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Development of an acceptable, stable and safe nitrate-rich vegetable juice beverage

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Food Technology

at Massey University, Albany, New Zealand.

Tejal Nikhil Kolte
2014
Ingestion of nitrates from a vegetable juice beverage has been reported to improve exercise performance. The research was therefore conducted to produce a vegetable juice beverage with stable nitrate content that could potentially enhance sports activity. In this study, a placebo drink was also produced with low nitrate content and to match the taste and quality parameters of the high nitrate juice beverage.

Juice was extracted from beetroot, pasteurised at 90±1°C for 15 s and blended with other ingredients and further tested for pH, titratable acidity, total soluble solids, nitrate and nitrite content and microbial counts. A sensory evaluation trial was conducted on four finalised juice blends along with the commercial product on the market. Orange flavour low acid beetroot juice beverage (1572±5 mg nitrate/L) was preferred formulation than the commercial juice beverage, BEET IT.

A shelf life trial, using a full factorial experimental design, was used to determine the effect of temperature (4±1°C and 20±1°C) and storage conditions (light or dark storage) on orange flavour low acid beetroot juice beverage. From the storage trial, the orange flavour low acid beetroot juice beverage containing more than 1500 mg nitrate/L, can be stored in transparent bottles and safely consumed after eight weeks storage if stored at 4±1°C.

The sensory results obtained from performing the triangle test on the orange flavour low acid formulation (standard beverage) and placebo drink suggested that only 28 % of the population could identify a difference between the two products. The placebo drink contained 181±4 mg nitrate/L which was nine times less than the nitrate concentration in the standard beverage.

In conclusion, an acceptable high nitrate juice beverage was formulated with a corresponding low nitrate drink placebo drink which could not be differentiated by consumers after sensory testing. It is recommended to develop a commercial manufacturing procedure to produce the nitrate juice beverage from beetroot, beet leaves and celery juices from which larger batches of samples can then be tested for exercise performance.
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<tr>
<th>Abbreviation</th>
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<tr>
<td>°B/A</td>
<td>°Brix/Acid</td>
</tr>
<tr>
<td>ADI</td>
<td>Acceptable Daily Intake</td>
</tr>
<tr>
<td>Hₐ</td>
<td>Alternative Hypothesis</td>
</tr>
<tr>
<td>BW</td>
<td>Body weight</td>
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<tr>
<td>Ca²⁺</td>
<td>Calcium</td>
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<tr>
<td>CIP</td>
<td>Cleaning In Place</td>
</tr>
<tr>
<td>CFU</td>
<td>Colony-Forming Unit</td>
</tr>
<tr>
<td>D</td>
<td>Decimal reduction time</td>
</tr>
<tr>
<td>DF</td>
<td>Degree of Freedom</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organisation</td>
</tr>
<tr>
<td>FSANZ</td>
<td>Food Safety Australia New Zealand</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>HDPE</td>
<td>High Density Polyethylene</td>
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<tr>
<td>HPLC</td>
<td>High Pressure Liquid Chromatography</td>
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<tr>
<td>HTST</td>
<td>High Temperature Short Time</td>
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<tr>
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<td>L</td>
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<td>UHT</td>
<td>Ultra High Temperature</td>
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