ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Extraction Of Starch From Potato Processing Waste Water And Its Effect On Growth Of Plants.

S Anbuselvi*, and Albenna Reji.

Department of Industrial Biotechnology, BIHER, Chennai-73, Tamil Nadu, India.

ABSTRACT

Rising demand for food, biomass and bio energy makes it imperative to breed for increasing crop yield. Organic manures play an important role for supplementing the essential plant nutrients for sustainable agriculture, economy and eco-friendly environment .In this work, a solution for the recovery of starch in wastewater during potato washing for chips, snacks or fries production is proposed. The problem of potato starch waste (PSW) management causes great concern to the potato industries. The proper recycling and solid part is used as animal feed only in large scale industries. The disposal of potato waste water causes sedimentation in drainage pipelines and causes environmental hazards. This study deals with starch enriched waste water was collected at different levels and different grade of starch were extracted. The remaining waste water can be used as nutrient source for growth of maize plants in order to reduce environmental pollution and enhance the economic importance of small scale industries. .

Keywords: starch, potato starch waste, yield, food industry.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Potato starch is a white substance starch extracted from potatoes. The cells of the root tubers of the potato plant contain starch grains (leucoplasts). To extract the starch, the potatoes are crushed; the starch grains are released from the destroyed cells. The starch is then washed out and dried to powder. Potato industry waste waters contain high concentrations of biodegradable organic components such as starch and proteins. .in addition due to high concentration of chemical oxygen demand (COD) and total suspended solids (TNS) in wastewater, the potato industries presents serious pollution problems Today modern lifestyle while consumption of potatoes in terms of processed products such as French fries ,chips and puree have experienced growing popularity[1]. The starch losses caused by potato peeling range from 15 to 40% amount depending on the procedure applied to steam ,abrasion and peeling [2,3].

The Industrial plants peel the potatoes as part of the production of French fries, potatoes chips and similar products ,.the waste produced is 90kg per tn of potatoes The another problem for the potato crisp industry is that it uses large amounts of water and therefore produces great quantities of liquid waste. for one tonne of influent potato,4.78 tn of water is required for the initial potato washing of 0.57tn,0.73tn for peeling ,0.28tn for the water transport, 1.66tn for cut and crisp washing and 1.54 tn for machine and floor washing. In most industries any starch separation and recovery method is not efficient since solid wastes leave the industry together with the waste waters.

An integrated system of potato soluble waste (PSW) management should included that minimization of water use by recycling..The separation of starch and PSW its utilization used for the production of high added value products, including bio ethanol for energy[4,5]. The improvement of the efficiency of biological treatment unit must be operated due to acceptance to less hydraulic and polluting loads [6].

The potato peel waste (PPW) contains sufficient quantities of starch , cellulose, hemicelluloses and fermentable sugars . This can serve as an raw material for production of ethanol feed stock The hydrolysis is required to produce ethanol by fermentation. The starch was traditionally hydrolysed by acids and specificity of the enzymes and saccharomyces yeasts [7,8]. Potato peel also used as organic manure for growth of plants [9].

Starch has high density and insoluble in cold water. It required utilization of heat to get dissolved in water. Environmental conditions affect the protein, amylose content, starch gelatinization temperature range, and phosphorus content in potato. The extracted starch from potato is utilized in many industries i.e. textile, pharmaceutical, paper, mining and food industries. Starch is increasingly used in industrial applications or food due to its ability to work as a thickener, texture and viscosity [10]. Starch is also widely used in yogurt manufacturing
.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

Enzymatic process using amylase 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. Enzymatic treatment of pulp is taken for complete recovery of starch .Immobilized (using sodium alginate).

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. Utilization of agro industrial waste may also help to solve pollution problems. The main aim of this study deals with the extraction of two grade starch from washing water and its checking its quality. The crude starch was extracted from two different levels were used as a nutrient source for growth of maize plants.

MATERIALS AND METHODS

Several kilograms of potatoes were peeled and washed with water for many times in potato chip Industry. The two grades of waste water were collected from small scale chips industry, Chennai. The waste water can be subjected to filtration followed by sedimentation for several hours. The white substance was sediment at the bottom of vessel must be dried to get crude starch. The extraction of the starch was

performed by successive washes followed by decanting, centrifugation and subsequent freeze drying, establishing a protocol for starch extraction in the laboratory.. The swelling property and solubility was analyzed to separate low grade and high grade starch.Pasting properties were determined in a rapid visco analyzer.

