

# A Comparative Study of Polysaccharides within the Jamaican Sugarcane Industry

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# Introduction

Total polysaccharide (TPS) may include starch, dextran, sarkaran, levans, pectins, cellulosans, hemicelluloses and gums

- Soluble polysaccharides other than starch
  - structural polysaccharides originating in the standing cane plant, and includes hemicelluloses, pentosans and pectins.
  - polysaccharides formed by bacteria before or during the processes of sugar manufacture and refining, e.g. dextran and levan.
  - polysaccharides e.g. sarkaran, similar to dextran formed by the action of natural enzymes present in the cane juice in the parenchyma of the stalk.

# Introduction

- Polysaccharides such as starch and dextran have been known to cause processing difficulties in raw sugar mills.
- Sarkaran confirmed as being a significant contributor to processing problems encountered in sugar processing.
- These compounds generally results in high process viscosities that may prove disadvantageous to the processing plant operation

# Introduction

- Polysaccharide in juice is linked to
  - the variety of cane,
  - maturity period,
  - harvest and transport conditions,
  - and agronomic and environmental conditions etc( Madhu, Godshall) .
- Methods to adequately identify and quantify specific polysaccharides have proven difficult to develop.
- The effect that each unknown polysaccharide has on the sugar process will prove difficult until proper methods to identify and quantify them are developed.

# Introduction

- investigations into the levels of total polysaccharide (TPS) in c massecuite began in 2003 at the Worthy Park Sugar factory.
- initiated by personnel at Worthy Park who were concerned about the difficulty they experienced in the boiling house due to abnormally high viscosities in the massecuite.
- Initial study showed that the levels of TPS remain fairly constant early in the crop but at around mid March into April the levels of TPS increase and generally show a gradual increase through to the end of the crop.
- this phenomenon seems to coincide with high amounts of rain (generally greater than 100mm/month) following a long dry spell.

# Introduction

- Subsequent studies at Worthy Park Estate looked at cane varieties, rainfall, and the age of the cane as possible factors contributing to the TPS levels in cane.
- The age of the cane (P value 0.0001) was found to be the most significant factor contributing to the TPS.
- TPS levels were found to increase with cane age from 9 to 12 months. Rainfall (P value 0.175) was next, TPS levels increased as rainfall levels increased.
- Variety (P value 0.406) was not found to be a statistically significant factor to TPS in cane (Reece 2006).

# Objectives

- To determine if the processing problems experienced at Worthy Park Estate were localized, attempts were made at determining the levels of total polysaccharide (TPS) in other factory areas
  - Ascertain if there were, and to what extent, there might be differences in total polysaccharides, starch, and dextran in two leading commercial varieties at the same age growing in various locations within the industry.
  - Determine if the levels of TPS, starch, dextran and sarkaran at various stages of processing were within the same range at different factories.

# Methodology

- Selection and sampling of cane
  - BJ7504 and BJ82119 were selected on the basis that BJ7504 had exhibited high levels of TPS while BJ82119 showed lower levels in earlier studies.
- Samples comprised 12 randomly selected stalks of 12 month-old green cane from each field of the specified variety in each factory area.
- Analysis was done within 24 hours at SIRI Central Laboratory Tests were carried out over the period April 24 to May 9 2007.
- Samples of syrup and C massecuite were collected from factories on April 18, 2007. Weekly final molasses samples were also collected and stored for analysis.
- C massecuite and syrup were analyzed for total polysaccharide, brix, pol dextran, and starch. TPS was analyzed using the Midland Gravimetric method. Dextran levels were determined by the DASA NIR method and the Midland Assay method. Other analyses were carried out using procedures outlined by ICUMSA

# Methodology

- Weekly final molasses samples from all factories were collected and combined to make a monthly sample for the respective factories.
- Molasses was acidified and high molecular weight polysaccharides isolated by precipitation with varying alcohol concentrations (80% to 100%). precipitate hydrolyze with pllulanase enzyme and incubation at 55°C for one hour.
- Sarkaran levels in molasses were determined by HPAEC-PAD analysis of the hydrolyzed precipitate.

