QUALITY PROFILE OF INDIAN CASSAVA STARCH DURING LONG TERM WET STORAGE

Dr.Yasodha Thirumal,Associate Professor,Microbiology Department,Adama University,Ethiopia
Email: tekindia4@gmail.com

Abstract: Cassava (Manihot esculenta) roots are largely cultivated in tropical countries. It has been earmarked as the crop that can spur rural industrial development and raise income for producers, processors, and traders.Hence in the present study with regard to economic value of the Cassava starch ,the quality in terms of various parameters such as Colour,Odour,Temperature of the storage tank,pH in the storage tank,Viscosity,Total Microbial Count,Enzyme activity,Types of contaminants were analysed during long term storage in Indian environment .

Key words: Cassava starch, storage, contamination , physico-chemical and microbial characteristics

– – – – – – – – – – ◆ – – – – – – – – – –

Introduction

Cassava (*Manihot esculenta*) has been earmarked as the crop that can spur rural industrial development and raise income for producers, processors, and traders.Hence in the present study with regard to economic value of the Cassava starch ,the quality in terms of various parameters such as Colour,Odour,Temperature of the storage tank,pH in the storage tank,Viscosity,Total Microbial Count,Enzyme activity,Types of contaminants were analysed during long term storage in Indian environment .

Samples have been analysed for the following characteristics which are important factors for the long term storage and quality of the unprocessed wet starch of Tapioca.

I. Colour
II. Odour
III. Temperature of the storage tank
IV. pH in the storage tank
V. Viscosity
VI. Total Microbial Count
VII. Enzyme activity
VIII. Types of contaminants

Materials and Methods

The fresh wet starch of tapioca samples had been collected and stored tubs of height 1X1X1.Samples had been stored from 30 days to 210 days time to assess various parameters.

The physical factors such as colour by colorimetric method,odour,temperature, pH and viscosity by AACC (2006) and AOAC (2005)

Total Microbial Count by plate assay method and Enzyme activity by Farias *et al.,* 2010; Voet and Voet ,2004.

These parameters were analysed for period of 30 days to 210 days in storage tanks without the chemical or biological treatments and initially the fresh tapioca starch was assessed for the above mentioned parameters.

Results and Discussion

The results pertaining to the physico-chemical and microbial characteristics were recorded and

I.Colour

Colour of the given samples are ranging from brownish yellow to dark blue and black .Colorimetric studies of the samples versus turbidity confirmed that it might be due to the contaminants in the wet tapioca starch.

II.Odour

Foul smell,Fermented sugar or heavy Odour of the given samples are experienced by the workers in the factory and the people living in that locality.

III. Temperature of the storage tank

The temperature on upper surface of the storage tank is comparatively lesser to the samples collected from the various depth ranging from 33 ^{0}C to 42^{0}C

IV.pH in the storage tank

It is the important physical factor by which we can assess the quality of unprocessed food for a long term storage.The given samples for quality study has the pH of the storage tank ranging from 5 to 8.3 due to the growth of anaerobic bacteria present in the cassava starch itself. Due to the metabolites or organic acids of alkaline pH released by the microbes ,there was an increase in the pH of starch stock.

The main physical factors reported to influence lactic acid fermentation are pH and temperature. pH is an important factor in the process that has a very strong impact on the microbial cell response and metabolism. Similar kind of physical characteristics were assessed in starchy wastes by Chatterjee *et al*.,1997.

V.Viscosity

This factor affecting the paste value and swelling volume of the quality storage as the samples stored in the tanks are ranging from 68 to 112 Bu. This might be due to the reducing sugar content of the tapioca starch.

VI.Total Microbial Count

TMC ranges from 244 to uncountable.That shows the lack of quality in the samples which will affect nutritive value.

Lactic acid is produced anaerobically 20 times more and faster than than the aerobic process.Hence the growth of LAB are faster during storage In

the storage tanks for a long term . Pyruvate may be produced from carbohydrates by glycolysis or from aminoacids under anaerobic conditions it may undergo LDH (Lactate Dehydrogenase) mediated conversion to lactate.Under anaerobic conditions the TCA cycle cannot operate ,leaving the cell dependent upon glycolysis of ATP production. Without a constant supply of NAD+ ,LDH mediated conversions of pyruvate to lactate can ensure the NAD+ levels are maintained .Therefore the microorganisms/ cells are oxygen starved an LDH isoenzyme M4 with high capacity for converting pyruvate to lactate is required (Mentham et al.,2008).

