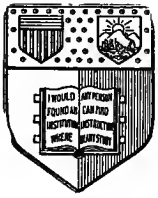

NORTH CAROLINA

DEPARTMENT OF AGRICULTURE

STARCHES USED IN COTTON MILLS, AND THEIR ADULTERATIONS.

BY

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POTATO STARCH.

JULY, 1907.

STARCHES.

INTRODUCTION.

Early in June two samples of starch were sent to this Laboratory for examination. One sample was represented to be potato starch and the other corn starch.

The corn starch was found to be as represented, but very little potato starch was found in the sample represented to be potato starch. The product was mainly corn starch.

This led to the belief that perhaps a mixture of corn and potato starch was being sold for pure potato starch.

After some correspondence with the sender of these samples as to their price and use, it was decided to investigate the quality of the different starches offered for sale in this State.

With this object in view, the following circular-letter was sent out to about eighty weaving mills:

DEAR SIR:—We desire to make an investigation of the kinds and quality of the different starches used in cotton mills in this State, for the benefit of the cotton mills.

We would appreciate it very much if you will send us a ¼-pound sample of each kind of starch used in your mill.

Please send in a sealed package, stating on the package kind of starch, name and address of manufacturer, your own name and address, or mill name and location, price per pound, and as near as you can the number of pounds used annually of the different kinds of starches in your mill or mills.

The replies showed much interest and a willingness to coöperate in the investigation. In a short while many samples of starch were received.

The samples were examined both chemically and microscopically, the following objects being in view:

First. To determine whether or not the starch was the kind it was claimed to be.

Second. To determine if any mineral matter such as talc, tremolite, ground soapstone, plaster of paris, or china clay, etc., had been added to give weight.

Third. To determine if there existed any difference in the gluten content of the different kinds of starch and different samples of the same kind of starch.

Fourth. To determine whether the samples were neutral, acid, or alkaline.

CONSUMPTION OF STARCH IN NORTH CAROLINA.

It is estimated that about 300 pounds of starch per loom are used in North Carolina annually.

There are 52,747 looms operated in the State; therefore, there are about 15,824,100 pounds of starch consumed by the cotton-weaving mills alone.

Reckoning the average price of all starch consumed at 2½ cents per pound, it is found that about $400,000 is spent every year for starch in this State. The economical expenditure of so large a sum of money is worth considering.

FRAUDS PRACTISED.

The fact that it is impossible to tell the difference between different kinds of starches without the aid of the microscope, has been taken advantage of by some manufacturers or dealers to deceive purchasers as to the actual composition of the product.

How long the fraud of substituting a cheaper form of starch for a more expensive one has been going on we have no way of knowing.

How much money consumers of starch have lost by this deception on the part of manufacturers or dealers cannot be estimated.

The fact that 66 per cent of the so-called potato starches examined were found to be mainly corn starch or cassava starch will give some idea of the magnitude of the sophistication.

This Department is willing and stands ready to be of any service it can to the textile manufacturers of the State to put an end to the adulteration of starches.

It does not mean to interfere in any way with legitimate trade.

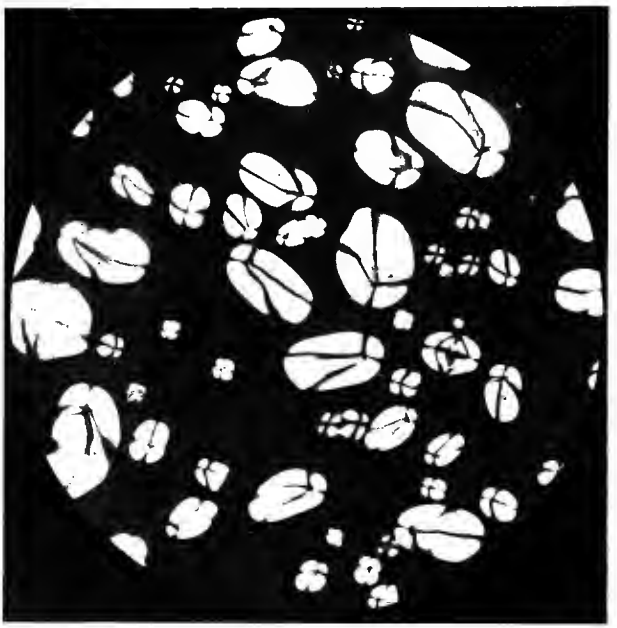
PROPERTIES OF STARCH.

Occurrence.—Starch is one of the most widely-diffused substances in the vegetable kingdom, occurring more or less abundantly in every plant that has up to the present time been examined.

It is found in different parts of the plants, especially in the seeds of all the cereals and in the tubers of the potato, canna, and cassava.

Starch is found in varying proportions in different parts of the same plant. For instance, it is found in green leaves of all plants during the daytime; the proportion varying according to the weather and time of day. It is generally present in greatest quantity toward the evening and least in the morning, whilst during the night the starch completely disappears from the leaves, especially during the summer months.

Starch is also found in the pith of trees and shrubs and in the various woody tissues, but its presence in these parts, as in the leaves, is



Pure Potato Starch. Magnified 200 times.

not constant, the same tissues at certain seasons being fully charged with starch and at others almost entirely devoid of it.

