Investigating Sports Drinks. Are they worth the money?

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Introduction and Aim of the investigation

The sports drinks industry is a huge global business which shows no signs of slowing down. The inspiration to conduct this investigation came from an observation that there is an increasing consumption of sports and energy drinks within our community, particularly amongst children. The message from the advertisers is clear- *athletes should replace lost body fluid with drinks that contain electrolytes, such as sports drinks*. However, there are conflicting suggestions from conducting literature reviews; that, not only are these drinks unhealthy in terms of the high sugar content, but instead water and milk are sufficient to hydrate children and adults before, during and after exercise. Indeed it is claimed that there are no beneficial effects of sports drinks for non-elite athletes and children. This investigation compares the electrolyte composition of a range of drinks marketed as sports drinks, as well as other drinks including milk and tap water. In addition, an assessment of the reducing sugar present in each drink was undertaken using colorimetry. A comparison was also made of the relative cost of each drink.

As a result of our findings we hope to determine if sports drinks differ significantly from other cheaper alternatives and if indeed, they are worth the extra cost.

Methodology

Experiment 1. Determining the Relative Electrolyte Concentration.

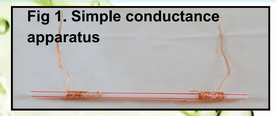
To determine the **electrolyte concentration** in each of the drinks, the **conductance** must be measured. **This is proportional to the electrolyte concentration**. Electrolytes are charged particles that carry current in solution, thus the conductance of the solution depends on the concentration of the electrolytes. The conductance was determined using the following equation:

Conductance (*Siemens*) = *Current* (*Amps*) / *Voltage* (*Volts*) [*G = I / V*]

We measured the conductivity of 16 drinks; 7 of which were specifically marketed as Sports drinks.

We did this by cutting a 5 cm piece from a drinking straw. Two pieces of copper wire each 5cm long were wrapped tightly around each end of the straw (Fig 1) and the circuit was assembled as shown. (Figs 2 & 3). Beakers for each drink were washed, rinsed thoroughly in distilled water and dried before use. A precise volume of each drink (100cm^3) was poured into each beaker, so that the sensor was submerged to the same depth for each drink. The conductance sensor was placed in the beaker containing the first drink. The voltage was then set to 3V using a voltmeter to confirm accuracy. The current was recorded using the ammeter. The sensor was cleaned using distilled water and the test was repeated. For each drink, 3 readings were taken at 3V, 6V and 9 V. Calculations were then undertaken to determine the conductance of each sample using the equation above. From this, a mean conductance was calculated for each drink.

Fig 1. Simple conductance apparatus



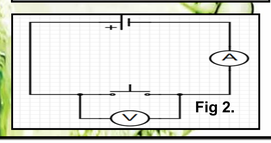


Fig 2.

Determining the Reducing sugar concentration in each drink.

Research into the sugar content of many sports drinks have revealed that the common sugars present are fructose and glucose; both reducing sugars. They are therefore detected using the Benedict's test.

First standard solutions of a variety of reducing sugar concentrations were prepared (between 1 and 10 %). Benedict's reagent was added to excess and the mixture was heated in a water bath for 10 minutes. Each solution was filtered, poured into a cuvette and placed into a colorimeter with the red filter inserted. A calibration curve was then plotted of absorbance against mass of glucose (Fig 4). Each sample of drink was then subjected to the Benedict's test using the same method and the concentrations of reducing sugar were established, by reading from the calibration curve.

