RAPID ASH ANALYSIS FOR MIXED JUICE

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Abstract

The determination of ash content *via* a conductivity measurement offers a rapid, environmentally friendly alternative to the sulfated ash analysis (gravimetric) presently employed by the South African sugar industry. The good correlation ($R^2 = 0.93$; n = 432) between the molasses conductivity and sulfated ash results prompted investigation into further applications of conductivity ash measurements. Consequently our investigations were extended to include a comparison of the mixed juice ash results obtained *via* conductimetric and gravimetric analysis. The results obtained in this investigation indicate that conductivity ash values are representative of the ash content in South African mixed juice and that both methods of ash determination are equally precise.

Introduction

As part of the continuing effort of the South African sugar industry to reduce its impact on the environment, further investigation into the potential replacement of the conventional sulfated ash (SA) analysis with a conductivity ash (CA) measurement was prompted. In addition to eliminating air pollution (noxious SO_2 fumes) through the use of a conductivity ash analysis; the occupational health and safety risks would be minimised once the use of concentrated sulphuric acid, a corrosive and environmentally hazardous chemical employed in the sulfated ash analysis, is discontinued. Another advantage is that the analysis time is reduced significantly when a conductivity ash method is used.

The official conductivity ash method adopted by ICUMSA was developed for the analysis of all factory products, *i.e*. molasses, raw sugar, juice and syrup (Anon, 1994). In a recent investigation we demonstrated that a good correlation ($R^2 = 0.93$; n = 432) exists between the molasses conductivity ash content, determined *via* this analysis, and the conventional sulfated ash result used at the Sugar Milling Research Institute (SMRI) (van Staden *et al*, 1999a). Hence, the potential application of the ICUMSA method to other factory products analysed routinely, *e.g.* mixed juice, required further investigation.

The present investigation was undertaken to determine whether the ICUMSA conductivity ash analysis would give an equally acceptable indication of the mixed juice ash content when compared with the sulfated ash results. Previous investigations aimed at establishing a relationship between the specific conductance and sulfated ash content of mixed juice samples had been unsuccessful (Dunsmore and Bax, 1983). The conductivity ash analysis was evaluated on a comparative basis, *i.e.* the mixed juice conductivity and sulfated ash results were compared for the 1999/2000 season. The respective ash analyses were completed simultaneously, *i.e.* same time and day, to eliminate the possibility of and resulting variability caused by sample deterioration. Filtered samples from all the South African mills were analysed.

Results and Discussion

A regression analysis of the mixed juice ash values recorded during the 1999/2000 season shows that good agreement exists ($R^2 = 0.86$; n = 335) between the conductivity (CA) and sulfated ash (SA) results for the mixed juice samples analysed. Both the mean CA-SA difference and mean of the absolute CA-SA differences are 0.04% for typical ash values ranging from 0.30 – 0.65%. All the South African mills are biased in the same direction (Figure 1), *i.e.* the ash result obtained *via* a conductivity measurement is on average 8% higher than the corresponding sulfated ash value (Figure 2) and this difference is statistically significant.

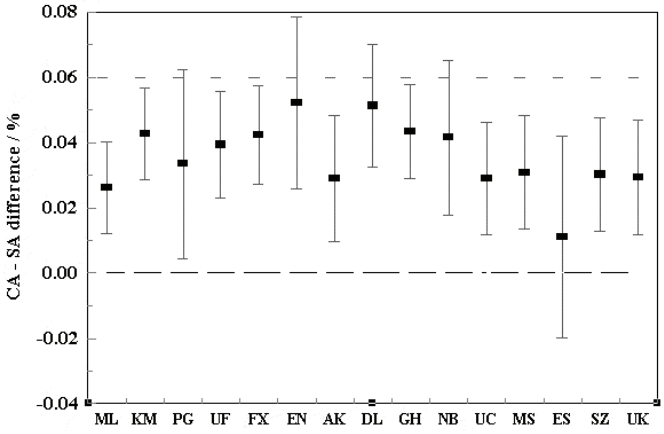

Figure 1. The mean CA-SA differences ± STD for the South African mills.

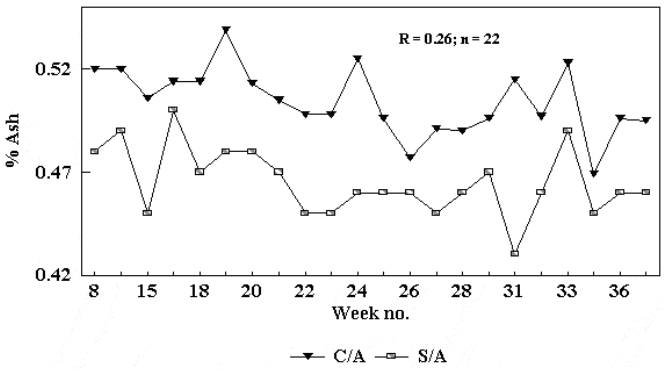

Figure 2. Seasonal trend for the worst case scenario.

An evaluation of the method precision showed that the conductivity and sulfated ash analyses are essentially equally precise, with method repeatabilities of 0.06 and 0.05% respectively and an overall reproducibility of 0.06% for both methods (Bissel, 1994 and Anon, 1979). Thus, the average CA-SA differences for the mills studied are within the confidence limits of these methods. The possibility of increasing the sample size to 10 g, so that it is more representative and analogous to that used in the sulfated ash analysis, was investigated. No improvement in the method repeatability and reproducibility was observed. This alternative was abandoned since the additional dilutions required to bring the conductivity readings into the correct range might introduce handling errors that could affect the method precision adversely.

Conclusions

The results obtained in this investigation indicate that both methods of ash determination are equally precise and that an effective and representative conductivity method for determining the ash in South African mixed juice has been identified. This simple method of analysis offers a rapid alternative to the hazardous sulfated ash analysis presently employed. Furthermore, the conductivity ash analysis could be used successfully in factory laboratories; the most important criterion being the calibration of the conductivity meter (Anon, 1994; van Staden *et al*, 1999b), as highlighted by DeVilliers (1986).

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