VII.Enzyme activity

The degradation of starch is due to the Amylolytic Lactic acid Bacteria (ALAB) .This is confirmed by the alpha –amylase activity of the ALAB. It ranges from 0.54 to 0.69 U/ml.

Due to the fast enzymatic degradation at high temperature and lack of maintenance of pH below 5 most of the Tapioca starch was utilized as substrate by the LAB.Moreover LAB could produce either L- or D-lactic acid or racemic mixture of lactic acid by fermentation depending on species. Lactate dehydrogenase is a key enzyme in lactic acid fermentation by most LAB. Most bacterial species possess only one lactate dehydrogenase gene. L-Lactic acid producing bacteria contain L-lactate dehydrogenase (L-LDH) which is a key enzyme converting pyruvate to L-lactic acid.

VIII.Types of contaminants

In the present investigation contamination with reference to Plate Assay method the list of following microbes were identified. Yeast,Enterococcus,Lactococcus,Proteus sp.Streptococcus,Aerococcus,Pediococcus etc

The fast enzymatic activity especially release of Alpha amylase by various LAB present in the given samples was

experimented . With reference to the fermentation and enzyme activity of LAB which possess extracellular amylase activity. This method involves a modification of the sensitive agar diffusion method and it was developed for macro-scale determination of alpha amylase .It can be used over a wide range in scientific investigation dealing with a large number of samples .

Lactic acid fermentation with emphasis on the use of starch or starchy substrates, was also reported. In most cases, starch cannot be used by LAB directly and the large starch macromolecules are converted into glucose molecules by treatment with acid or enzymes (Voet ,D and Voet J.G,2004).

Bioconversion of polysaccharide carbohydrate materials to lactic acid can be made much more effective by coupling the enzymatic hydrolysis of substrates and microbial fermentation of glucose form the raw starch substrates like Tapioca or corn.

Hence in the given samples the contamination is due to the racemic mixtures due to the group of LAB present in the Tapioca starch.This view is supported by Morlon-Guyot *et al*.,1998; Giraud *et al*., 1994

Conclusion

From the results pertaining to the physico-chemical and microbial characteristics of wet starch of Tapioca samples No - 1 to 6 were found as highly contaminated due to following factors and reasons.

- It has been observed foul smell or heavy odour from the samples and colors ranging from brownish yellow to black due to the growth anaerobic bacteria
- Samples are contaminated due to the anaerobic degradation by the microbes present naturally in the stock and that raise temperature from 33 to 42^0C

- pH an important factor which was observed in the samples are ranging from 5 to 8.3.This is due to the activity of fast degradation of the starch by the Amylolytic Lactic acid bacteria and some moulds like Fusarium,Rhizopus and Aspergillus.
- Growth of various microbial contaminants such as Bacteria:Lactobacillus, Streptoco*ccus,* E.coli,Staphyloccus,Enterobacter Moulds:Rhizopus,Aspergillus,Trichoderma,Fusarium and Yeast cause rapid fermentation and release aflotoxins and mycotoxins .

Due to the above mentioned reasons the samples can not be used for further food processing and the quantity of the starch is very less in these samples as the recovery % of the samples are 12 to 20%.So these samples are unfit for the recovery of starch It is recommended that all samples must be decontaminated or disposed safely without affecting the environment.