Nomenclature.—In this country the term starch appears to be applied generally to that obtained from all sources, with the name of the substance from which it is made usually prefixed to it, such as potato starch, wheat starch, rice starch.

In a few instances the affix "starch" is dropped, as in "sago," "arrowroot," or the product is known by some name given it in commerce, as "tapioca," etc.

RELATIVE PROPORTION OF STARCH IN VARIOUS PLANTS.

The per cent of starch in various plants differs, as seen in table below.

	Per Cent. Starch.
Potato, air-dried	16–23
Corn	55–67
Wheat	53–56
Barley	38–46
Oats	27–38
Rye	45–47
Rice	75–77
Buckwheat	44
Tubers of Yam	25.2
Dried Apples	5.2
Dried Pears	10.3
Pease	38.0

Physical Characteristics.—To the naked eye pure starch presents the appearance of a white glistening friable powder, having a harsh feel when rubbed between the fingers, perfectly neutral, without taste or smell, is uncrystallizable and undergoes no change under ordinary atmospheric conditions.

Under Microscope.—Under the microscope it is seen to consist of granules of various forms; the granules are in most cases perhaps more or less ovoid and differing widely in size, form, and appearance, dependent upon the source from which they are derived.

These starch granules may vary in size from 0.002 mm. in diameter to 0.185 mm.

These wide differences are the principal means by which the various kinds of starch may be differentiated one from another as they occur in commerce.

It must be noted, however, that the size of the starch granules varies very greatly in different plants, being in some immeasurably minute, as in certain species of cacti; in others, as in the potato, attaining a comparatively very large size.

In the same plant and often in the same cell the size of the starch granules will be found to vary, being chiefly dependent upon the relative age of the grains, so that when measures of starch grains from various sources are given they must be taken only to represent an

average; but although the dimensions of the starch granules produced by one species of plant are by no means constant, yet none of them depart very widely from the average, and so can be readily differentiated microscopically one from another by an expert.

DIAMETER OF THE COMMON VARIETIES OF STARCH GRANULES.

	Millimeters.	*Inches.*
Tubers of Potato	.140	.0055
Wheat	.050	.0019
Corn	.030	.0012
Tapioca	.028	.0011
Buckwheat	.009	.00035
Rice	.022	.0008
Barley	.025	.00098

Under Polarized Light.—Starch assumes under polarized light a most characteristic appearance.

When examined with polarized light the field remains dark, but each granule assumes a glistening gray appearance, as if self-illuminous, and is marked with a black cross. If a thin plate of selenite be introduced between the polarizer and the objective while the prisms are crossed, beautiful chromatic effects may be obtained.

Chemical Properties.—Starch is insoluble in cold water, alcohol, ether, or any other known solvent.

Ordinarily air-dried starch usually contains 18 per cent of water, which can be driven off by heating to 100 degrees C. Under this condition starch appears to be a most highly hygroscopic substance which rapidly absorbs moisture from the air until it regains its original 18 per cent, and if exposed to damp atmosphere it is capable of absorbing as much as 35 per cent of moisture.

Action of Heat on Starch.—Freed completely from moisture, starch may be heated to a temperature of 160 degrees C., without undergoing any change; at temperatures higher than this it becomes colored and is partly converted into dextrine.

If ordinarily air-dried starch be heated to 160 degrees C., it quickly undergoes decomposition, becoming converted into dextrine and reducing sugars.

Potato starch is entirely decomposed under these conditions.

Action of Hot Water.—When starch is brought in contact with hot water, the contents of the granules, owing to a large absorption of water, swell up enormously, and at a temperature varying according to the variety of starch, ultimately rupture the outer layer, forming a viscous liquid which is known as starch paste.

The different varieties of starch gelatinize with hot water at very different temperatures, as seen in the following table by Lintner, which gives the temperatures of complete gelatinization for the common varieties of starch:

TEMPERATURE AT WHICH COMPLETE GELATINIZATION TAKES PLACE.

	Degrees C.
Potato	65
Corn	75
Wheat	80
Barley	80
Rice	85

Under the action of boiling water the starch granules do not all swell up and burst at once, the younger ones being attacked first, the older last.

According to Brown and Heron, starch which has been treated with dilute potash and acid in the process of purification produces a paste of less viscosity than the same starch which has not been so treated. They also find that immense variations in the consistency of the resulting paste are produced by slightly altering the manner of drying.

Thus starch which has been dried slowly and at a low temperature yields a more viscous solution than if dried quickly at a higher temperature.

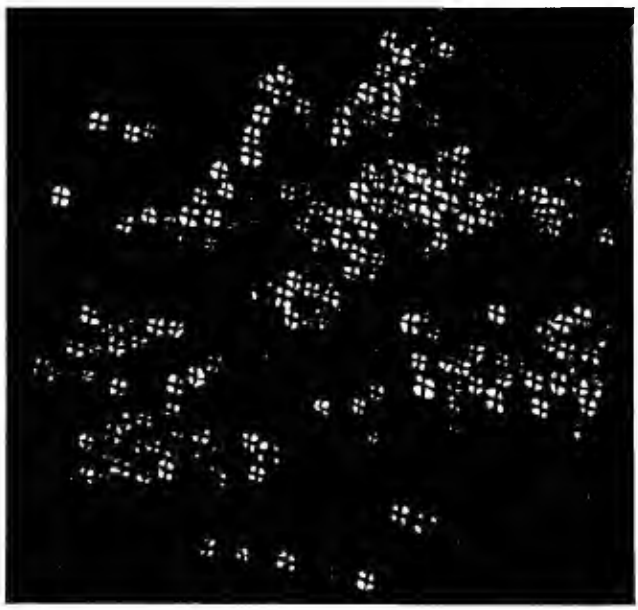
From the manufacturer's point of view the viscosity of starch is most important, as the value of starch in certain industries depends entirely upon the viscosity produced by it when acted on by boiling water.

