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Der Pharmacia Lettre, 2016, 8 (8):55-57
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN 0975-5071
USA CODEN: DPLEB4

Production of ethanol from elephant yam and its optimization

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ABSTRACT

Ethanol is generally produced by the fermentation of sugar cellulose and ligno-cellulose rich fruits and vegetable Ethanol reduces country's dependence. The production of ethanol from waste which contain raw materials made of carbon, hydrogen and nitrogen. Ethanol is an economically demand for its utilization in chemical and biological ways .The fermented product have low cost productivity from different industrial waste. The present study deals with production of ethanol from yam pulp using baker's yeast. The optimization is achieved in production of ethanol by fermented medium enriched with glucose and peptone.

Keywords: Ethanol, carbon, nitrogen, fermentation

INTRODUCTION

Aroids are the tuber bearing plants belong to the family Araceae viz. Taro (Colocasia esculent) and Elephant foot yam (Amorphophallus paeonifolius). Taro is highly cultivated in Asia, Africa and pacific as well as Caribbean Island. . Tuber crops are the third among the important food crops. after cereals and legumes[1,2]. The starchy root crops are marginal to poor in protein content, but they contain variety of minerals and trace element, including relatively substantial quantities of iron of calcium, as well as potassium and magnesium [3]. Elephant foot yam pickles are very popular in Eastern India.

Elephant foot yam has some useful health benefits. The root of this yam acts as carminative, restorative, stomachic and tonic. The dried form is used in the treatment of piles and dysentery, the fresh root acts as an acid stimulant and treatment of acute rheumatism. Elephant foot yam is considered to be a low-fat food and more amount of essential fatty acids (Omega-3 fatty acids) which are known to increase the good cholesterol levels in the blood. The elephant yam helps to increase the estrogens levels in women and is found to be analgesic and used in treatment of piles [4].

Yam tubers contain several toxic substances that affect both human and animals when they are consumed, despite their high nutritional value[5]. Yam tubers are acrid and they are correlated with irritation and inflammation of the buccal cavity and throat; consumption can result in gastrointestinal disturbances, vomiting and diarrhoea[6]. Yam also contains several anti-nutritional factor, which consists of polyphenol, oligosaccharide (α-galactoside), lectins, proteases and amylase inhibitors, are widely distributed in most plants [7]. As a result, the tubers have not been processed to any significant extent commercially to establish their potential food and industrial application in the production of ethanol. The main objective of this study was to extract the ethanol from elephant yam tubers and optimize its production from different carbon and nitrogen sources.

MATERIALS AND METHODS

The damaged elephant yam was collected from the market. The basal growth media was purchased from Hi media and yeast culture and α amylase were consumed commercially. Initially cassava mash was prepared and distributed into 4 flasks and cooled to 62.8^{o}C. Different concentration of barley malt (10 %) in the form of slurry was added in equal amount to each treatment. This mixture of malt and mash was placed on shaker and conversion of elephant yam starch to reducing sugar was carried out for specified times. The mash were cooled to 22^{o}C and made up to 100 ml. The pH was adjusted to 4.8 to 5.0. Mash in each treatment was divided into four portions. Different carbon sources of glucose, fructose, maltose lactose and nitrogen sources of peptone ,ammonium chloride and urea. To this sterilized basal medium actively growing yeast was inoculated aseptically. It was kept in an incubator for overnight at 37ºC. To eighth portions, *S. cerevisae* (yeast) was added to it acted as control. Fermentation was permitted to continue for 68 to 70 hours. The physicochemical properties of yam were analyzed at regular intervals of fermentation. The hydrogen ion concentration was measured by pH meter. The turbidity was checked by nephelometer. The moisture content was analyzed.

RESULTS AND DISCUSSION

The productions of ethanol from elephant yam using baker's yeast have been analyzed. The physical parameters of elephant pulp were summarized in Table (1). The pH of pulp was found to be acidic. The pH of fermentation medium was gradually increased on 8 day of fermentation with different substrates. The pH of fermentation attained neutral pH using different Carbon and Nitrogen sources at end of fermentation. Source enriched medium gradually increased from 4.2 to 6.2.

Table 1: pH content of fermentation medium

	Days of incubation				
Parameter	Initial	1-8	9-16	17-24	25-32
Glucose	4	5	5.2	6.0	7.2
Peptone	5	6	4	6.0	7.1
Fructose	5.2	6.0	5.8	6.0	7.0
Sucrose	4.2	5	5.2	6.0	6.2
Maltose	4.7	6.2	6.0	6.8	7.1
Ammonium Chloride	5	6.6	6.5	6.8	7.0
Urea	6	6.5	6.5	6.8	7.8

The pH of different fermentation medium should attain neutral before subjected to ethanol distillation. The rate of production of hydrogen ions also gradually increased in the fermenting medium. The may be due to the hydrolysis of carbohydrate and subsequent conversion of sugar to acid by fermentation microbes [8].

Table 2: Temperature (°*c*) content of fermentation medium

	Days of incubation				
Parameter	Initial	1-8	9-16	17-24	25-32
Glucose	28	26	27	28	29
Peptone	27	29	30	28	26
Fructose	27	25	26	27	28
Sucrose	27	29	28	29	30
Maltose	29	28	29	28	27
Ammonium Chloride	28	29	29	29	29
Urea	27	30	27	27	28

The temperature of the medium attained around 30°c at end of fermentation(Table2). The turbidity content was rapidly increased up to 145 NTU in glucose enriched medium showed maximum when composed with nitrogen sources(Table3). The initial turbidity of ammonium chloride enriched medium was 126NTU. Different nitrogen enriched medium were gradually declined from 126NTU to 52NTU. The production of ethanol indicated the reduction in turbidity.

Table 3: Turbidity of different fermented medium

Days of incubation					
Parameter	Initial	1-7	8-16	17-25	26-32
Glucose	76	28.7	98	145	110
Peptone	78	24.4	101	136	115
Fructose	75	82	105	142	121
Sucrose	80	90	95	102	116

The moisture of elephant yam is found to be range of 5.26-7.24%. The maximum reduction of moisture was observed in 9-16 day of fermentation(Table 4) . The moisture was found to be increased in nitrogen enriched medium at 17-24 day of fermentation. The moisture content was rapidly reduced from 5.31 to 4.02 using sucrose enriched medium. Moisture content also gradually increased during the fermentation process. Similar results were reported in cassava[9]. This was an indicator that water had moved into tissues making more mineral nutrients available for fermenting microbes[10].

Table 4: Moisture (%) content of fermentation medium

Days of incubation					
Parameter	Initial	1-8	9-16	17-24	25-32
Glucose	7.31	6.71	5.61	4.28	4.62
Peptone	6.42	6.02	5.61	5.06	4.98
Fructose	5.26	5.49	5.03	4.96	5.02
Sucrose	5.31	5.32	4.01	3.98	4.02
Maltose	6.13	5.09	4.05	3.86	4.15
Ammonium Chloride	5.97	5.10	6.09	6.15	6.00
Urea	7.24	6.12	5.74	6.12	6.04

CONCLUSION

The great demand of bio fuel and its application were required for its utilization in various fields. The production of ethanol at an economy based rate from the pulp. This elephant pulp can be used as a raw material for many industrial applications and to improve the economy of country through its cultivation at cheaper rate. The need of ethanol for clinical, pharmaceutical and neutraceuticals and herbal formulation are required. Thus ethanol production is in great demand and produce from cheap raw materials.

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