# Extraction, Characterization and Dextrinization of Starch From *Solanum Tuberosum* Linn. (Ar-Lu)

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## Abstract

Potato is the world's leading vegetable crop and is grown in 79 % of the world's countries. Potatoes are non-flattening, nutritious and supplies many important nutrients to the diet. In this research work, tuber of *Solanum tuberosum*, (Ar-lu) was selected for quantitative determination of isolated starch contents. The starch content was 15.8 g in 1 kg of potatoes. It was qualitatively identified by iodine test. In potato powder, fat content was 0.795 %, moisture content was 4.25 % and ash content was 9.75 % respectively. Dextrin was produced from potato starch. The dextrin was identified by iodine test and was indicated by deep blue color.

*Keywords*: Starch content, fat content, moisture content, ash content, dextrinization

## Introduction

Starch is the most significant form of carbon reserve in plants in terms of the amount made, the universality of its distribution among different plant species, and its commercial importance. It consists of different glucose polymers arranged into a three-dimensional, semicrystalline structure-the starch granule. Starch is synthesized transiently in organs, such as leaves, meristems and root cap cells, but its major site of accumulation is in storage organs, including seeds, fruits, tubers, and storage roots (Cathie and Alison, *et al*., 1995).

The application of starch includes in adhesives, agrochemicals, cosmetics and toiletries, detergents, paper making additives, pharmaceuticals, paints, textiles, water purification, biodegradable plastics and as super-adsorbent materials to mention a few, partly because of the wide range of functional properties such as gelatinization, pasting, retrogradation, water absorption capacity, swelling power, and solubility derived from it in its various natural and modified forms and partly because of its low cost relative to alternatives (Sanderson, 1981). Modification of these starches will increase their chances of finding more applications especially in the industries for a variety of applications. The process of modification may be physical or chemical. The physical modification which does not involved any chemical reaction of starch with a modifying reagent is referred to as physical modification of starch and the products are known as physically modified starches. However, most modifications of starches are performed through chemical processes. In this research, potato sample were obtained from Aungpan Township, Southern Shan State. Starch has found various applications; the application of starch in adhesive production is a vital one as the choice of raw material for adhesive production rests squarely on determinants such as cost, availability, convertibility and starch yield.

The chemical reactions of starch are generally exploited in the industry to produce converted or modified starches fit for different purposes in the industry (Egharevba, 2019).

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**Botanical Description**

Whole plant

Flower

Tuber

Figure 1. Plant, flower, and tuber of *Solanum tuberosum* L.

| | | |
|---|---|---|
| Scientific name | - | *Solanum tuberosum* L. |
| Family name | - | Solanaceae |
| Genus | - | Solanum |
| Species | - | S. tuberosum |
| English name | - | Potato |
| Myanmar name | - | Ar-lu |

**Medicinal Uses of Potatoes**

Potato is commonly eaten as a vegetable. Potato is also used to make medicine. People take raw potato juice for stomach disorders and water retention (edema). Some people put raw potato directly on the affected area for arthritis, infections, boils, burns, and sore eyes. In foods, potato is eaten, used as a source of starch, and fermented into alcohol. Excessive doses of potato juice can be toxic- do not drink the juice of more than one large potato per day. UK scientists have identified bioactive plant chemicals in the most practical of staple foods, the potato. These natural chemicals have been associated with reduced blood pressure and they

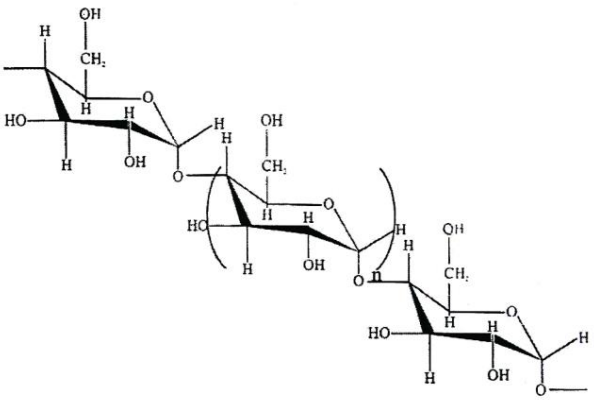
selectivity affect a chemotherapeutic target for trypanosomes and similar diseases such as sleeping sickness (Umadevi *et al*., 2013).