Potato starch is used in large quantities for the sizing and stiffening of yarn and cloth, so that it is of importance to the manufacturer to obtain that sample of starch which will make the stiffest cloth and which has the greatest tenacity.

Viscosity of Starch Important to Manufacturers.—If the viscosity of one sample of starch is 18 and the other 28, it means that it requires 28 pounds of one sample to give the same stiffness as 18 pounds of the other.

Action of Alkalies on Starch.—When starch is treated with an alkaline solution, the granules swell and form an exceedingly tough viscous mass.

Action of Acids.—A swelling of the starch granules similar to that occasioned by sodium, or potassium hydroxide is produced imme-



Pure Corn Starch. Magnified 200 times.

diately by all mineral acids and by some organic acids—tartaric and citric—after being in contact for some time. No swelling is produced by acetic or oxalic acid, no matter how concentrated their solutions may be.

Chemical Composition.—Although starch from different plants has the same percentage composition (the formula being $C_6H_{10}O_5$ or some multiple), it is not one single substance.

Three isomeric carbohydrates occurring in varying proportions have been described:

(1) Granulose colored blue with iodine.

(2) Starch cellulose colored yellow with iodine, and

(3) Amylodextrine colored red with iodine.

True starch consists of granulose with a small amount of starch cellulose, and is colored blue by iodine.

Starch is converted into a paste by boiling with water, passing successively into soluble starch, dextrine, and dextrose on boiling with dilute sulphuric acid or hydrochloric acid.

By heating at 150 to 160 degrees C., it is converted into dextrine. It is soluble in caustic soda or potash.

MANUFACTURE OF STARCH.

General Considerations.—In growing various starch-producing plants for manufacturing purposes, the following facts must be taken into account:

1. The average percentage of starch contained in the root, tuber, or grain.

2. Yield per acre.

3. Amount of starch yield per acre.

Thus, although the potato at best contains only 20 per cent of starch, wheat, on the other hand, contains 55 per cent. Nevertheless, the total amount per acre is in favor of the potato in proportion of two to one; since one acre of land, on the average, produces 12,994 pounds of potatoes, containing 2,598 pounds of starch, as against 1,860 pounds of wheat, containing 1,023 pounds of starch.

Again, different varieties of the same species of plants will show very marked difference in the quantity of starch which they yield.

For instance, the potato as ordinarily consumed as food in this country contains only 13 per cent of starch, but in Germany, where the potato is cultivated for starch production by means of careful selection and suitable manuring, the percentage of starch has been raised to as much as 20 per cent. In some instances as great a yield as 24 per cent has been obtained.

The yield of starch is also affected by the age of the raw material, conditions of harvesting, and exposure to heat and cold during storage.

Diseased potatoes contain considerably less starch than sound ones, owing to its conversion into sugar by the fungus that attacks them. Exposure to extreme cold tends to diminish the amount of starch in potatoes.

Yield of starch may also be low, due to carelessness in the process of manufacture.

Raw Materials.—The raw materials almost exclusively employed in Europe and North America for the preparation of starch therefrom are wheat, potatoes, corn, and rice.

Wheat was very generally used at one time, but now has been almost entirely replaced by the other substances.

Potatoes are very largely employed on the continent, rice principally in England, and corn almost exclusively in America.

USES OF STARCH.

The uses of starch may be classed under three heads:

First. For manufacturing purposes generally, such as the sizing of paper and of cotton goods, the dressing of cloth, the thickening of mordants and colors in calico printing, the preparation of gums of white glucose syrups, etc.

Second. For laundry purposes.

Third. For edible purposes either by itself or in the preparation of corn flours, arrowroot, tapioca, etc., or in conjunction with other substances in the preparation of sauces, macaroni, etc.

Manufacture of Starch from Maize or Corn.—This process is principally confined to the United States, and no industry in this country has grown so rapidly and concentrated itself into a small circle of factories within the last half century as the manufacture of starch from maize or Indian corn, which in this country is termed "corn starch."

The following analysis of corn, as given by Dr. Archbold, represents the average of many samples analyzed in the course of one year's working:

	Per Cent.
Water	11.2
Starch	54.8
Cellulose	16.4
Gum and Sugar	2.9
Gluten	8.2
Fat	4.7
Ash	4.8

The Manufacture of Starch from Potatoes.—At one time the manufacture of starch from potatoes was carried on to a certain extent in

Great Britain as well as in Ireland, the first published specification relating to starch being taken out as far back as 1717 by Newton, Nowell, Clark, and Jones, for a way or method to make starch from the roots called potatoes, but its development has been considerably checked by potato diseases.

In France and Germany, however, where much more attention has been directed to the growth of the potato as a starch producer, the manufacture of starch from this source has attained considerable dimensions, and large quantities of potato starch are imported yearly to this country.