# RESULTS

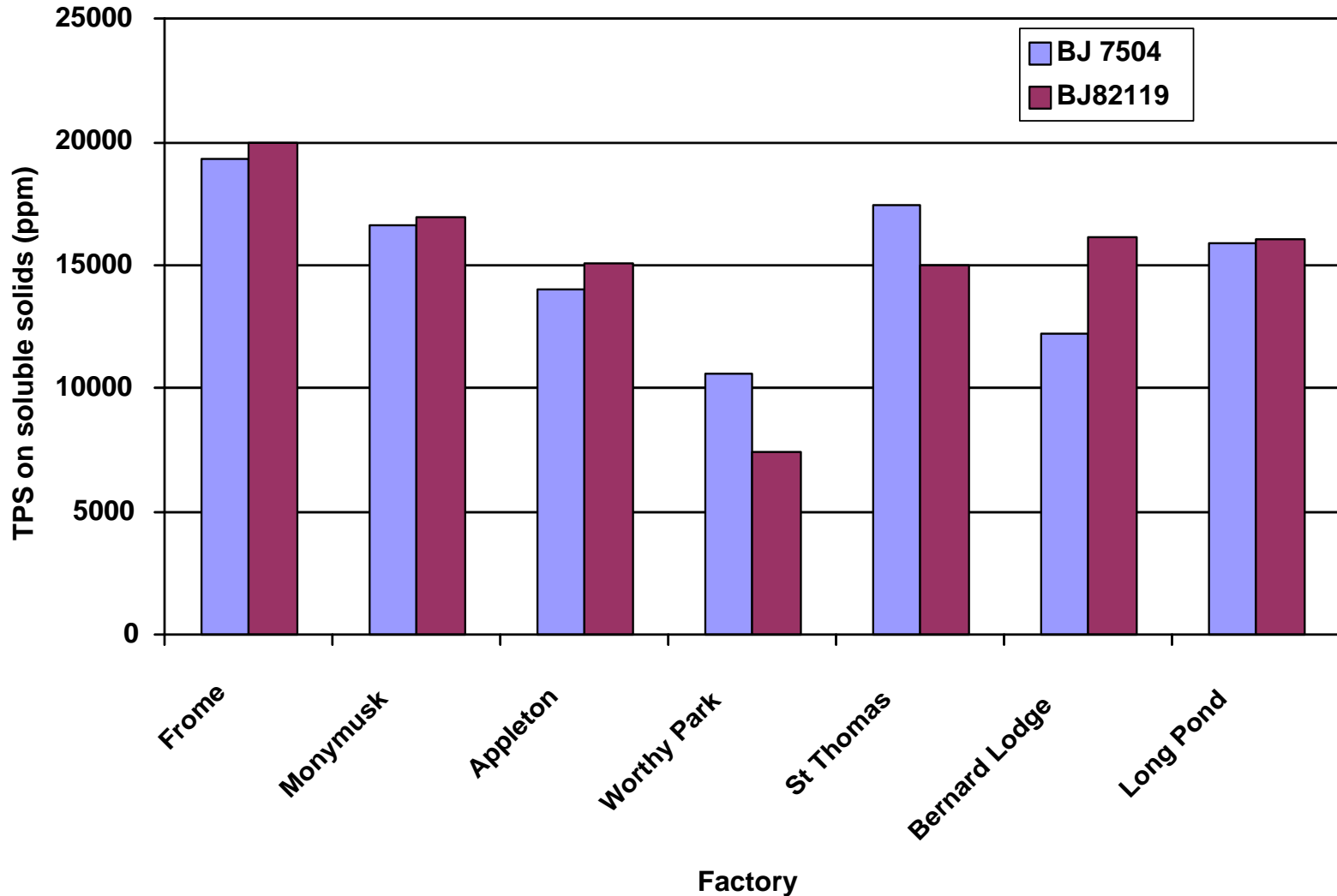
- Variety Comparison

Juice	TPS		Dextran		Starch	
	ppm on soluble solids		ppm on soluble solids		ppm on soluble solids	
Factory	BJ 7504	BJ82119	BJ 7504	BJ82119	BJ 7504	BJ82119
Frome	19280	19960	1822	1593	1437	1038
Monymusk	16617	16933	9929	8843	1858	759
Appleton	14005	15058	3037	5028	1287	936
Worthy Park	10601	7432	6737	7167	1409	1398
St Thomas	17460	14989	19164	16230	1107	239
Bernard Lodge	12220	16120	11757	12800	650	597
Long Pond	15890	16023	7341	7857	2421	962
Average	15153	15217	8541	8503	1453	847

