Comparing the effectiveness of drinking beetroot and pomegranate juice in enhancing cardiovascular endurance

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Abstract

Pomegranate juice and beetroot juice are both proven to be able to enhance cardiovascular endurance performance during exercise. However, as both juices have never been compared against each other before, this study served to find out which juice is more effective in enhancing cardiovascular endurance so that people doing their IPPT/NAPFA or other endurance related competitions such as Cross-Country can benefit from the findings. In this study, both juices' effectiveness in enhancing cardiovascular endurance (i.e. allowing the participant to do more repetitions of 20m) were compared in a Multi-Stage Fitness Test (MSFT), more commonly known as the beep test. The MSFT is proven to be a reliable test for VO2 Max, and one's VO2 Max is one's cardiovascular endurance level. Hence, this will determine which juice is more effective at enhancing cardiovascular endurance. 500ml of pure beetroot and pure pomegranate juice was compared against the same volume of a placebo, which was water. It was proven that consuming both juices led to significant improvement from the results after consuming water. Pomegranate juice showed more improvement than beetroot juice, proving that pomegranate juice is more effective at enhancing cardiovascular performance before exercise. This shows that for the greatest boost in performance, pomegranate juice should be taken over beetroot juice in activities or competitions where one's cardiovascular endurance is key.

Introduction

Beetroot and pomegranate juice were proven to enhance cardiovascular endurance. However, the juices have never been compared in any study prior to this study[1], hence it is not known which juice is more effective in enhancing cardiovascular endurance.

[1] As of 23 July 2019, there is still no research paper published comparing beetroot and pomegranate juice

Therefore, this study compares beetroot and pomegranate juice so that people doing their IPPT/NAPFA or other endurance related competitions such as Cross-Country can benefit from the findings of this study. This is because those that want a greater boost for their cardiovascular endurance, which translates to a greater performance boost, will know which juice to consume pre-activity, which is the juice that proved to be the most effective in improving cardiovascular endurance in this study.

Studies have shown that Nitric Oxide (NO) is able to enhance cardiovascular endurance during endurance exercise (Cermak NM et al, 2012), (Lansley KE et al, 2011). This is because NO is a vasodilator (Garg UC & Hassid A, 1989), which allows for vasodilation, which is the widening of blood vessels. This will allow for more nutrients like glucose and oxygen to be transported to all parts of the body in the same amount of time, allowing for glucose and oxygen to be replenished in the muscles faster, reducing the time taken for the human body to succumb to fatigue.

Beetroot juice proved in multiple studies (Murphy M et al, 2012), (Wylie LJ et al, 2013) that it was able to enhance cardiovascular endurance during exercise by raising the amount of NO in the human body. Beetroot contains dietary nitrates, which are then converted into NO by the human body (Lansley KE et al, 2011). Research showed that beetroot was able to reduce the time taken to run a 5km time trial in healthy adults (Murphy M et al, 2012), which was due to the higher levels of NO in the human body. In another study, beetroot juice was able to reduce the amount of oxygen healthy men needed during exercise and increase the amount of time the men can exercise for (Wylie LJ et al, 2013). However, although effective, beetroot juice was not proven to be more effective[2] at enhancing cardiovascular endurance than pomegranate juice.

Pomegranate is able to protect NO from oxidative destruction in the human body (Ignarro LJ et al, 2006), meaning that it is also able to enhance cardiovascular

[2] Refer to [1] (above)

endurance (Trexler ET et al, 2014). For example, the consumption of pomegranate extract was able to increase the time taken to exhaustion during exercise (Trexler ET et al, 2014). Like beetroot juice, although pomegranate juice was also proven to be effective in enhancing cardiovascular endurance, there was no proof that it was more effective[3] than beetroot juice.

The Multi Stage Fitness Test (MSFT), more commonly known as the beep test, is a 20 metre shuttle run maximal test that has been proven to be able to accurately evaluate one's VO2 Max, which is one's cardiovascular endurance level (Aandstand A et al, 2011), (Paliczka VJ et al, 1987). In the MSFT, the higher level one reaches, the more fit one is. This study used the MSFT to assess the participants' exercise performance 3 hours after consuming the beetroot and pomegranate juice.

Participants took part in the MSFT 3 hours after consuming the drinks as that is the time it takes for the endurance enhancing effects of both pomegranate and beetroot juice to kick in (Wylie LJ et al, 2013), (Lansley KE et al, 2011)[4]. There was a 7-day washout period in between each MSFT to allow the effects of the juices to completely wear off (Ross R et al, 2015), (Trexler ET et al, 2014)[5]. This study also used 500ml of juice as the juices need to contain an ample amount NO for the effects of NO to kick in effectively.