ANALYSIS OF POTATO.

	Average Per Cent.
Water	78.9
Ash	1.0
Protein	2.1
Fiber	0.6
N. Free Extract	17.3
Fat	0.1
Starch (Air-dried Sample)	16–23

Details in Starch Manufacture.—The details of the manufacture of starch will not be gone into in this paper.

The general procedure includes the following operations: steeping, washing, separations of stones, rasping, straining, settling, removal of the starch, purification, second straining, washing, draining, and drying in the air or in a centrifugal machine, drying in an oven, and packing.

MICROSCOPICAL APPEARANCE OF DIFFERENT KINDS OF STARCHES.

In examining different starches with the microscope, the following points should be observed:

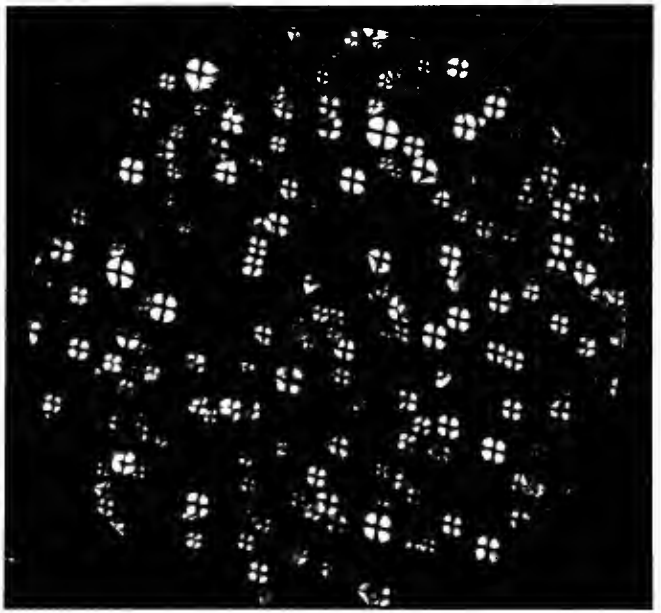
The size and form of the granules, the position and character of the hilum, the nature of the striations or concentric rings, and the appearance presented by the granules under polarized light.

It is only by careful microscopical examination that one particular form of starch can be differentiated from another, and it is comparatively easy, when only one kind of starch is present, but when mixtures of different starches occur in the same sample the detection of each particular one becomes a matter of some difficulty.

A DESCRIPTION OF WHEAT, CORN, AND POTATO STARCHES.

Wheat Starch.—The granules of wheat starch differ greatly in size, varying from 0.05 to 0.01 mm. in diameter. There seem to be, in fact, two kinds of granules in wheat starch, both of them shaped like circular discs, one class much larger than the other, but very few of an intermediate size. The hilum of the starch is almost invisible and the rings which characterize it are not prominent.

Corn Starch.—The granules of corn starch are of a more uniform size than those of wheat, varying from 0.02 to 0.03 mm. in diameter.



Pure Cassava Starch. Magnified 200 times.

Now and then a few are seen which are much smaller. In general, they differ in shape from the wheat granules, and some are found to be polyhedral with rounded angles. They resemble the granules of rice starch, but are larger. Under polarized light they appear as brilliant objects, but under the microscope with ordinary illumination they give only the faintest sign of rings, but show a well-developed hilum, which is at times starch-shaped, or like an irregular cross, and at others resembles a circular depression. The corn starch granule is a type of the angular, as the wheat is of the spherical form.

Potato Starch.—The granules of potato starch are large, oyster-shell shaped, with hilum in small end, size 0.140 mm. in diameter. Rings are very distinct and are evident without special illumination. Polarization crosses are very distinct; with the selenite plate a fine play of colors is obtained.

POTATO STARCH IN THE TEXTILE ARTS.*

1. Potato starch possesses peculiar properties rendering it especially valuable for use in print works.

The makers of prints are willing to pay an increase in price for potato starch over that which they would have to pay for starch made from corn. This higher value has led to the adulteration of potato starch with corn starch.

Potato starch is used in the manufacture of cotton, woolen, linen, and silk goods for three (3) distinct purposes, viz.: first, as a sizing for the warp yarn before it is woven; second, for finishing the goods after they have been woven, bleached, dyed, or printed; third, in the form of dextrine or roasted starch, as a thickening or vehicle for applying the colors to the fabric.

2. The preparation of starch for sizing and finishing consists mainly in mixing it with the proper amount of water. The starch mixture is boiled from ten minutes to an hour or more as the size-maker may deem best, and after straining, to remove any lumps or gritty matter, is ready for use in the sizing or finishing machine.

Besides starch and water, various other substances are added to impart peculiar qualities to the size. Thus, to give softness to the size or finished yarns or fabric, it is customary to add some oil of fat, as tallow, cocoanut oil, bone fat, or even soaps, before or during the boiling, while various hydroscopic agents, such as glycerine and the chlorides of magnesium, zinc, or calcium, are added to prevent the size from drying too much so as to be harsh, stiff, or brittle.

