dioxide Determination*, Appendix X.

TESTS (ADDITIONAL REQUIREMENTS)

Acetyl Groups Determine the content of acetyl groups in *starch acetate*, *acetylated distarch adipate*, and *acetylated distarch phosphate* as directed under *Acetyl Groups*, Appendix X.

Manganese Determine the residual manganese in *bleached starch prepared with potassium permanganate* as directed under *Manganese*, Appendix IIIB.

Phosphate Determine the residual phosphate (calculated as P) in *starch phosphate*, *distarch phosphate*, and *phosphated distarch phosphate* as directed under *Phosphorus*, Appendix IIIB.

Propylene Chlorohydrin Determine the residual propylene chlorohydrin in *hydroxypropyl starch*, *hydroxypropyl starch phosphate*, and *oxidized hydroxypropyl starch* as directed under *Propylene Chlorohydrin*, Appendix X.

Packaging and Storage Store in well-closed containers.

Food Starch, Unmodified

DESCRIPTION

Food Starch, Unmodified, occurs as white or nearly white powders; as intact granules; and if pregelatinized, as flakes, powders, or coarse particles. Food starches are extracted from any of several grain or root crops, including corn (maize), sorghum, wheat, potato, tapioca, sago, and arrowroot and hybrids of these crops such as waxy maize and high-amylose maize. They are chemically composed of either one or a mixture of two glucose polysaccharides (amylose and amylopectin), the composition and relative proportions of which are characteristic of the plant source. Food starches are generally produced by extraction from the plant source using wet milling

processes in which the starch is liberated by grinding aqueous slurries of the raw material. The extracted starch may be subjected to other nonchemical treatments such as purification, extraction, physical treatments, dehydration, heating, and minor pH adjustment during further processing steps. Food starch may be pregelatinized by heat treatment in the presence of water or made cold-water swelling.

Food starches are insoluble in alcohol, in ether, and in chloroform. If they are not treated to be pregelatinized or cold-water swelling, then they are practically insoluble in cold water. Pregelatinized and cold-water swelling starches hydrate in cold water. When heated in water, the granules usually begin to swell at temperatures between 45° and 80°, depending on the botanical origin of the starch. They gelatinize completely at higher temperatures.

Function Thickener; colloidal stabilizer; binder.

REQUIREMENTS

Labeling Indicate the presence of sulfur dioxide if the residual concentration is greater than 10 mg/kg.

Identification

A. Suspend about 1 g of sample in 20 mL of water, and add a few drops of iodine TS. A dark blue to red color appears.

B. Place about 2.5 g of sample in a boiling flask, add 10 mL of 3% hydrochloric acid and 70 mL of water, mix, reflux for about 3 h, and cool. Add 0.5 mL of the resulting solution to 5 mL of hot alkaline cupric tartrate TS. A copious, red precipitate forms.

C. Examine a portion of sample with a polarizing microscope in polarized light under crossed Nicol prisms. The typical polarization cross is observed, except in the case of pregelatinized starches.

Crude Fat Not more than 0.15%.

Lead Not more than 1 mg/kg.

Loss on Drying *Cereal Starch*: Not more than 15.0%; *Potato Starch*: Not more than 21.0%; *Sago and Tapioca Starch*: Not more than 18.0%.

pH of Dispersions Between 3.0 and 9.0.

Protein Not more than 0.5%; except in high-amylose and other hybrid starches, not more than 1%.

Sulfur Dioxide Not more than 0.005%.

TESTS

Crude Fat Determine as directed under *Crude Fat*, Appendix X.

Lead Determine as directed for *Method II* in the *Atomic Absorption Spectrophotometric Graphite Furnace Method* under *Lead Limit Test*, Appendix IIIB.

Loss on Drying Determine as directed under *Loss on Drying*, Appendix IIC, drying a 5-g sample in a vacuum oven, not exceeding 100 mm Hg, at 120° for 4 h.

pH of Dispersions Determine as directed under *pH Determination*, Appendix IIB, using the following suspension: Mix 20 g of sample with 80 mL of water, and agitate continuously at a moderate rate for 5 min. (For pregelatinized starches, suspend 3 g of sample in 97 mL of water.)

Note: The water used for sample dispersion should require not more than 0.05 mL of 0.1 *N* acid or alkali per 200 mL of sample to obtain the methyl red or phenolphthalein endpoint, respectively.

Protein Transfer about 10 g of sample, accurately weighed, into an 800-mL Kjeldahl flask, and add 10 g of anhydrous potassium sulfate or anhydrous sodium sulfate, 300 mg of copper selenite or mercuric oxide, and 60 mL of sulfuric acid. Gently heat the mixture, keeping the flask inclined at about a 45° angle, and after frothing has ceased, boil briskly until the solution remains clear for about 1 h. Cool, add 30 mL of water, mix, and cool again. Cautiously pour about 75 mL (or enough to make the mixture strongly alkaline) of a 2:5 aqueous solution of sodium hydroxide down the inside of the flask so that it forms a layer under the acid solution, and then add a few pieces of granular zinc. Immediately connect the flask to a distillation apparatus consisting of a Kjeldahl connecting bulb and a condenser, the delivery tube of which extends well beneath the surface of an accurately measured excess of 0.1 *N* sulfuric acid contained in a 50-mL flask. Gently rotate the contents of the Kjeldahl flask to mix, and distill until all ammonia has passed into the absorbing acid solution (about 250 mL of distillate). Titrate the excess acid with 0.1 *N* sodium hydroxide, using 0.25 mL of methyl red–methylene blue TS as the indicator. Perform a blank determination (see *General Provisions*), substituting pure sucrose or dextrose for the sample, and make any necessary correction. Each milliliter of 0.1 *N* sulfuric acid consumed is equivalent to 1.401 mg of nitrogen. Calculate the percent nitrogen in the sample, and then calculate the percent protein in starches obtained from corn by multiplying the percent of nitrogen by 6.25, or in starches obtained from wheat, by 5.7. Other factors may be applied as necessary for starches obtained from other sources.

Sulfur Dioxide Determine as directed under *Sulfur Dioxide Determination*, Appendix X, using a 25-g sample.

Packaging and Storage Store in well-closed containers.

Formic Acid

HCOOH

CH_2O_2 Formula wt 46.03

INS: 236 CAS: [64-18-6]

FEMA: 2487

DESCRIPTION

Formic Acid occurs as a clear, colorless, *highly corrosive* liquid with a characteristic, pungent odor. It is miscible with