The thermal properties of the starches was determined using a differential scanning calorimeter with intra cooler .. About 2 mg of starch, on dry basis, were placed in hermetic aluminum capsules.and is then added to three times its weight of deionized water and subsequently sealed. These capsules were kept at room temperature for 2 h to equilibrium before analysis. The capsules were then heated at a rate of 5˚C/min from 25˚C to 125˚C using an empty capsule as reference. The initial gelling temperature *To*, *Tp* and the peak *Tf* and the variation of the enthalpy Δ*H* from starches were determined using the software of the equipment, in triplicate.

The extracted starch was quantitatively analyzed by Anthrone method The amylose content was determined using the colorimetric method The quality of starch was assessed by anthrone method[11]. The extracted starch was used for marketing in detergents, textile and enzyme production. The two levels of extracted starch were used as supplementary source for growth of plants.

RESULTS AND DISCUSSION

The small scale industry of potato chips industry storage is needed to provide a constant supply of tubers to the processing lines during the operating season.. The major problems associated during storage are sprout growth, reducing sugar accumulation, and rotting. Reduction in starch content, specific gravity, and weight may also occur. Raw potatoes must be washed thoroughly to remove sand and dirt prior to processing. Abrasion peeling is used in particular in potato chip Industry, where complete removal of the skin is not essential.. The processing of potatoes to potato chips essentially involves the slicing of peeled potatoes, washing the slices in cool water, rinsing, partially drying, and frying them in fat or oil. The potato processing wastewater contains high concentrations of biodegradable components such as starch and proteins, in addition to high concentrations of chemical oxygen.demand (COD), total suspended solids (TSS), the potato processing industry presents potentially serious water pollution problems(Table1).

Table 1: Physicochemical properties of starchy water

S.No	Parameters	Control	Washing of potatoes	Peeling of potatoes	Cutting of potatoes in water
1	pH	7.3	7.5	8.2	10.0
2	Bulk density (g/cm^3)	0.007	0.0119	0.128	0.0105
3	Specific gravity (g/cm^3)	0.009	0.02	0.08	0.16
4	Moisture content (%)	17	50	32	45
5	Turbidity (NTU)	22	169	267	293
6	BOD(ppm)	280	4000	6600	8200
7	C0D(ppm)	05	76	10,000	11,700
8	Total Solids (ppm)	800	9000	16,280	18,900
9	Suspended Solids(ppm)	13,000	5000	6800	8250
10	Organic Carbon (%)	20	46	59	38

The ratio of amylose/amylopectin may influence the functional properties, which is due to the degree of intermolecular association, shape,composition and distribution of crystalline regions in the starch granule. The paste properties viscosity and gelling power, swelling power were varied. .The swelling power of starch (SP) determined the ability of hydration of the starch granules and for determining pulp viscosity is related to the viscosity maximum[12]. The solubility of starches could be attributed in large extent due to amylose

leaching, which occurs during gelatinization[13]. Starch shape and size, chains arrangement of amylose and amylopectin are determined by the crystalline structure of the starch granule, which control the capacity of retaining water in the string.[14].These first processing samples were presented the highest amylose conten(12.7%). The lowest amount of amylose (8.7%) was observe din second stage processing water. Similar results were observed by Kadle,1997[. Starch has different proportions of amylose and amylopectin ranging from about 10–20% amylase and 80–90% amylopectin depending on the source[15]. Amylose is easily soluble in water than amylopectin. Starch occurs naturally as discrete granules since the short branched amylopectin chains are able to form helical structures which crystallize. Starch granules exhibit hydrophilic properties and strong inter-molecular association via hydrogen bonding formed by the hydroxyl groups on the granule surface.

The chemical constituents of soil such as nitrogen ,phosphorous and potassium were analysed High graded starch was treated to soil as well as the low grade starch and as a result nitrogen content was found to be low .The phosphorous content of the soil was observed as medium in 100gof high grade starch .The low level of phosphorous was observed in all treated high grade soil and less constituent of low grade starch .the potassium content of soil was found to be high in 100g of high grade starch and low in 50g low grade starch treated soil .The control soil and standard soil showed the medium level of potassium.