**Starch**

Starch is isolated mainly from corn, potatoes, cassava and wheat in the native and modified forms and this account for 99 % of the world production. Starch is a mixture of two polymers: amylose and amylopectin. Natural starches consist of about 10 to 30 % amylose and 70 to 90 % amylopectin (Kaur *et al*., 2020).

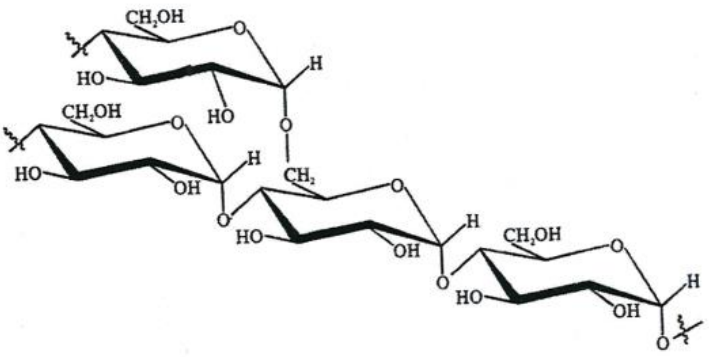
**Amylose**

It is a linear polysaccharide composed entirely of D-glucose units joined by the α-1,4-glycosidic bonds. Evidence indicates that amylose is not a straight chain of glucose units but coiled like a spring, with six glucose monomers per turn. When coiled in this fashion; amylose has enough room in its core to accommodate an iodine molecule. The characteristic blue-violet color that appears when starch is treated with iodine is due to the formation of the amylose-iodine complex.



**Amylopectin**

It is a branched-chain polysaccharide composed of glucose units linked primarily by α-1,4- glycosidic bonds but with occasional α-1,6-glycosidic bonds, which are responsible for the branching. A molecule of amylopectin may contain many thousands of glucose units with branch points occurring about every 25 to 30 units.



**Dextrin**

Dextrins are glucose polysaccharides of intermediate size. This could be seen in the shine and stiffness imparted to clothing by starch when clothing is ironed. Dextrin is more easily digested than starch and are therefore used extensively in the commercial preparation of infant foods. The complete hydrolysis of starch yields, in successive stages such as; starch → dextrins → maltose → glucose pattern. However, in the human body, several enzymes known collectively as amylases degrade starch sequentially into usable glucose units. (Belitz *et al*., 2009)

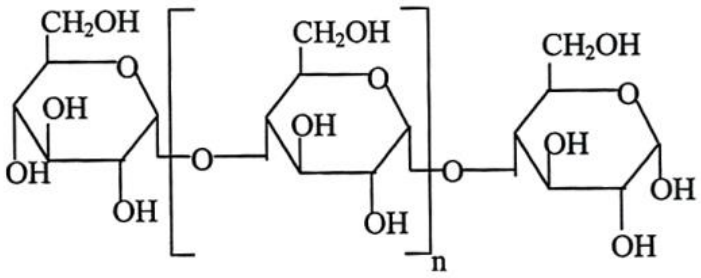



Figure 4. Structure of dextrin

**Other use of Dextrin**

**Adhesive**

Adhesive are part of a lager family called glue. Most adhesives are chemical based, which adhesive is generally mode from organic compounds. These terms, however, are used loosely today and most adhesives are still referred to as glue. The earliest glues were made from various plant-based materials.

## Materials and Methods

**Sample Collection**

The sample, potatoes were collected from Aungpan Township, Southern Shan State.

**Isolation of Starch from Potato**

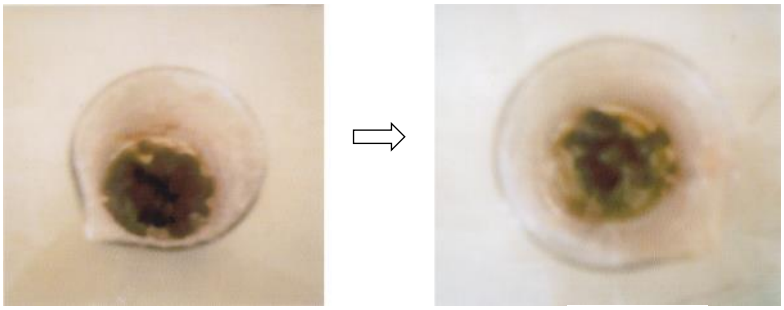
The mature and undamaged potato was first washed with water and air dried at room temperature for 24 hours. About 1 kg of potato was peeled and sliced into small pieces. They were dried in air and stored in well stoppered bottle which was used throughout the experiment.

