EXTRACTION OF STARCH FROM POTATO BY ENZYMATIC PROCESS

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ABSTRACT:-*Five types of Potato were selected such as Coroda, SH-5, SH-69, Barna and SH-70.Average price of each type was found by conducting market survey and Initial starch percentage was also checked. The most economical potato type SH-5 was selected for starch extraction due to low price 45Rs./Kg and high initial starch percentage 15.70%.Cellulase enzyme was used for the extraction of starch. Effect of different variables enzyme concentration, time period and broth dilution was analyzed to get the maximum recovery of starch from potato. Potatoes were grinded after removing adhered dirt by washing and cutting without peeling then distilled water was used for dilution. Starch recovery showed the direct relationship with enzyme concentration and time period, but inversely proportional to the broth dilution. Increase in broth dilution decreased the amount of starch recovered from 89.8% to 33.8%. Maximum starch recovery was achieved 89.8% from SH-5 potato at enzyme concentration 0.5 g/100g potato meal, time period 5 hr and broth dilution 20ml.This research work concluded that enzymatic process is most suitable for better extraction of starch from potato in comparison to other conventional processes.*

Key words: Cellulase Enzyme, Potato, Starch, Extraction, Broth dilution, Time Period

1. INTRODUCTION:

Most significant food crop in the world is potato after wheat, rice and maize. Its production and utilization is being increased in developing countries due to fast industrial growth and urbanization. Production of potatoes in different environmental condition affect the potato physical and chemical properties [1-2]. Starch has high density and insoluble in cold water. It required utilization of heat to get dissolved in water [3]. Starch extracted from different types of potatoes grown under the similar conditions in similar season was hydrolyzed by α-amylase. It shows the more hydrolysis by gelatinization than the structure or composition of the granules [4]. Environmental conditions affect the protein%, amylose content, starch gelatinization temperature range, and phosphorus content in potato and explained that it is easier to store potato starch for long period than the potato itself, which also makes potato processing an economical way for starch production [5].Starch is utilized in many industries i.e. textile, pharmaceutical, paper, mining and food industries [6]. Annealing of potato is taken mostly before storage to maintain its original properties including amylose content, gelatinization temperature and its functional properties. Potato starch have a large starch granules size than other cereal and tuber starches[7]. In tlarge scale production of potato starch, mechanical separation method is used in most industries worldwide for releasing starch from tuber and cereal crops, after mechanically disintegration, washing is taken with water for maximum recovery of starch [8].Potato starch manufacturing industry produces waste in the form of potato pulp and wastewater. This waste was converted to single cell protein to use for animal feed by batch fermentation with mixed cultures[9].Heat stable α amylase, protease and amyloglucosidase enzymes can be used for starch separation from tuber crops containing cellulosic material like potato. Enzymatic process requires less grinding and smaller energy inputs for starch separation. Potato pulp is obtained as waste stream from potato starch processing industries in bulk quantity. Its use as cattle feed is decreasing due to formation of controlled feed regimes, so it is more beneficial to remove starch from this waste pulp. Enzymatic treatment of pulp is taken for complete recovery of starch [10-11].Immobilized (using sodium arginate) α-amylase used for hydrolysis of potato starch powder into glucose and studied the effect of starch concentration, time and temperature on starch hydrolysis [12].Starch can be separated by alkaline treatment from potato, rice and sago. Steeping of these raw materials was taken separately to observe the effect at the physiochemical properties. Alkaline treatment affected the potato, rice and sago particle structure, which causes change in physical and chemical properties. Alkaline process reduced the viscosity and breakdown ability of starch granules. Enhancement in swelling power of potato and maize starch was observed after increasing steeping time during alkaline treatment. It also reduced the amylase content of starch. This study showed that alkaline treatment alters the different physical and chemical properties of many botanical origin starches [13].

This research work was carried out for better recovery of starch from potato by an enzymatic process which helps in releasing starch contents from cell wall components too.

Enzymatic process is the most effective than other conventional processes as it gives better starch recovery with less grinding and smaller energy inputs. Enzymatic treatment will also be helpful in proper utilization of potato at the time of overproduction, when huge quantity goes into the in spite of having cold storages. It is easier to store starch for longer period than potato and to utilize it in many commercial applications.

2. MATERIAL AND METHODS

2.1 Raw Materials

Potato type 'SH-5' and other Varieties were obtained from Plant Virology section Ayub Agricultural Research Institute Faisalabad, Pakistan. Cellulase enzyme was procured from Bio-Enzyme lab, University of Agriculture, Faisalabad, Pakistan. It was used for all experiments.

2.2 Proximate Analysis

Initial trials were taken to find out the proximate composition of different type of potato including starch %age and moisture content.