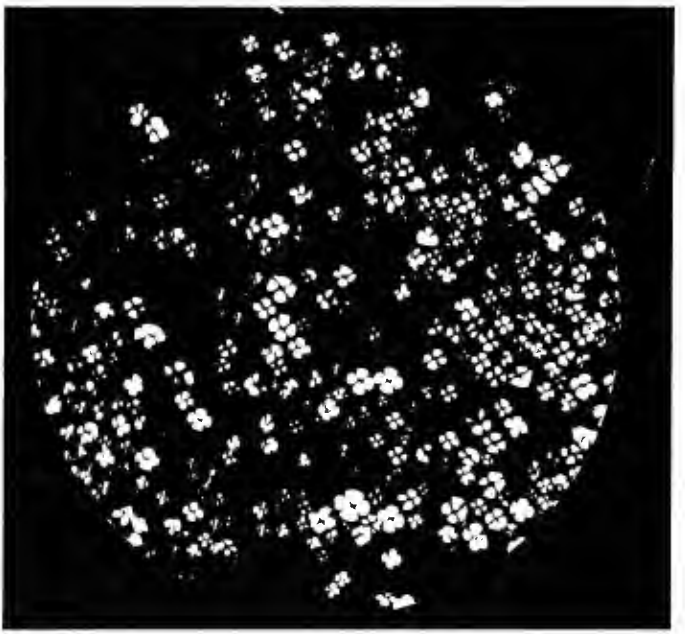
The latter salts also act as antiseptic on heavily-sized yarn or goods, preventing the souring or mildewing which is liable to take place when the goods are stored in a damp place.

When it is desired to make the yarn or fabric seem heavier than it does in its normal state or to give the goods more body, make them appear thicker and more closely woven, various white pigments are added to the size, such as china clay, whiting, etc. Finally, to make

*Bulletin 8, U. S. Department of Agriculture.

the goods appear whiter, by taking away the slightly yellowish tint of the natural fiber, even after it is bleached, certain blue or bluish-violet coloring matters are added to the size or finish, chiefly ultramarine or prussian blue.

The above represents in general terms the composition of the size and finishes, though each individual sizer and finisher has his own receipts, which he considers to be essential to his own particular requirements, and a list of the ingredients used in those receipts would cover almost every chemical known.



Sample No. 1 was represented to be Potato Starch. It proved to be mostly corn and cassava, as shown by the cut.

It is quite an art to be able to size or finish a fabric or fiber so as to imitate any sample that may be furnished, no matter whether the fabric or fiber are the same or wholly different. It is the business of the expert in charge of the sizing to make a piece of cotton feel and look like a wool or silk fabric, if he is requested to do so.

The third use of potato starch mentioned above—its use in the form of dextrine for thickening colors—is no longer a very impor-

tant one, as the various corn dextrines have replaced the potato almost altogether, owing to their cheapness and greater thickening power.

For very fine, light work, especially in silk and wool printing, potato dextrine still holds its own on account of its lighter color and closer resemblance to gum arabic in its thickening properties. Its greater freedom from smell is also an advantage in certain sizing work.

Corn starch resists the action of chemicals better than potato starch and gives a better working paste.

SOURING.

Potato and corn starch do not contain enough gluten or nitrogenous matter to warrant the long and tedious operation of souring before using.

POTATO STARCH AND WARPS.

Of the several uses for potato starch mentioned above, by far the most important is for sizing of warps; very little potato starch is used for finishing cloth.

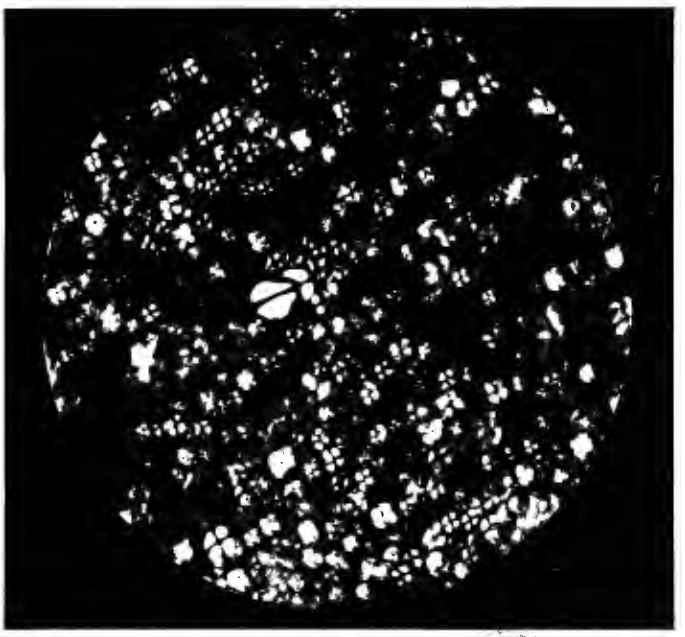
In spite of the higher price of potato starch and in spite of the fact that, weight for weight, corn starch will give a stiffer paste than potato starch, it is claimed for potato starch that it is better for sizing purposes, especially for the sizing of fine yarns. Potato starch gives a more elastic size, at the same time is thinner and more penetrating. Corn starch lies more on the surface of the fiber than the potato starch, so that a given number of threads sized with corn starch will take up more room when laid side by side than the same number sized with potato starch. Thus a yarn sized with corn starch, then woven and the size washed out, will give a more open fabric than if it had been sized with potato, provided the yarn has been woven as close together as possible. The fact that the potato size penetrates more thoroughly and is more elastic than corn size is the reason why the former dusts off less in weaving than the corn size.