Lastly, this study also used a placebo (plain water), which was also the control. The placebo is required as it will affect the results. The placebo induces the placebo effect, which is proven to boost endurance performance as there is a boost mentally (Ross R et al, 2015). Hence, for the juices to be deemed truly effective, they need to have better the results from the control to prove that they not only give a mental boost, but actually physically boost the body as well.

[3] Refer to [1] (previous page)
[4] Studies that ran the test 2.5-3h post consumption
[5] Studies that had a 7-10 day washout period

Solution Design

Boys (n=18) and girls (n=2) aged from 14 to 18 years with no history of heart or lung disease from Hwa Chong Institution volunteered to take part in the study.

The participants underwent 3 MSFTs in 3 consecutive weeks, on the exact same day and time during each week of testing. Each MSFT was separated by a 7-day washout period. In each of the 3 MSFTs, the participants drank 500ml of either water (the placebo and control), pure beetroot juice or pure pomegranate juice exactly 3 hours before their stipulated test times. The order of the juices they drank before each trial was randomized. They were also advised to keep their daily routine (i.e. the amount of water they drink, the food they eat, etc.) as similar as possible throughout the 3 weeks of testing. For the plain water (placebo and control) that they drank, they were informed it was a special type of water that could boost performance to allow the placebo effect to take place. The location of testing was sheltered to prevent different weather conditions from affecting performance. Participants were also informed of the rules of the MSFT at least 2 days before their first MSFT to ensure that the results will not be affected by the participants' lack of knowledge of the MSFT rules. This study followed all rules of the MSFT when recording the results.

The distance between starting and ending lines (20m) was measured with a measuring tape. marked out by a long piece of duct tape (approx 8m) and a plastic bottle at each end of the duct tape. When the participants arrived at the venue, a test MSFT audio was played by a wireless bluetooth speaker to ensure that all participants were able to hear the audio clearly. The rules of the MSFT were read out to the participants as a reminder. When the participants were ready, the audio for the MSFT was played, and the MSFT started. Thereafter, the results of the participants were recorded down.

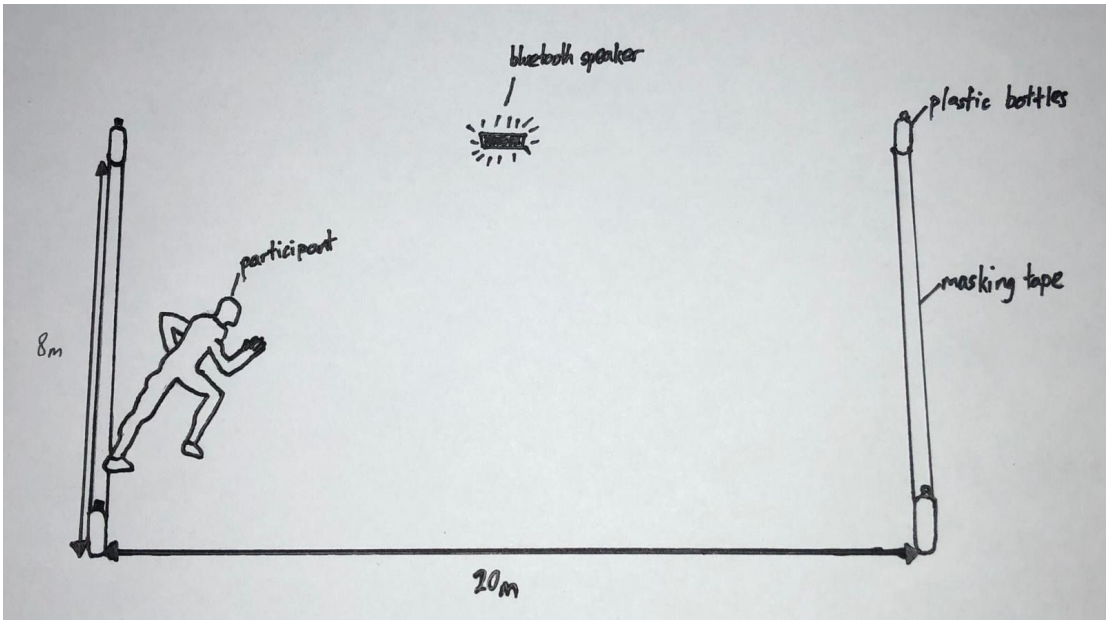

Fig 1: Set-up of the MSFT (as described below)

Participants who had at least one foot on the pieces of duct tape when the beep sounded passed the level. Participants who did not have their foot on the duct tape after the beep sounded were recorded as having missed the level. Final results were recorded as the last level the participant managed to hit before missing two beeps in a row or pulling out of the beep test by choice.