2.3 Recovery of Starch

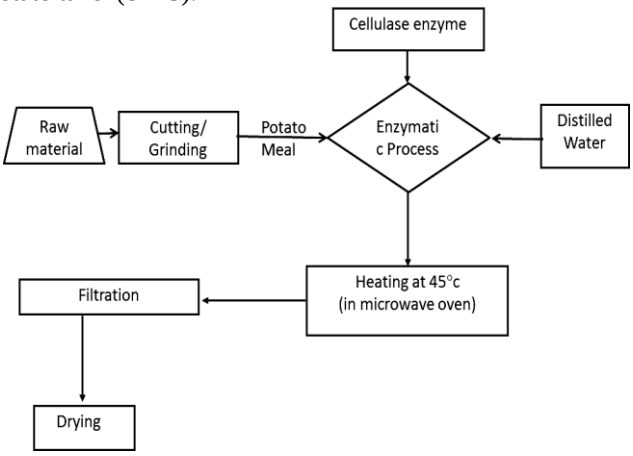
Starch was recovered from potatoes by adopting the following steps cutting & grinding of raw Material, addition of cellulase enzyme and distilled water, mixing of solution, heating, filtration and drying, as shown in Fig. 1. (Process Flow Diagram). Microwave oven, multishaker, grinder, conical flask , beaker, digital weight balance and nylon tea straine (100 mesh size) were used in experimental work.Potatoes washing was taken to clean the deposited dirt/dust. After washing potatoes weight was taken at digital weight balance. Potatoes cutting was taken in smaller pieces without peeling. Grinding was done in grinder 1560RPM by standardizing time 2 minute at which material was found uniformly mixed, in such a way that no solid piece of potato left. Uniform potato meal was prepared.

For the preparation of Enzyme solution 1 gram of enzyme was mixed in 10ml of water by glass rod. Potato meal was transferred to conical flask and appropriate amount of water was added into it 10, 20, 30, 40ml respectively as required for each experiment. For a concentration of 0.1g/100g of potato meal, mixed the 1 ml of enzyme solution in 100g of potato meal. The flask was closed by cotton to stop the vapours exhaust and placed in multishaker at 150 RPM for 60 seconds for uniform mixing of enzyme with potato meal. pH of solution was maintained at 5 by adjusting with NaoH and Hcl. Then flak was kept in microwave oven for different time periods 1,2,3,4,5hrs respectively. All experiments were performed with levels of each enzyme concentration (0.1,0.2,0.3,0.4,0.5g/100g of potato meal),time period(1,2,3,4,5 hrs) and broth dilution (0,10,20,30,40ml) respectively.

Then solution was passed through Nylon tea strainer of 100 mesh size in a 500 ml beaker, collected pomace at top of screen was washed twice with distilled water for maximum recovery of starch. Starch settled at bottom by sedimentation due to high density, so water at the top of starch was discarded. Then starch was dried in microwave oven to reduce its moisture content ≤15%.Then calculated the starch recovery by measuring the weight of dried starch and dividing it with weight of initial starch content present in the potato taken(SH-5).

Table (1) :- Economical Survey of different types of potato

Variety Of Potato	Average Price (Rs.)/Kg	Starch Content %
SH-5	46	15.71
SH-69 (White)	46	12.46
SH-5 (Red)	51	13.21
Coroda	61	11.86
Barna	56	14.12



Fig(1):- Process Flow Diagram

3. RESULTS AND DISCUSSIONS

Initial starch content percentage and average price of each potato type was found by conducting analysis and market survey to select the most economical and productive variety for further experiments.

Potato type 'SH-5' is having high initial starch content 15.70% and lowest price as shown in Table#1. It was economical in better productivity and recovery of starch, so SH-5 variety was used in all the experiments. Starch yield was calculated by using the formula as given below

Starch Yield=Starch recovery (recovered) / Initial Starch content. Time period units were used in hr, enzyme concentration g/ml and broth dilution in ml.

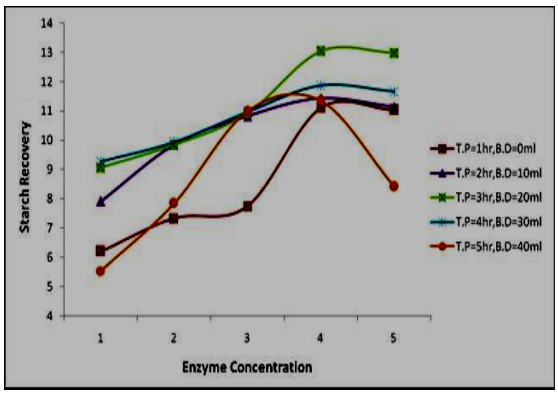


Fig. (2) :- Enzyme Concentration vs Starch recovery at different Time period and Broth Dilution

Fig. 2 showed the trend of starch recovery vs enzyme concentration at different time periods and broth dilutions. Maximum starch yield was achieved 83.05% by varying different enzyme concentration.