POTATO STARCH PREPARATIONS.

There are one or two preparations of potato as well as of corn starch which are coming into use as ingredients of sizes and finishes, used in connection with the ordinary starch.

One of the oldest of these is the exceedingly thick, pasty preparation formed by kneading starch with strong caustic soda or potash. Sometimes the alkali is partially neutralized without losing any of its thickening properties.

Another product is formed by heating starch with a solution of zinc or magnesium chloride, with or without pressure, by which an important change is effected in the properties of the starch paste. They are sold in the paste or dry form to be used in connection with ordinary starch size.



Sample No. 3, represented to be Potato Starch. It proved to be mostly corn and cassava, as shown by the cut. The large starch granule seen is potato starch, but its presence is probably accidental.

POTATO STARCH AS A SOURCE OF DEXTRINE.

In Europe large quantities of potato starch are used for the manufacture of dextrine or British gum, as it is often called.

In the process of manufacture the starch is submitted to a high temperature, preferably in contact with the diluted vapors of nitric acid.

The action of heat in connection with the slight quantity of nitric acid present is sufficient to convert the starch into dextrine, in which form it is used for various kinds of mucilage.

The manufacture of dextrine or gum of this kind is an important branch of the industries connected with starch.

SAMPLES OF POTATO STARCH FOUND ADULTERATED.

Sixty-six (66) per cent of the samples sent in represented to be potato starch were found not to be potato starch, but mixtures of different starches in which there was very little potato starch.

Sample No. 1, sent in by Caraleigh Cotton Mills, Raleigh, N. C., and sold by Arnold Hoffman & Co., new York, at $3.50 per 100 pounds, for potato starch, was found to be mostly corn and cassava starch, with perhaps some potato starch.

Sample No. 3, sent in by The Worth Manufacturing Company, Worthville, N. C., and sold by New York Starch Concern, at $3.65 per 100 pounds, for potato starch, was found to be mostly corn starch and cassava, with perhaps some potato starch.

Sample No. 37, sent in by Chatham Manufacturing Company, Elkin, N. C., and sold by Arnold Hoffman & Co., for $3.58 per 100 pounds, for potato starch, was found to be mostly corn starch, with perhaps some potato starch.

Sample No. 51, sent in by Ivey Mill Company, Hickory, N. C., and sold by Arnold Hoffman & Co., for $4.50 per 100 pounds, for potato starch, was found to be a mixture of corn and potato starch, mostly corn starch.

Sample No. 9, sent in by Great Falls Manufacturing Company, Rockingham, N. C., and sold by Arnold Hoffman & Co., New York, for $3.75 per 100 pounds, for potato starch, was found to be mostly corn starch, with perhaps some potato starch.

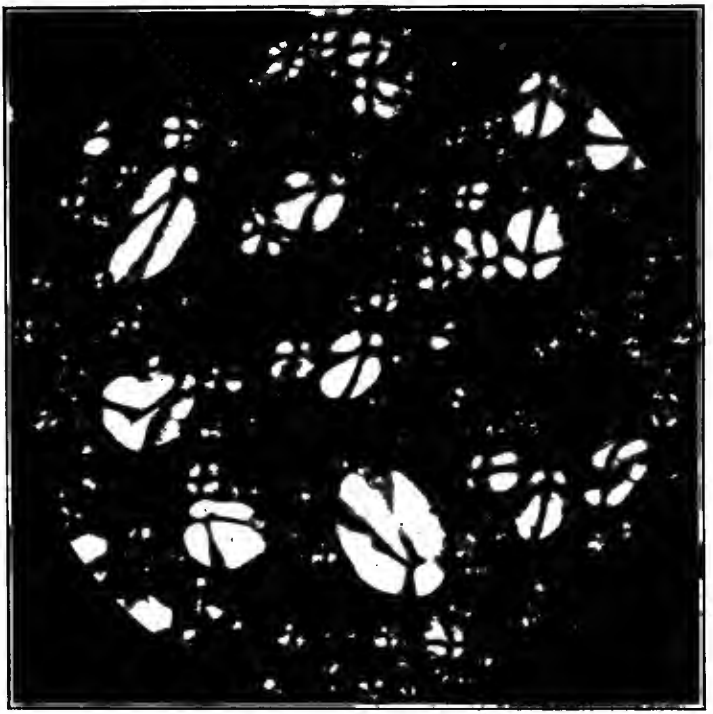
Sample No. 21, sent in by Leaksville Cotton Mills, Leaksville, N. C., and sold by Arnold Hoffman & Co., New York, for $3.65 per 100 pounds, for potato starch, was found to be mostly cassava starch. No evidence of potato starch.

WHEAT STARCH FOUND ADULTERATED.

One sample of wheat starch, No. 13, sent in by Gibson Manufacturing Company, Concord, N. C., and sold by Arnold Hoffman & Co., for $4.20 per 100 pounds, for wheat starch, was found to be a mixture of corn and wheat starch.

SAMPLES OF POTATO STARCH NOT ADULTERATED.

Sample No. 26, sent in by Hoskins Mill, Charlotte, and sold by Eustis, Pennock & Co., Boston, at $3.70 per 100 pounds, for potato starch, was found to be potato starch.



Sample No. 39 was represented to be Potato Starch. The cut shows it be a mixture of corn and potato starches. The large granules are potato stareh, the small ones corn starch.