Fig 3. Conductance set-up

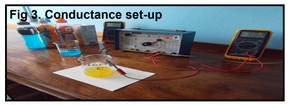
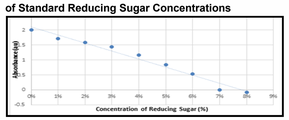
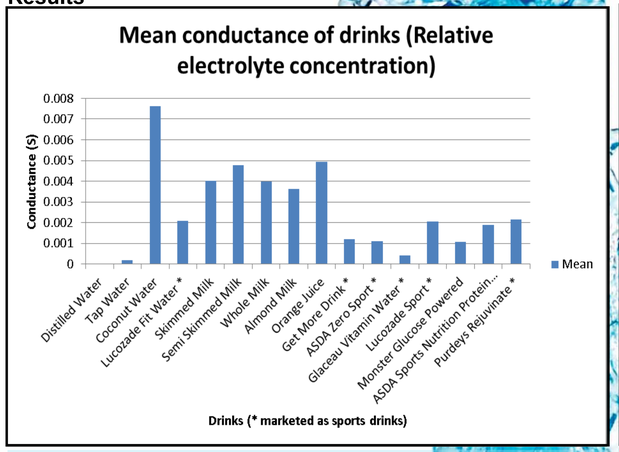
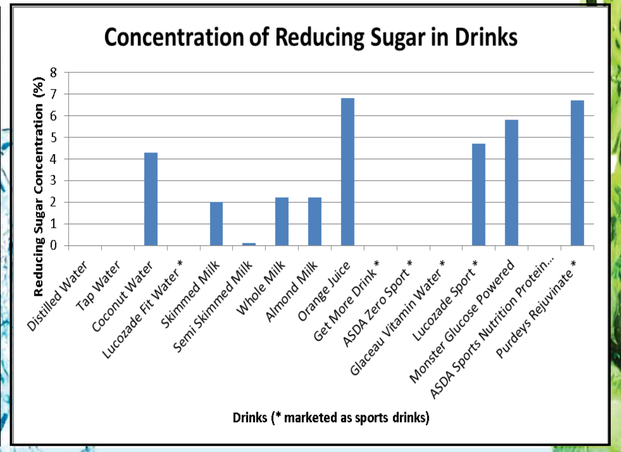


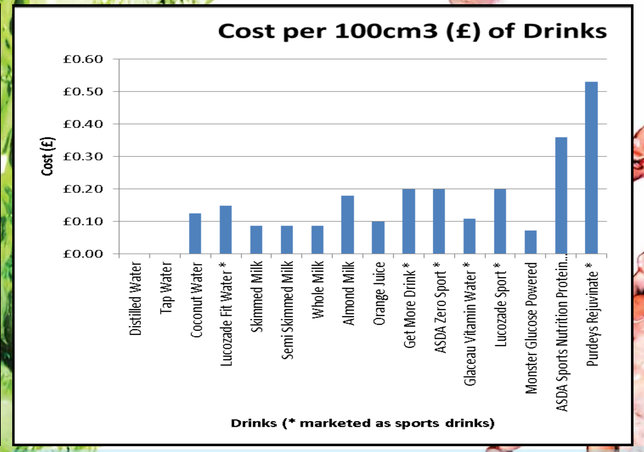
Fig 4. Calibration Graph for Determining Absorbance of Standard Reducing Sugar Concentrations

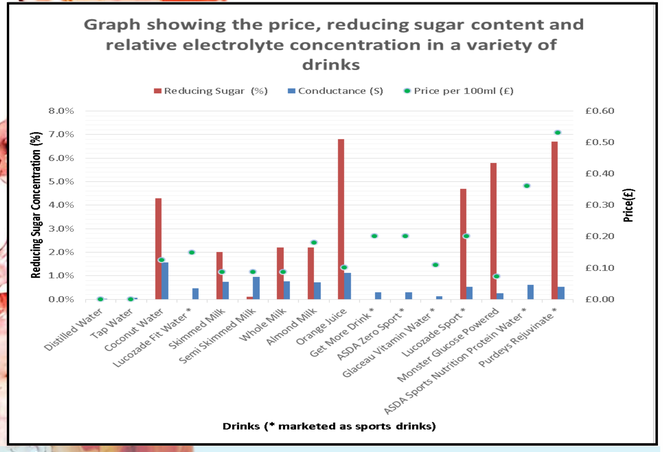


Results









Conclusion:

All drinks (apart from distilled water) contained a measurable electrolyte concentration. There was a considerable variation between them. Sports drinks generally had a lower concentration of electrolytes compared to all other tested drinks. All milk types had an electrolyte concentration which was twice that of the sports drink. Coconut water had significantly more electrolytes than any other tested drink.

Conclusion:

There was a wide variation in results: Two of the drinks marketed as "sports drinks" had very high levels of reducing sugars, as did orange juice. (Between 5-7% sugar). This was almost x3 that of milk. The other five sports drinks had no detectable reducing sugar concentration, (although may have contained a non- reducing sugar). Three of the four types of milk contained a low level (2% of sugar concentration.