Table 2: Morphological features of plant growth using starchy water

S.No	Parameters	Leaf Area (cm)		Height (cm)		Chlorophyll(mg/g)		Dry weight(mg/g)	
1		Low Grade	High Grade	Low Grade	High Grade	Low Grade	High Grade	Low Grade	High Grade
2	Control	106.2	104.5	20.7	20.8	23.6	24.7	20.6	20.9
3	Soil+10g starch	134.5	157.2	24.5	25.1	44.5	45.3	23.5	25.4
4	Soil+20g starch	141.2	167.4	25.7	26.7	45	47.2	26.6	28
5	Soil+50g starch	157.1	189.3	26.3	28.1	46.5	48.3	27.4	28.8
6	Soil+100g starch	203.6	254.5	29.4	29.5	50.3	56.4	30.7	31.5

The morphological of plant were observed at regular intervals .The height of plant was gradually increased from 24.5cm to36.7cm in high grade starch. The control plants have lack of nutrient and died at 20 days treatment .The low grade starch treated soil attained the height of 38.1cm in 100g sample .The height of the plant is directly related to the nutrient availability in soil.(Table2).

The size of leaf was found to be high in 100g of low grade and high grade treated plants. The leaf area was observed as small in control as well as starch treated soil. The maximum number of leaves were observed in high grade treated plants. The growth plant is represented by gradual increase in heigh,t leaf area and no of leaves etc .the extracted starch also supported plant growth. The starch content of leaf was found to be high 1.75gstarch in 100g starch treated plants the minimum amount of starch was observed as 0.30g in control plants.

CONCLUSION

The waste water was collected from potato chips industry at two stages and were used as starch supplement for growth of maize .The extracted starch was used as useful products of adhesive starch for food .industry and these nutrients enhance for growth of cereals rich plants.. This starchy waste and water can be used as a recycler and reuser for alternative source to be reduce environmental pollution.

REFERENCES

[1] ZMP, – Marktbilanz Kartoffeln. ZMP (Zentrale Markt- und Preisberichtsstelle GmbH), 2000,Bonn.
[2] Schieber A., Saldaña MDA. (2009) . *Food*,2009, 3, 23-29.

[3] Scieber, A., Stintzing, FC., Carle,. Trends in Food Science and Technology ,2001,1, 401–413.
[4] Kilpimaa, S.; Kuokkanen T. and Lassi U. Energy research at the University of Oulu. Proceedings of theEnePro conference, June 3rd, 2009, University of Oulu, Finland.Kalevaprint, Oulu, ISBN 978-951-42-9154-8.2009 pp. 21-23.
[5] Liimatainen H., Kuokkanen T., Tanskanen J. and Kaariainen J. Journal of Solid Waste Technology and Management, 2005, 31 (3): 122–125
[6] Vlyssides, A., Barampouti EM., Mai S., Stamatoglou E., Rigaki K., Chemical Engineering Transactions, 2009
[7] Gray, A.K., Zhao, L., Emptage, M., 2006. Bioethanol. Current Opinion in Chemical Biology ,2006,10, 141–146.
[8] Vlyssides, A., Barampouti, S., Mai, E. Waste minimization in potato processing industry. In: XI International Waste Management and Landfill Symposium, 1–5October 2007, Sardinia, Italy.
[9] Priyanga K, Albenna Reji, Jyoti kumar Bhagat and S.Anbuselvi, International Journal of chem..Tech, 2016,9(5):845-847.
[10] Hadjivassilis, I. Gajdos, S., Vanco, D., Nicolaou,T, Water Science and Technology 1997.
[11] AOAC, Official Methods of Analysis of AOAC International. In: Cunniff, P. (Ed.),16th ed. AOAC International, Arlington, Virginia, USA.1995.
[12] D. Arapoglou , Th. Varzakas ,Waste Management,2010,30 ,1898–1902
[13] Hung, YT. Am Potato J. 1983, 60 (7), 543–555.
[14] Pailthorp, RE.; Filbert, JW., Richter, GA. In PotatoProcessing; Talburt, W.F., Smith, O., Eds.; Van Nostrand Reinhold Co.: New York, 1987; 747–788.
[15] Kadlec, R.H.; Burgoon, P.S.; Henderson, M.E. Integrated natural systems for treating potato processing wastewater. Water Sci. Technol. 1997, 35 (5), 263–270.