Results and Discussion[6]

The MSFT results ranged from stages 4.1 to 10.4 for the control (placebo, plain water) MSFT, stages 4.2 to 11.6 for the MSFT which beetroot juice was consumed beforehand, and stages 4.3 to 10.9 for the MSFT which pomegranate juice was consumed beforehand. However, there is a significant mean improvement of 5.10 (±6.50[7]) sub-levels (ie no. of 20m repetitions) when beetroot juice was consumed beforehand, and an even greater mean improvement of 9.65 (±7.71) sub-levels when pomegranate juice was consumed beforehand.

[6] All results are in 2 d.p.
[7] ±SD (Standard Deviation)

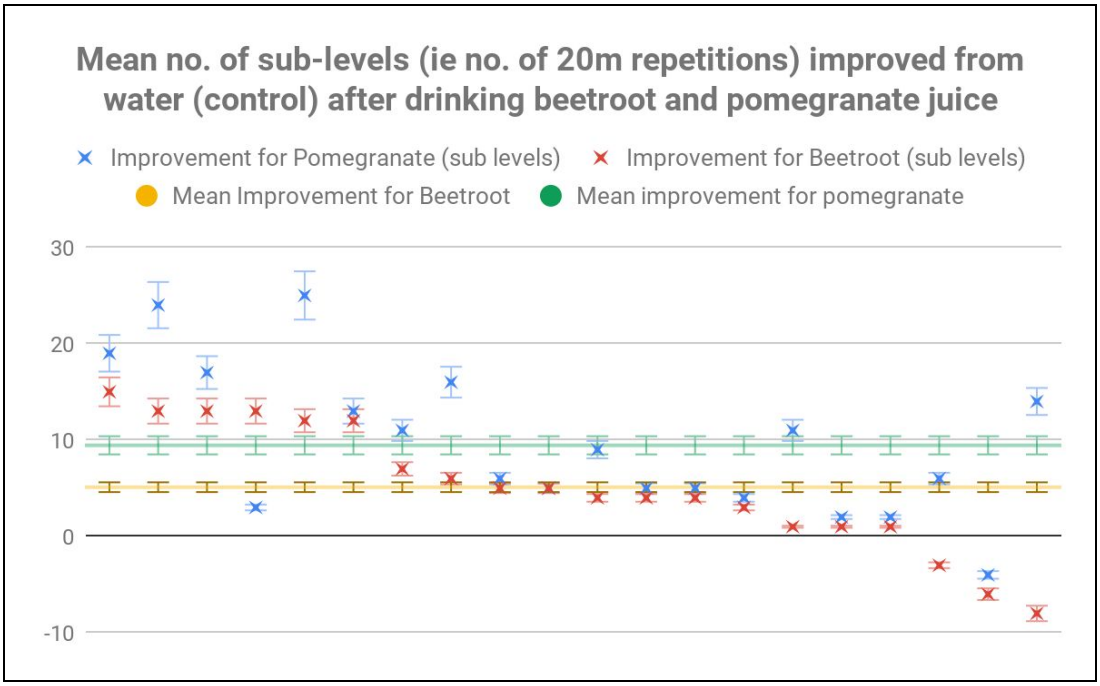

Fig 2: Chart of mean improvement of sub-levels for both juices in MSFT from control test

The MSFT results ranged from stages 4.1 to 10.4 for the control (placebo, plain water) MSFT, stages 4.2 to 11.6 for the MSFT which beetroot juice was consumed beforehand, and stages 4.3 to 10.9 for the MSFT which pomegranate juice was consumed beforehand. However, there is a significant mean improvement of 5.10 (±6.50) sub-levels (ie no. of 20m repetitions) when beetroot juice was consumed beforehand, and an even greater mean improvement of 9.65 (±7.71) sub-levels when pomegranate juice was consumed beforehand.

All the MSFT results were then converted to its VO2 Max (ml/kg/min) equivalent using the Ramsbottom Equation (Ramsbottom R et al, 1988). Throughout all the tests, the predicted VO2 Max ranged from 26.4ml/kg/min to 52.0ml/kg/min. The mean VO2 Max from the placebo test was 36.99ml/kg/min (±6.18), 38.89ml/kg/min (±6.12) for the beetroot test and 40.15ml/kg/min (±5.88) for the pomegranate test. The mean improvement of VO2 Max for the beetroot test from the placebo test is significant, standing in at 1.90ml/kg/min (±2.04). However, the mean improvement of VO2 Max for the pomegranate test from the placebo test is even greater, at 3.16ml/kg/min (±2.39).

These results prove that both juices are effective at enhancing cardiovascular endurance and pomegranate juice is significantly more effective at enhancing cardiovascular endurance than beetroot juice.