Sample No. 4, sent in by Worth Manufacturing Company, Worthville, N. C., and sold for $3.81 per 100 pounds (manufacturers not given), for potato starch, was found to be potato starch.

Sample No. 38, potato starch, sent in by Erwin Cotton Mills, West Durham, N. C., (manufacturers and price not given), was found to be potato starch.

SUMMARY.

RESULTS OF THE CHEMICAL EXAMINATION OF COMMERCIAL POTATO, CORN, CASSAVA, AND KEEVER STARCHES.

From the analyses just completed in this Laboratory the average per cent of protein and ash in the starches examined is as follows:

	Protein, Per Cent.	*Ash, Per Cent.*
Corn starch	0.44	0.16
Potato starch	0.26	0.35
Cassava starch	0.23	0.34

It will be seen from the above that there is very little difference in the composition of cassava and potato starches.

The more protein a starch contains the more gluten it contains. Therefore, the higher the per cent of protein in starch the higher the per cent of gluten.

It will be seen from the chemical composition of corn and potato starches that corn starch contains nearly twice as much protein as potato starch.

This indicates that the gluten content of corn starch greatly exceeds that of potato starch.

Corn starch, having a higher per cent of gluten than potato starch, makes a thicker and more viscous paste. Potato and cassava starches make a thinner paste which penetrates the cloth or fiber to a much greater extent.

The corn starches examined showed very little difference in chemical composition.

N. STARCH.

This starch is a corn product. It differs from other corn starches in that it has had some chemical added to it which renders it alkaline.

It has a higher per cent of ash, but not sufficiently high to indicate that any mineral substance had been added for the purpose of increasing its weight.

KEEVER STARCH.

This starch is made by the Keever Starch Company, of Columbus, Ohio, and is sold under the trade name of Victor Mill Starch.

It is a mixture of corn, wheat, and rice starches, the corn starch composing quite the largest part. Its protein and gluten content is higher than that of corn starch.

This is due, perhaps, to high protein content of the wheat starch present.

HAWKEYE BRAND.

The Hawkeye Brand of corn starch, manufactured by the National Starch Company, was found to be corn starch to which some chemical had been added which rendered it alkaline.

NEUTRAL STARCHES.

All natural starches are neither acid nor alkaline, but neutral.

All starches examined were neutral except the two above mentioned, which were alkaline.

MINERAL MATTER.

No mineral matter added for the purpose of increasing the weight was found in any of the starches examined.

PROPRIETARY OR TRADE-NAME STARCHES.

Starch should never be bought because it has some proprietary or trade name. There is nothing in a name. In purchasing starch the buyer, in order to protect himself from fraud, should insist upon a guarantee of its composition. That is, he should require the manufacturer or dealer to state the kind of starch or, if a mixture, the percentages of the different kinds present.

RESULTS OF SAMPLES OF STARCHES EXAMINED.

The following table shows the results of starches examined:

Laboratory Number.	Name.	Sent in by	Manufactured by
1	Potato Starch	Caraleigh Cotton Mills, Raleigh, N. C.	Arnold Hoffman & Co., Providence, R. I.
2	Tapioca Starch	----do	----do
3	Potato Starch (a)	Worth Mfg. Co., Worthville, N. C.	New York Starch Concern
4	Potato Starch (b)	----do	Not given
5	Corn Starch (second sample.)	----do	----do
6	Hoosier Pearl Corn Starch.	Pilot Cotton Mills, Raleigh, N. C.	Piel Bros. Starch Co., Indianapolis, Ind
7	Warner's Eagle Pearl Corn Starch.	----do	Corn Products Refining Co., Waukegan, Ill.
8	Pearl Starch	Aurora Cotton Mills, L. J. Holt & Sons.	Douglas & Co., Cedar Rapids, Iowa.
9	Holland Potato Starch.	Great Falls Mfg. Co., Rockingham, N. C.	Arnold Hoffman & Co., Providence, R. I.
11	Hawkeye Pearl Corn Starch.	Proximity Mfg. Co., Greensboro, N. C.	Corn Products Refining Co., Pekin, Ill.
12	Hawkeye Brand Corn Starch.	Gibson Mfg. Co., Concord, N. C.	National Starch Co., New York
13	Wheat Starch	----do	Arnold Hoffman & Co., Providence, R. I.
14	N. Starch	Delgado Mills, Wilmington, N. C.	National Starch Co., New York
15	----do	----do	----do
16	Pearl Starch	Asheville Cotton Mills, Asheville, N. C.	Piel Bros. Starch Co., Indianapolis, Ind.
18	Corn Starch	Eugenia Mfg. Co., Jonesboro, N. C.	T. S. Southgate & Co., Norfolk, Va.
19	N. Starch	Leaksville Cotton Mills, Leaksville, N. C.	National Starch Co., New York
20	Victor Mill Starch	Leaksville Cotton Mills, Leaksville, N. C.	Keever Starch Co., Columbus, O.
21	Holland Starch	----do	Arnold Hoffman & Co., Providence, R. I.
22	Corn Starch	Naomi Falls Mfg. Co., Randleman, N. C.	Corn Products Refining Co., New York.
23	Java Starch	----do	Arnold Hoffman & Co., Providence, R. I.
25	Corn Starch	Chadwick Mill, Charlotte, N. C.	National Starch Co., New York
26	Potato Starch	Hoskins Mill, Charlotte, N. C.	Eustis, Pennock & Co., Boston, Mass.
27	N. Starch	Cliffside Mills, Cliffside, N. C.	National Starch Co.
28	Corn Starch	Holt Granite Mfg. Co., Haw River, N. C.	----do
29	Eagle Starch	Nokomis Cotton Mills, Lexington, N. C.	----do
30	Victor Starch	----do	Keever Mfg. Co., Columbus, O.
31	Java Starch	Randleman Mfg. Co., Randleman, N. C.	Arnold Hoffman & Co.
32	Pearl Corn Starch	----do	Corn Products Refining Co., New York.
33	N. Starch	The High Shoals Co., High Shoals, N. C.	National Starch Co., Indianapolis, Ind.
34	Pearl Grade Starch	Nantucket Mills, Spray, N. C.	National Starch Co., New York
35	----do	Lily Mills, Spray, N. C.	----do
36	Keever Starch	Odell Mfg. Co., Concord, N. C.	Keever Starch Co., Columbus, O.
37	Potato Starch	Chatham Mfg. Co., Elkin, N. C.	Arnold Hoffman & Co., New York
38	Potato Starch		
39	Potato Starch	Ivey Mill Co., Hickory, N. C.	Arnold Hoffman & Co., New York