# RESULTS

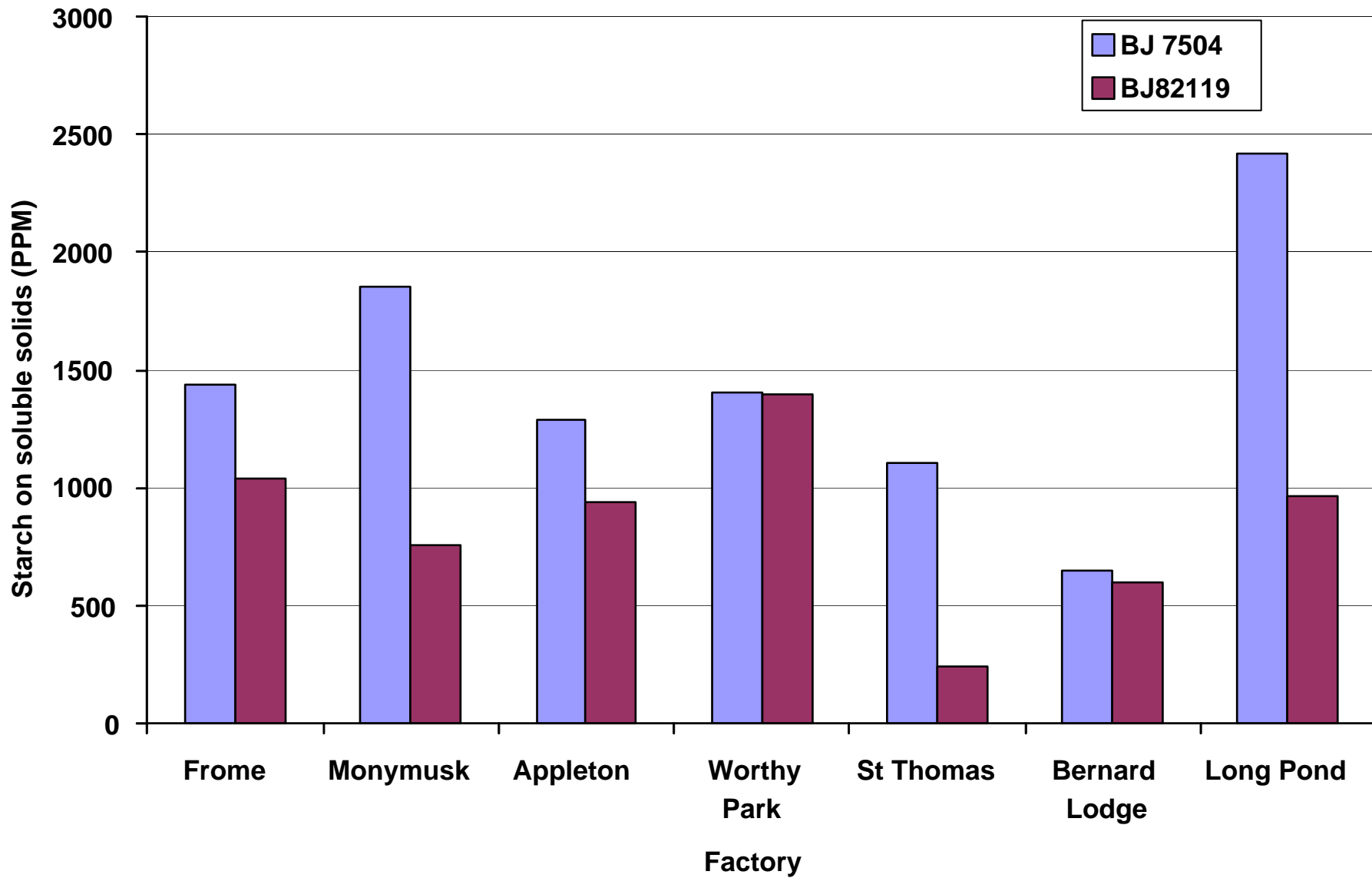
- Variety Comparison

Plot of TPS content of BJ7504 and BJ82119 from each Factory Area



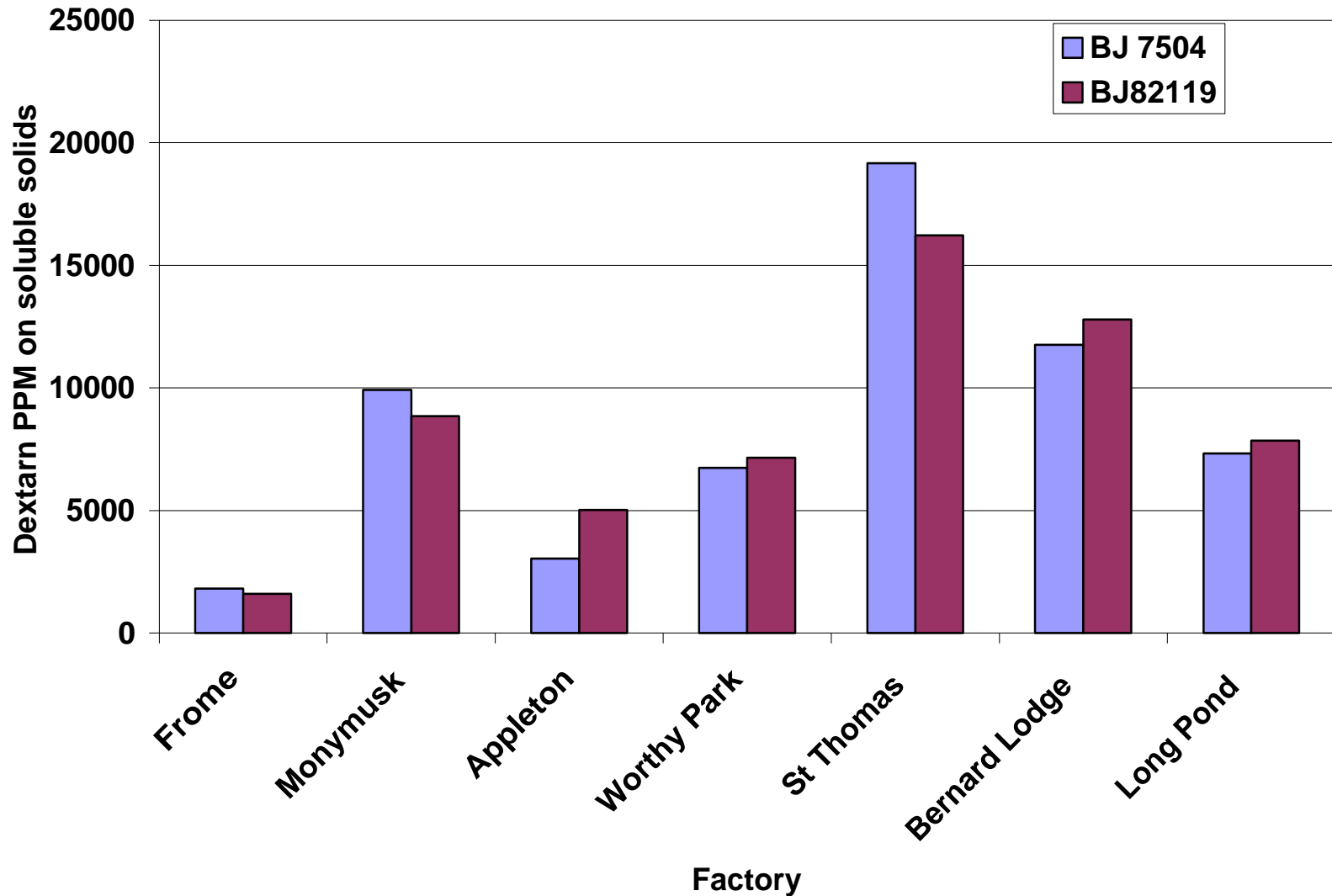
# Starch

Starch Levels in BJ7504 and BJ82119 from each Factory area

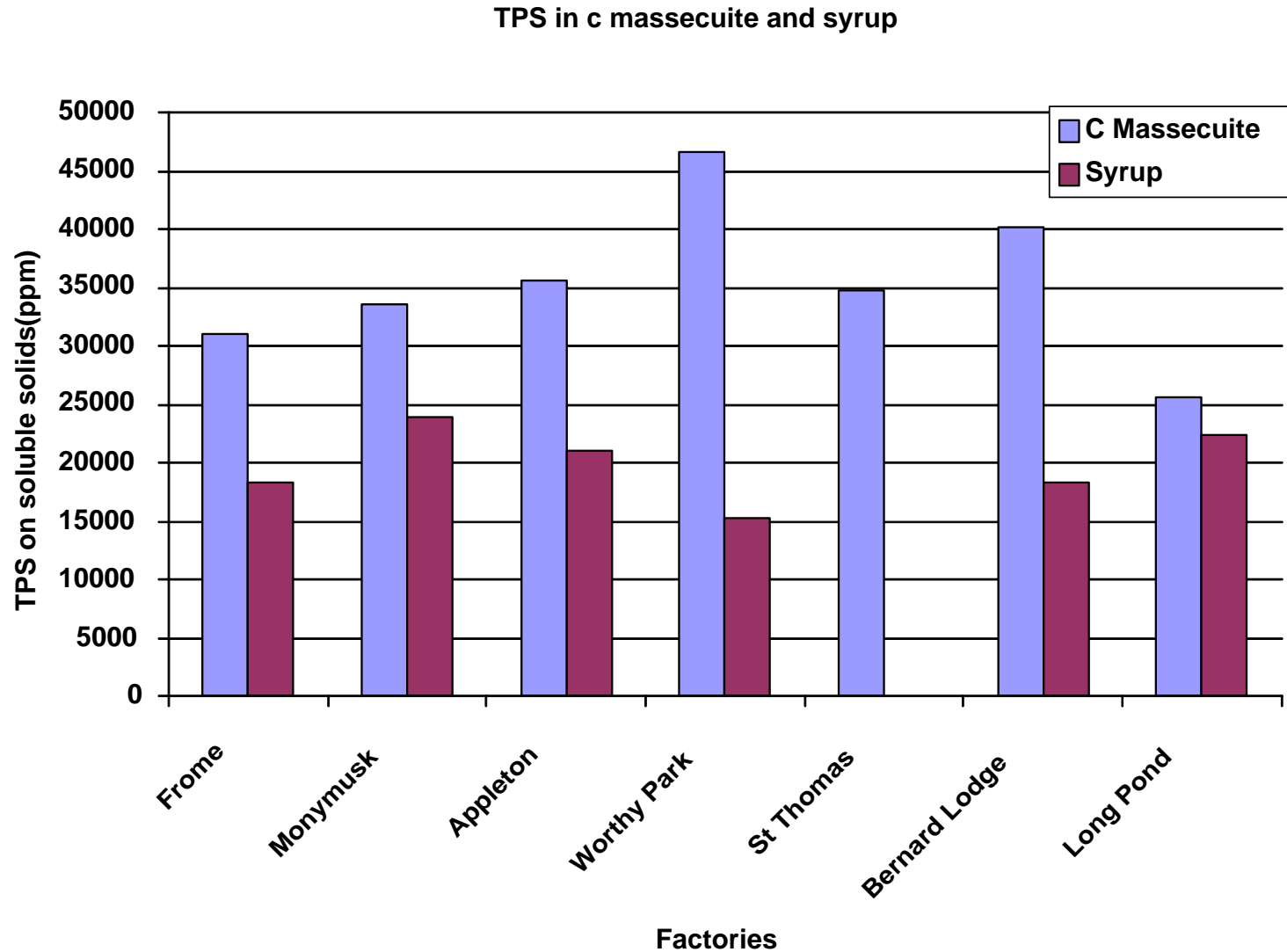


# Dextran

Dextran Levels in BJ7504 and BJ82119 from each Factory area