The potato pieces were immersed in 750 mL of 1 % NaCl solution in a beaker and left overnight. They were ground in the blender for 15 minutes at full speed. The ground slurry was sieved through a 100 mesh copper wire screen. The residue was mixed with 750 mL of 1 % NaCl solution in a beaker and the mixture was agitated with a stirrer for about 10 minutes and allowed to stand for starch to settle at the beaker. The supernatant liquid was decanted. The starch layer was washed with 1 % NaCl and 750 mL of 0.01 N NaOH solution. The starch layer was washed with 750 mL of distilled water, allowed to settle for 15 minutes and the supernatant was removed by decantation. The remaining starch was dried in an oven at 40° C for 6 hours. The dried starch was ground with mortar and pestle to give a fine powder. The fine powder was sieved with 200 mesh screen and stored in a well-capped bottle.

Figure 5. Isolated starch from potatoes

**Identification of Starch**

About 1 g of potato starch was mixed with 15 mL of water in beaker and the mixture was heated to the boiling point. A jelly like substance was obtained on cooling the solution. When iodine solution 2 drops, ( 1 g of iodine dissolved in 2 % Kl solution) was added, a deep blue color was observed with disappeared when heated to boiling in a water bath.



Before After

Figure 6. Iodine test for starch

**Determination of Fat Content**

Accurately weighed potato powder 20 g was introduced into the weighed extraction thimble. The open end of the thimble was closed with a plug of cotton wool. Thimble was closed the extractor and a round bottle flask 250 mL which had been weighed was attached. Sufficient petroleum ether (b.p 60º C – 80º C) was poured into extractor so as to start the siphon. The extractor was attached to the condenser and the flask was heated on a water bath for 10 hours. When the extraction was completed the petroleum ether was removed by vaccum distillation. The last trace of the solvent was then removed by placing in an oven at about 100º C until constant weighed was obtained. After extraction, the thimble containing the meal cake as placed in an oven until no odour of ether remains.

Calculation

$$\% \text{ of fat content} = \frac{\text{fat wt (g)} \times 100}{\text{sample wt (g)}}$$

**Determination of Moisture Content**

A wide-mouthed weighing bottle was dried in a drying oven at 100-105º C, cooled at room temperature and weighed. 5 g of the potato powder

sample was weighed in it. The weighing bottle with its content was placed in the drying oven and dried at 105-110º C for 6 hours until a constant weight was obtained.
Calculation

$$\% \text{ Moisture content} = \frac{100(W_1 - W_2)}{W_1}$$

where, $W_1$ = weight in g of the sample before drying
$W_2$ = weight in g of the sample on drying to constant weight

**Determination of Ash Content**

The porcelain crucible and its cover were heated, cooled and weigh at room temperature. About 5 g of potato powder was added in crucible. The covered crucible containing sample was heated on open flame. After evolving vapours and gases had stopped, the crucible was heated in muffle furnace. Heating was stopped until the incombustible residue was completely free from carbon and the ash became absolutely white. The crucible was cooled at room temperature and weighed. Ash content can be calculated from difference between the mass of crucible with the ash and that of empty crucible.

Calculation

$$\% \text{ Ash content} = \frac{\text{wt of residuce (g)} \times 100}{\text{wt of sample (g)}}$$

**Dextrinization of Starch**

10 g of potato starch powder was taken and 1 mL concentrated hydrochloric acid was added drop by drop from a micropipette to it. The acidified powder was incorporated with the rest of the starch. It was dried at 60° C in an oven for one hour. The beaker carefully immersed in water bath so as to ensure that the level of starch in the beaker was well below the level of water and dextrinized at 100° C with constant stirring. Aliquot was taken from the beaker and tested with iodine reagent at regular intervals until the simple did not give any color with reagent. After dextrinization, the dextrin sample was immediately cooled at room temperature and stored in screw-capped bottle.

