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**Determination of Individual Sugars and Organic Acids
of New Zealand Varietal Apple Juice and Their Use in
Evaluating Authenticity.**

**A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF PHILOSOPHY IN
FOOD TECHNOLOGY AT MASSEY UNIVERSITY - NEW ZEALAND.**



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ABSTRACT

High pressure liquid chromatography techniques were used to determine sugars and acids in the juice of apples grown in New Zealand. A total of 189 samples were analysed and the results were used to assist with the determination of the authenticity of New Zealand apple juice. The values obtained were compared to other literature values and criteria used to determine authenticity of apple juice. As a number of factors affect the composition of juice, the data was gathered from a number of apple cultivars commonly grown in New Zealand, from different growing regions over two seasons, with the fruit harvested at the three maturities used in juice production. Fruit is also stored for varying lengths of time under different conditions for juice production at a later date, and therefore such samples were included in the testing.

In the apple juices tested the Brix ranged from 8.3 to 15.3 and titratable acidity (calculated as malic acid) from 210 to 1130mg/100ml. Fructose and sorbitol ranged from 4.0 to 8.6g/100ml and 0.13 to 1.4g/100ml respectively. Of the cultivars examined, Granny Smith, Red Delicious, Golden Delicious and Fuji were observed to have sucrose and glucose present at less than 3.5g/100ml which is a commonly reported literature maximum for authentic apple juice. Cox's Orange apple juice was observed to have sucrose levels typically in excess of 3.0 g/100ml for first pick fruit and in excess of 5.0g/100ml, for second and third pick fruit. One sample of this cultivar had the highest sucrose level of 7.5g/100ml seen in the study, and on average was found to have sucrose present at 4.9g/100ml. Cox's Orange apple juice generally had the lowest glucose level with levels typically less than 1.1g/100ml. Braeburn apple juice was observed to have sucrose present at levels frequently in excess of 4.0g/100ml in 1992 and 3.0g/100ml in 1993. Storage trials of this cultivar showed that it was not until the fruit had been stored for prolonged periods (45, 149 and 195 days at ambient, cold and controlled atmosphere conditions respectively) that the sucrose levels of the juice decreased to the 3.5g/100ml referred to above for authentic juice. Royal Gala, Gala, Hillwell, Fiesta, GS330 and GS2850 generally had sucrose levels ranging from 2.0 to 5.0g/100ml.

Malic acid was the most predominate acid present with levels of between 231 and 1067mg/100ml. Quinic and succinic acids were present at levels of 22 to 129mg/100ml and 8 to 41mg/100ml respectively, with succinic acid present at levels four times those that are commonly reported. Citric and shikimic acid levels were typically below 20 and 3.5mg/100ml respectively while fumaric acid never exceeded 0.22mg/100ml.

The juice of cold stored fruit was observed to have succinic and citric acids at levels greater than those observed from ambient and controlled atmosphere storage. The level of fumaric acid in the juice of ambient stored Braeburn fruit showed a marked increase from 0.06mg/100ml to 0.22mg/100ml during storage. Small increases of about 0.03mg/100ml were seen for cold and controlled atmosphere stored Braeburn fruit. Similar trends were observed in the juice of stored Granny Smith fruit.

The application of Brause and Raterman (1982) and the German RSK criteria for authentic apple juice to New Zealand varietal apple juice showed that the cultivars Granny Smith, Red Delicious, Golden Delicious and Fuji produced juice that could be considered authentic. Braeburn, Gala, Royal Gala, Cox's Orange, Hillwell, GS330, GS2850 and Fiesta were observed to have at least one component outside the proposed standard ranges, with some samples exceeding the 95% confidence levels and juices from all would often be considered as "not authentic".

The use of overseas sucrose and glucose levels and their ratios for authentication of juices from all New Zealand apple varieties is inappropriate because values outside of the published guidelines for authenticity were frequently found. The use of criteria for authentication can only be applied to juice from which the standard values are derived. Application of standard values to juices from other regions, cultivars or even years could lead to authentic juice being rejected. While published criteria for authentic juice are a starting point, their application is inappropriate for some cultivars grown New Zealand. If they are applied to New Zealand apple juice the assessment of the juice data needs to be undertaken by an expert or group of experts who have knowledge of juices (rather than the

limited information which is available in the RSK values and commentaries) to be sure that any abnormalities in the data are recognised.

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