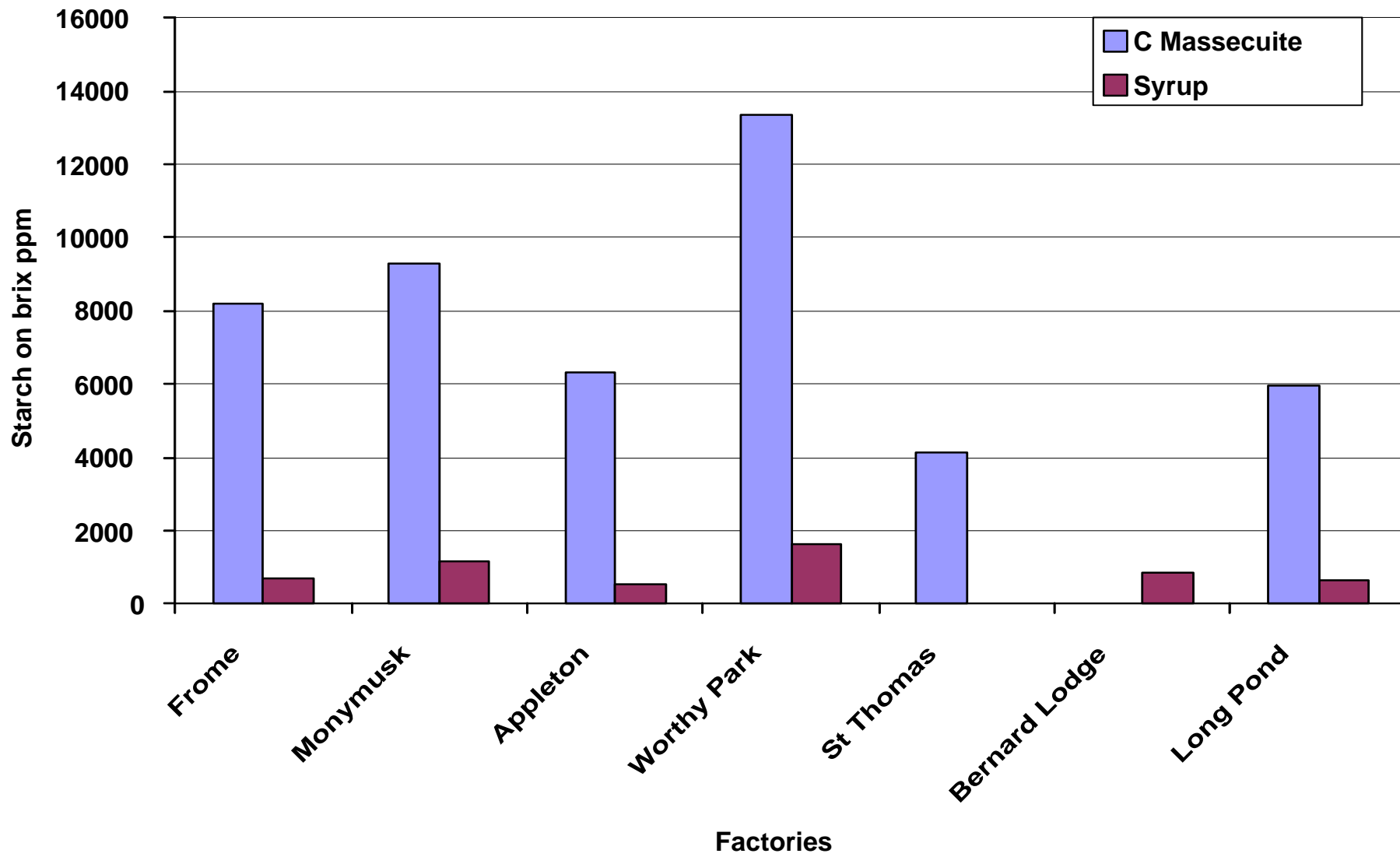


# TPS in syrup and C massecuite



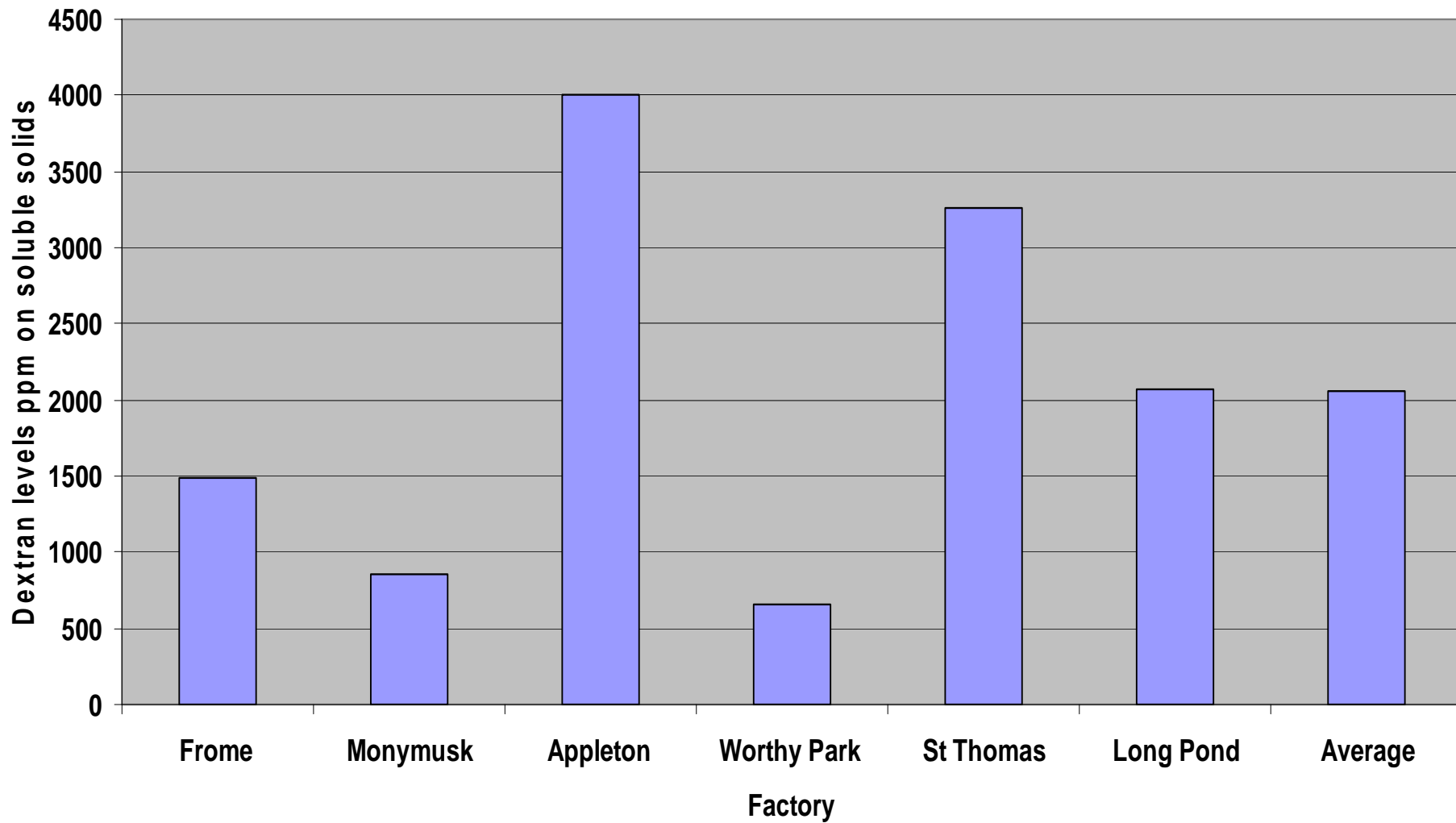
# Starch

Starch in c massecuite and syrup at the different factories



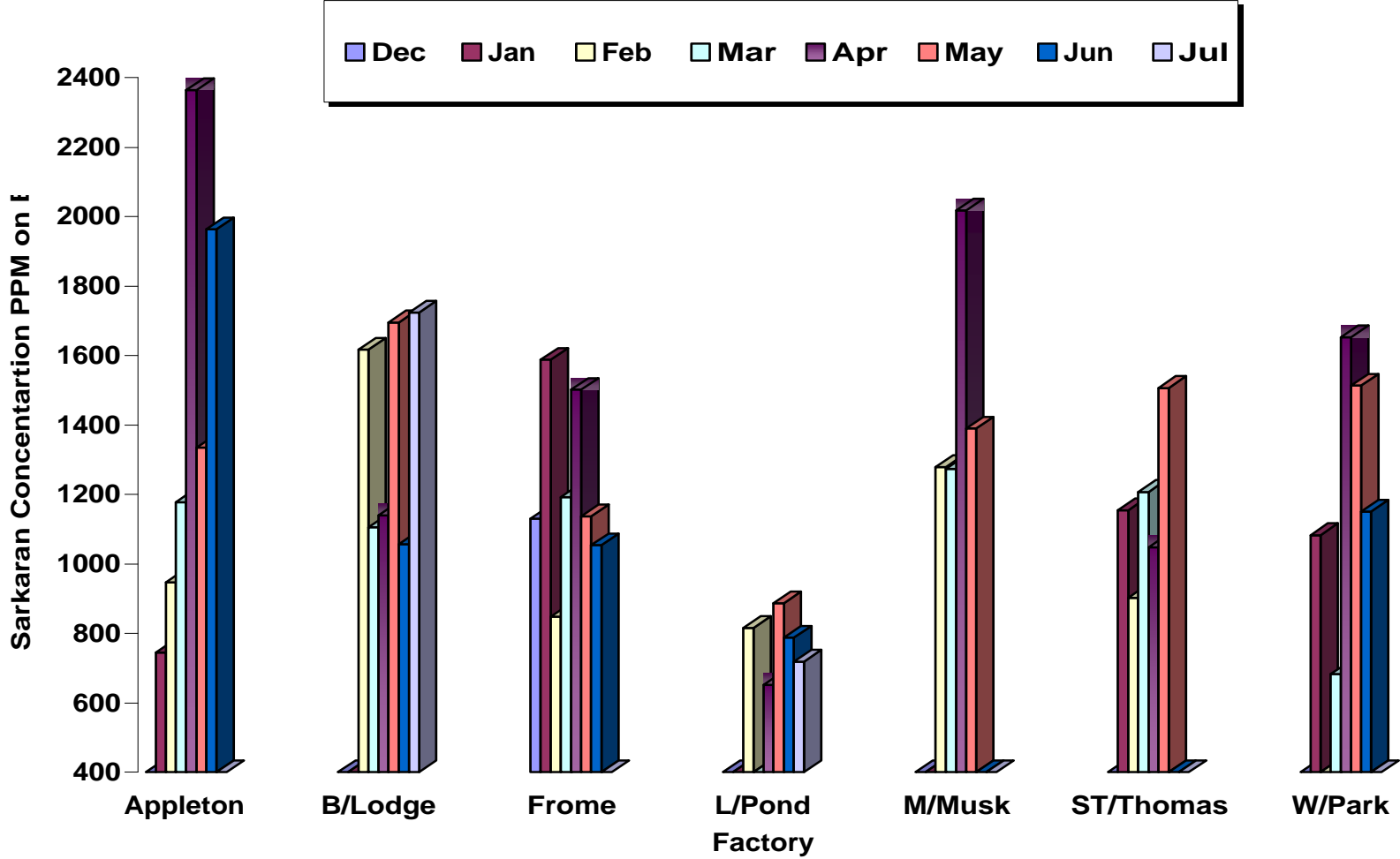
# Dextran

Dextran in C Masseurite



# Monthly molasses sarkaran concentrations

Concentration of Sarkaran in monthly final molasses



# SUMMARY & CONCLUSION

- No statistically significant differences in levels of TPS between field samples of two of the industry's leading sugar cane varieties, BJ7504 and BJ82119.
- Observed occurrence of viscosity as the crop progresses at Worthy Park (not reported elsewhere) could therefore not be ascribed to any particular sugar cane variety examined in this study.
- Starch levels in BJ7504 were found to be significantly higher than in BJ82119, this suggests that it may be more meaningful to look at the individual components of the TPS complex within varieties at harvest.
- While the study gives some indication of the trends in the TPS, dextran and starch levels, data obtained did not allow for any definitive conclusion at this time.

# SUMMARY & CONCLUSION

- Starch emerged as one of the major polysaccharides encountered in processing.
- Polysaccharide components varied within each factory and from factory to factory.
- A comprehensive assessment of each polysaccharide component may be necessary to accurately identify the true source of the processing problems experienced.
- The data identifies the stage at which polysaccharide builds up to undesirable levels during processing and therefore indicates where future investigative work must be directed.

# ACKNOWLEDGMENT

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Thank You