STARCHES EXAMINED.

Laboratory Number.	Price Per 100 Pounds.	Per Cent Protein.	Per Cent Ash.	Per Cent Moisture.	Acid, Neutral or Alkaline.	Viscosity.	The Microscopical Examination Shows This Product to be
1	$ 3.50	0.42	0.27	10.50	Neutral --	13	Mainly Corn and Cassava Starch, with perhaps some Potato Starch.
2	3.50	0.25	0.41	8.36	----do -----	23	Cassava, Java or Tapioca Starch.
3	3.65	0.34	0.27	9.05	----do -----	15	Corn and Cassava Starch, with perhaps some Potato Starch.
4	3.81	0.22	0.40	12.91	----do -----	22	Potato Starch.
5	2.50	0.52	0.23	7.83	----do -----	11	Corn Starch.
6	2.40	0.47	0.30	5.95	----do -----	11	do.
7	2.40	0.45	0.24	6.58	----do -----	11	do.
8	2.40	0.42	0.14	10.06	----do -----	11	do.
9	3.75	0.37	0.30	7.54	----do -----	15	Corn Starch, with perhaps some Potato Starch.
11	2.41	0.45	0.07	6.64	----do -----	11	Corn Starch.
12	2.44	0.25	0.71	7.80	Alkaline--	12	do.
13	4.20	0.42	0.20	8.11	Neutral --	14	A mixture of Wheat and Corn Starch.
14	2.42	0.40	0.83	10.30	Alkaline--	12	Corn Starch.
15	2.42	0.37	0.85	8.34	----do -----	12	do.
16	2.50	0.50	0.23	7.66	Neutral --	12	do.
18	2.30	0.50	0.23	9.19	----do -----	11	do.
19	2.50	0.42	0.81	11.25	Alkaline--	12	do.
20	3.56	0.57	0.26	9.71	Neutral --	11	Corn Starch, with some Wheat and Rice Starch.
21	3.65	--------	0.31	12.02	----do -----	18	Corn and Cassava Starch—no evidence of any Potato Starch.
22	2.44	0.50	0.08	7.75	----do -----	11	Corn Starch.
23	3.75	0.25	0.31	12.29	----do -----	23	Cassava, Java or Topioca Starch.
25	2.40	0.47	0.22	6.44	----do -----	11	Corn Starch.
26	3.70	0.26	0.30	13.47	----do -----	22	Potato Starch.
27	2.51	0.37	0.90	8.77	Alkaline--	12	Corn Starch.
28	--------	0.60	0.10	9.20	Neutral --	11	do.
29	--------	0.50	0.14	9.20	----do -----	11	do.
30	--------	0.55	0.12	7.71	----do -----	11	Corn Starch, with some Wheat and Rice Starch.
31	3.75	0.20	0.32	9.00	----do -----	23	Cassava, Java or Topioca Starch.
32	2.44	0.50	0.10	6.85	----do -----	11	Corn Starch.
33	2.66	0.37	0.70	6.86	Alkaline--	12	do.
34	--------	0.42	0.12	7.27	Neutral --	11	do.
35	--------	0.45	0.11	6.26	----do -----	11	do.
36	--------	0.60	0.35	7.88	----do -----	11	Corn Starch, with some Wheat and Rice Starch.
37	3.58	--------	--------	--------	----do -----	------	Corn Starch with some Potato Starch.
38	--------	--------	--------	--------	----------	------	Potato Starch.
39	--------	--------	--------	--------	----------	------	A mixture of Corn and Potato Starch.

The following samples of starches were received too late for a chemical examination, but were examined microscopically:

Two samples from Pee Dee Manufacturing Company, Rockingham. Both were found as represented to be, corn starch.

One sample from McAden Mills was found as represented to be, corn starch.

One sample from Charlotte Cotton Mills was found as represented to be, corn starch.

One sample (N.) starch from Charlotte Cotton Mills was found as represented to be, corn starch.