RESULT

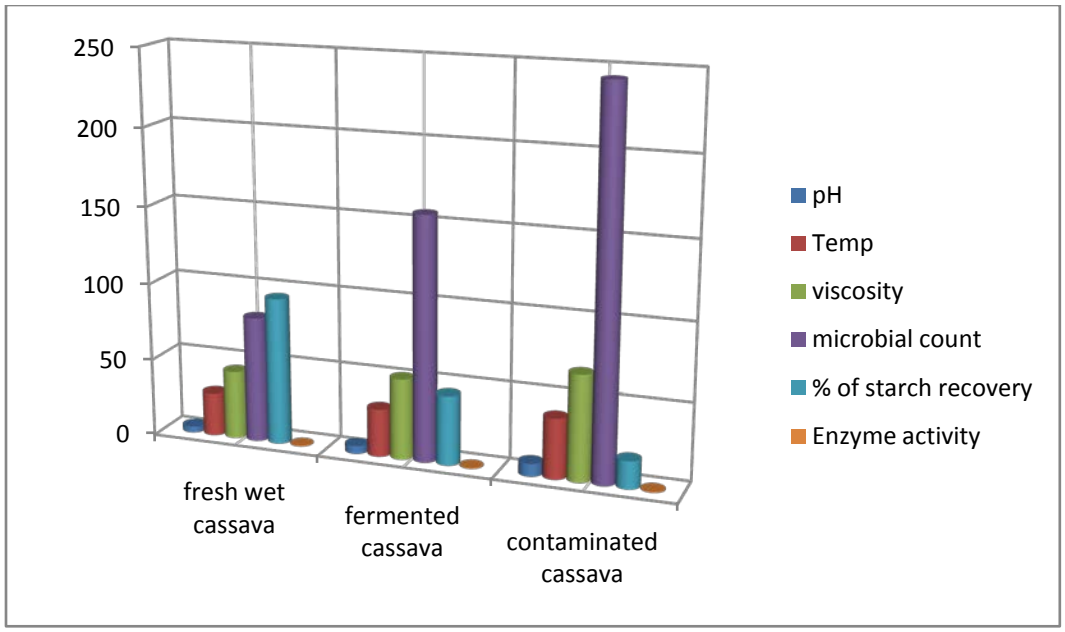
Table-1.Changes in the physico – chemical and microbial characteristics of Indian Tapioca starch during long term wet storage

S.No	Sample1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Temperature(^{0}C)	35-39^{0}C	40 - 42^{0}C	33- 41^{0}C	39-42^{0}C	34-40^{0}C	40- 42^{0}C
pH	5.5 to 6.5	5.9 to 8.5	5 to 6-8.2	5.2 to 8.7	5.9 to 6.5	6.5 to 8.3
Viscosity (Bu)	68	75	82	69	104	112

Total microbial counts	244	Uncountable	Uncountable	250	290	Uncountable
Spoilage due to microbes	Yeast, Lactobacillus,Streptococcus, Proteus sp	Aerococcus, Lactobacillus Streptococcus	Enterococcus, Lactococcus Streptococcus	Pediococcus, Lactococcus sp,E.Coli	Lactococcus Proteus sp Streptococcus	Lactococcus Streptococcus,E.coli
Enzyme activity (U/ml)	0.59	0.53	0.46	0.48	0.55	0.54

Figure 1

Storage time Vs Physico-chemical and microbial features of Fresh & contaminated wet cassava



References

1. AACC. American Association of Cereal Chemists: St. Paul, MN; 2005. Approved methods of the AACC.
2. AOAC. Association of Official Analytical Chemists: Gaithersburg, MD; 2006. Official methods of analysis of the Association of Official Analytical Chemists.
3. Chatterjee M, Chakrabarty SL, Chattopadhyay BD, Mandal RK .1997 Production of lactic acid by direct fermentation of starchy wastes by an amylase-producing Lactobacillus. Biotechnol Lett: 19:873–4.
4. Farias DF,Carvalho AFU,Oliveria CC,Sousa NM, Rocha Bezerra LCB,Ferreira PMP,Lima GPG and Hissa,DC.2010.Alternative method for quantification of alfa-amylase activity.Braz.J.BiolVol,70.no.2,p.405-407
5. Giraud E, Champailler A, Raimbault M .1994.Degradation of raw starch by a wild amylolytic strain of *Lactobacillus plantarum*. Appl Environ Microbiol 60: 4319–23.

6. Lin LL, Chyau CC, Hsu WH .1998.Production and properties of a raw starch degrading amylase from thermophilic and alkaliphilic Bacillus sp TS-23. Biotechnol Appl Biochem, 28 (1): 61-68.
7. Mendham J,Dennay R.C and Thomas. M.J.K. 2008.Vogel's Text book of Quantitative Chemical analysis, 6th Edition,Pearson Education Limited.
8. Morlon-Guyot J, Guyot JP, Pot B, Jacobe de Haut I, Raimbault M .1998. *Lactobacillus manihotivorans* sp. Nov., a new starch-hydrolysing lactic acid bacterium isolated during cassava sour starch fermentation. Int. J. Syst. Bacteriol. 48: 1101-1109.
9. Voet .D and Voet.JG.2004 ,Biochemistry,3ed,Hoboken: John Wiley & Sons.