Conclusion:

Drinks that are marketed as "sports drinks" were generally more expensive. Five out of the seven sports drinks tested were at least double the price (in some cases 3 or 4 times the price) compared with the other drinks.

Overview:

There was a huge variation in composition and price of all the drinks tested. Generally, sports drinks are twice the price of the other drinks, whilst having a similar electrolyte concentration. Two of the sports drinks, as well as orange juice had in excess of 6% sugar- an unhealthily high level. Overall the best option from all of the drinks that we tested was the milk; cheaper than all of the other drinks, whilst still supplying one of the highest electrolyte replenishments and incorporating low levels of carbohydrate for energy replacement.

What have we learnt: Sports drinks are beverages specifically formulated to: Prevent dehydration; provide a source of carbohydrate (the most efficient source of energy) and replenish lost electrolytes. They can be: Isotonic - containing similar concentrations of salt and sugar in the body ; Hypertonic – containing higher concentrations of salt and sugar than in the body or Hypotonic– containing lower concentrations of salt and sugar than the human body. It is clear from our investigation that each drink had a different formulation.

However, when consumers are purchasing their drink, do they really know what they are getting? Is the more expensive sports drink really necessary?

Conducting literature reviews yielded some interesting observations: A study conducted by Cardiff University and published in the British dental journal highlights *that parents and children are unaware that sports drinks are not intended for consumption by children. Their recommendation is that water and milk are sufficient to hydrate before, during and after exercise.* They continue - *Sports drinks high in sugar increase cardio - metabolic risk and contributes to tooth decay.* The BMJ *voiced that there was a lack of evidence to support the beneficial claims by the vast majority of products. "Indeed water was generally sufficient for shorter sessions, only for exercise lasting more than 60 mins was an isotonic sports drink recommended".* Study by researchers at Harvard university found that *13% of marathon runners had suffered hyponatremia (too little Na+ in the blood).* However, they suggested *that this was due to over-hydration (drinking too much fluid). There appeared to be no difference between those who consumed sports drinks compared with those that drank water.*

There is agreement between bottled water companies and the sports drink industry in promoting hydration; however the disagreement is about **what type of fluid that should be.**

Our natural instinct is to respond to dehydration by drinking - "thirst is a good guide for hydration" – **but what drink should it be?**

Our recommendations: **A sports drink rarely can be justified in terms of both cost and benefit to health (particularly for children). For most exercise of less than 60 minutes, tap water appears to be sufficient to hydrate people. For more intensive exercise, where electrolytes may need to be replenished and a source of energy is required, then milk seems a good, alternative – cheaper with lower levels of carbohydrate, than many of the sports drinks and a significant electrolyte concentration.**

Future Research: We are aware that the potential benefits of sports drinks is a very controversial area, with many conflicting opinions. We would like to get more involved with working with drinks companies and sports physiology departments in universities to conduct studies into the difference in blood electrolyte concentrations before, during and after exercise in a range of individuals at different durations and intensities of exercise.

Bibliography:

https://www.health.harvard.edu/blog/trade-sports-drinks-for-water-201207305079,(Accessed: 01/05/2018), (*http://blogs.bmj.com/bjsm/2016/06/29/regular-consumption-of-sports-drinks-are-a-risk-to-childrens-health/* , Available at: *https://www.diabetes.co.uk/sports-drinks.html* (Accessed: 01/05/2018), *http://theconversation.com/sports-drinks-help-athletic-performance-and-nothing-else-32041,* (Accessed: 01/05/2018), *http://theconversation.com/sports-drinks-help-athletic-performance-and-nothing-else-32041,* Available at: *https://www.diabetes.co.uk/sports-drinks.html* (Accessed: 01/05/2018).*http://www.bbc.co.uk/programmes/articles/4N5drb9Vm3jmkkSgg8LBWMj/what-s-actually-in-sports-drinks,* (Accessed: 01/05/2018), *https://www.newscientist.com/article/mg23731601-200-are-sports-drinks-any-good/,* Accessed: 01/05/2018). *ttps://www.theguardian.com/lifeandstyle/2009/jul/27/sports-drink* (Accessed: 01/05/2018).