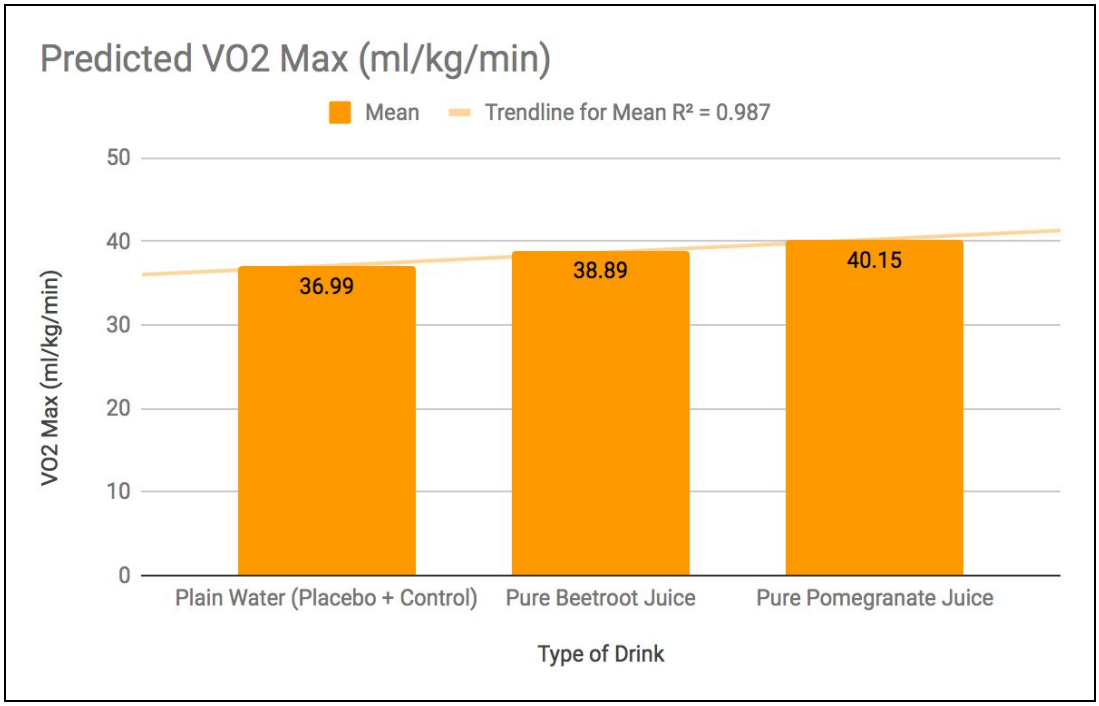

Fig 3: Chart of predicted VO2 Max (ml/kg/min) for all 3 tests calculated using the Ramsbottom equation

These results support other studies done which proves that beetroot juice and pomegranate juice consumption can enhance cardiovascular endurance during exercise. It also suggests that pomegranate juice consumption is more effective at enhancing cardiovascular endurance during exercise as compared to beetroot juice, solving the problem this study wanted to address.

It is still unclear why pomegranate juice is more effective than beetroot juice at enhancing cardiovascular endurance. However, it seems like pomegranate's ability to protect NO from oxidative destruction in the human body is more effective in enhancing cardiovascular endure than beetroot's ability to raise the amount of NO in the human body.

Conclusion

Implications

As both pure pomegranate juice and pure beetroot juice tests significantly outperformed the placebo test, they were proven to be effective at enhancing cardiovascular endurance. However, pomegranate juice is proven to be significantly more effective than beetroot juice at enhancing cardiovascular activity and therefore it is recommended that people seeking to improve their results in endurance-related competitions like Cross-Country and tests like the NAPFA 1.6km/2.4km Walk-Run Test take 500ml of pomegranate juice 3 hours before participating. Although these findings have not been confirmed in elite athletes and different modes of exercise other than running, these results have obvious implications for food and nutrition practitioners in the field of sports nutrition and athletes, as they can consider the results of this study and build on it in future studies. Also, researchers can seek to find out why and how pomegranate's ability to protect NO from oxidative destruction in the human body is more effective in enhancing cardiovascular endure than beetroot's ability to raise the amount of NO in the human body (if even true).

Limitations & Future Research

However, there are some limitations to this study. Firstly, the participants were mostly 14 year-old males (n=16), hence the results may not apply to people of different ages and gender. The sample size was also small (n=20). A greater sample size will make the results more conclusive. The results also may not apply to people of different fitness levels (differing VO2 Max). Furthermore, the participants may not have strictly adhered to consuming the same food and drinks in the same portion/volume on all three days of testing. This may affect the findings. Finally, as the test did not track the heart rate of the participants, there is no way of knowing whether the participants pushed themselves. If some participants didn't push themselves, it will affect the findings.

Further studies can be conducted to find out why and how pomegranate juice is more effective than beetroot juice in enhancing endurance performance during exercise, if it is actually due to the differences in effects. Future research can also have a larger sample size of with varied types of participants (varying fitness levels, gender, age, etc.). A different tasting placebo can be used, while diet, heart rate and other dependent variables can be more strictly controlled.

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