When the enzyme concentration was increased from 0.1 to 0.5g/100g potato meal, starch yield was also increased from 39.58 to 83.05% .But starch recovery decreased in spite of increasing enzyme concentration at maximum broth dilution 40ml.It decreased might be due to dilution of enzyme which could not properly react with substrate. Excessive dilution also causes sedimentation of cell wall components which causes lesser interaction with enzyme.

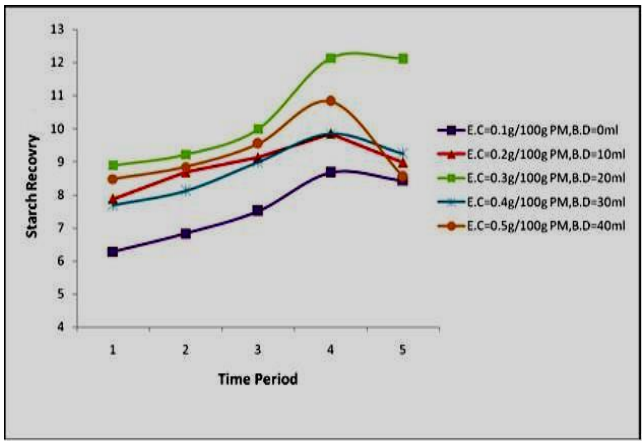
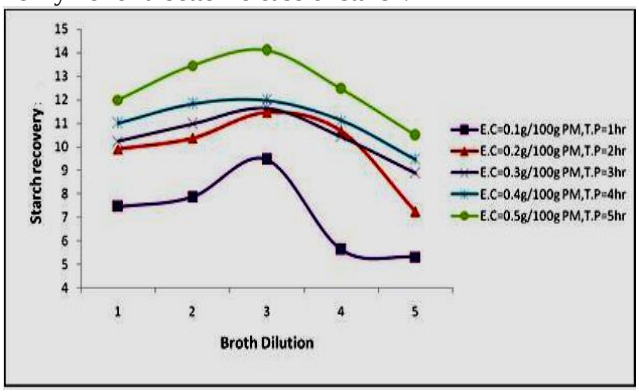


Fig. (3) :- Enzyme Concentration vs Starch recovery at different Time period and Broth Dilution

Fig.3 represents the starch recovery vs time period at different enzyme concentrations and broth dilution. Maximum starch yield was obtained 77.21% by varying different time periods. Overall as shown in fig amount of starch recovered increased from 40 to 77.21% by varying time period from 1 to 5 hrs at different enzyme concentration and broth dilution.

Starch recovery decreased at higher broth dilution and small enzyme concentration in spite of the maximum time period provided for the enzymatic reaction. It occurs due to lesser amount of enzyme for reaction to consume substrate completely and higher dilution causes ineffective interaction of enzyme for a better release of starch.



Fig(4) :- Broth dilution vs Starch recovery at different Time period and Enzyme concentration

Fig.4 described the effect of broth dilution on starch recovery. Increase in broth dilution increased the starch recovery up to 20ml, but it decreased on further dilution. Maximum starch yield was achieved 89.05% and decreased to 33.83% at higher broth dilution 40 ml. It may be reduced due to sedimentation of cellulosic material due to higher level of reaction column at higher broth dilution. It makes poor interaction between suspended enzyme and sediment cellulosic particles resulting in lesser release of starch. Small broth dilution provides required enzyme concentration which helps in better release of starch by hydrolysis of cellulosic material.

4. CONCLUSION:

It is concluded from this research work that enzymatic process is most effective in starch recovery from potatoes(which gave yield upto 89%) in comparison to other conventional processi.e. starch recovery by mechanical process (which gave yield ~70%) and also found the optimum operating conditions.Time period, broth dilution and enzyme concentration also affect the starch recovery in enzymatic process. Maximum starch yield was obtained 89.05% at higher enzyme concentration 0.5g/100g potato meal, broth dilution 20 ml and time period 5 hr. Enzymatic process helped in releasing starch from cell wall components, which is not effective in mechanical extraction process. Hence it increased the process efficiency and starch recovery. Enzymatic process needs less grinding and smaller energy requirements. Other enzymes can be used for further release of starch from cell wall components.

5. ACKNOWLEDGMENT:

I would like to thanks Prof.Dr.Shahid Raza, Saba Chaudhary and other colloquies for their expert advices and effective encouragement.

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