Figure 7. Dextrinization of potato starch powder

**Determination of Iodine Test for Dextrin**

An aliquot, about 1 g of the sample was taken in beaker and mixed with 15 mL of distilled water. The suspension was warmed in a water bath while shaking, for five minutes and one drop of iodine reagent was added. The early stages of dextrinization were indicated by a deep blue color but as dextrinization progressed the color gradually grew lighter until dextrinization completed, indicated by disappearance of color.

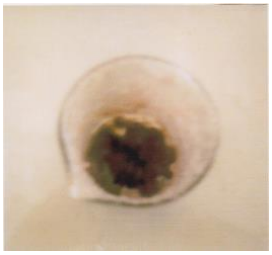


Figure 8. Iodine test for dextrin

**Adhesive production**

Dextrin 5 g was weighed inside a beaker, 15 g of water was added and the mixture heated to 70° C, then 1.50 g of borax was added and the temperature increased to 90º C. 2 mL of phenol was added to the mixture. Adhesive material was obtained from dextrin.

Figure 9. Prepared adhesive from dextrin

## Results and Discussions

In this research work, potato sample were obtained from Aungpan Township, Southern Shan State. The quantitative determination of isolated starch contents and qualitatively identified by iodine test. A jelly like substance was obtained and a deep blue color was observed. The result of the yield of starch was found to be 15.8 g in 1 kg of potatoes as shown in Table 1.

Starch consists of amylose and amylopectin and from the results obtained it is noted that starch is insoluble in water due to the presence of amylopectin.

Some chemical constituents of potato powder, such as fat content, moisture content and ash content are shown in Table 2, 3 and 4.

Table 1. The yield of starch from 1 kg of potatoes and result of iodine test

| No. | Weight of sample | g $kg^{-1}$ (starch) | Iodine Test |
|---|---|---|---|
| 1 | 1 kg | 15.7 | blue coloration jelly |
| 2 | 1 kg | 15.8 | blue coloration jelly |
| 3 | 1 kg | 15.8 | blue coloration jelly |

Table 2. Fat content in potato powder

| No. | Weight of sample (g) | Percentage of fat |
|---|---|---|
| 1 | 20 | 0.795 |
| 2 | 20 | 0.795 |
| 3 | 20 | 0.795 |
| 4 | 20 | 0.795 |
| | Mean | 0.795 |

According to table 2, the fat content of potato powder was found to be 0.795%.

Table 3. Moisture content in potato powder

| No. | Weight of sample (g) | Percentage of moisture |
|---|---|---|
| 1 | 5 | 4.4 |
| 2 | 4.99 | 4.3 |
| 3 | 4.98 | 4.2 |
| 4 | 4.98 | 4.1 |
| | Mean | 4.25 |

According to table 3, the moisture content in potato powder was found to be 4.25%.

Table 4. Ash content in potato powder

| No. | Weight of sample (g) | Percentage of Ash |
|---|---|---|
| 1 | 5 | 9.9 |
| 2 | 4.90 | 9.8 |
| 3 | 4.98 | 9.7 |
| 4 | 4.97 | 9.6 |
| | Mean | 9.75 |

According to the above table, the ash content of the potato powder was found to be 9.75 %.

The starch of potato consists of dextrin. Dextrin is a sticky substance formed during the chemical breakdown of starch. Dextrin was produced from all commercial grain and tuber starches. The dextrin was identified by iodine test and was indicated by deep blue color. The starch of potato was made adhesive. Starch has found various applications; the application of starch in adhesive production is a vital one as the choice of raw material for adhesive production rests squarely on determinants such as cost, availability, convertibility and starch yield.

## Conclusion

The starch is important and inexpensive source of energy in human nutrients. It is a widely distributed material which occurs in roots, seeds, fruits and tubers. Therefore, potato was selected for qualitative and quantitative determination of isolated starch. The starch content was found to be 15.8 g in 1 kg of potatoes. In potato powder, fat content, 0.795 %, moisture content, 4.25 % and ash content, 9.75 % were obtained. Potato may be important staple food. The potato is a good source of dietary energy. Adhesive obtained from potato starch could be applied for industrial production of adhesives.

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