THE EFFECTS OF MONTMORENCY TART CHERRY JUICE SUPPLEMENTATION AND FATMAX EXERCISE ON CARDIO-METABOLIC MARKERS IN HEALTHY HUMANS

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Introduction

The current global status of cardio-metabolic health paints a dull picture, cardiovascular disease, type 2 diabetes and associated diseases combined are the leading health burden and cause of mortality worldwide (Guo and Ling, 2015), therefore the necessity for an intervention is paramount.

Dietary interventions rich in polyphenols, in particular anthocyanins, have been reported to reduce the risk of cardiovascular disease and improve metabolic function in rodents and humans by augmenting fat oxidation and modulating cellular and molecular cascades (Reis *et al*., 2016). A recent epidemiological study highlighted a significant correlation with anthocyanin consumption and long-term weight management (Bertoia *et al*., 2016).

Tart cherries (*Prunus cerasus*) possess a greater phenolic content compared to most foods at habitual portions and are rich in anthocyanins (Fig 1) thus possess potent antioxidative properties. Tart cherry supplementation in rodents reduced symptoms associated with Metabolic Syndrome including, percentage fat mass, abdominal fat weight, hyperinsulinaemia, fasting blood glucose, hyperlipidaemia and inflammation due to modulation of PPAR signalling pathways (Seymour *et al*., 2008; 2009). Certain polyphenols have been classified as calorie restrictive mimetics (CRM) (Madeo *et al.,* 2014), thus tart cherries may fall into this bracket based on the responses observed in rodents. Therefore these responses may be replicated in humans when combined with exercise, but have not been examined until now. FATMAX exercise (intensity eliciting maximal fat oxidation rate) has been suggested as the best form of exercise to reduce HbA1c, blood glucose, fat mass and total cholesterol (Brun, Romain and Mercier, 2011).

Aims and Hypothesis

- The first study to examine whether Montmorency Tart Cherry Juice (MTCJ) supplementation with exercise could improve cardio-metabolic function. Therefore recruited healthy participants to assess for any adverse effects.
- To evaluate whether MTCJ acts as a CRM.

Hypothesised that MTCJ supplementation with FATMAX exercise would augment fat oxidation rates at rest and during exercise, whilst also improving body composition, functional and in sera cardio-metabolic markers.

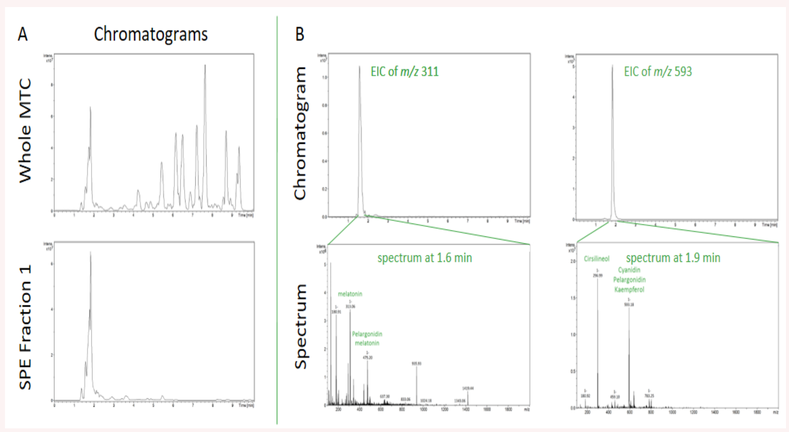

Figure 1. (A) HPLC analysis of Cherry concentrate and most polar fraction from solid phase extraction. (B) Extracted ion chromatogram. Putatively identified a number of peaks as being anthocyanins or other flavonoids. Provided by Dr. Samantha Hughes and Karin Struijs, HAN BioCentre, Nijmegen, Netherlands.

Methods

- 11 recreationally active, male and female participants (age 30.91 ±10.14 years. height 1.76 ±0.09 m, body mass 76.42 ±13.19 kg, $\dot{V}O_2$peak 35.87 ±4.78 mL.kg.min^{-1}).
- Random counterbalanced, within-group, single-blind study design.
- MTCJ v/s Placebo – (130ml twice daily for 20 days with 14 day washout between trials).
- Habitual Diet (no polyphenol restrictions).
- 6 sessions per trial (Fig 2).
- Fat Oxidation, CHO Oxidation, EE, RER, HR and RPE measured during 1hr FATMAX exercise.
- Body Composition, BP, HR, RMR, Glucose, Lactate, Triglycerides, HDL, LDL, Total Cholesterol, Total Antioxidant Status measured pre-post 1hr exercise.
- Substrate oxidation and energy expenditure calculated using stoichiometric equations (Jeukendrup and Wallis, 2005).
- A within-group two-way (time x condition) repeated-measures ANOVA with post-hoc Bonferroni's adjustment, measured differences between conditions, time and interactions.

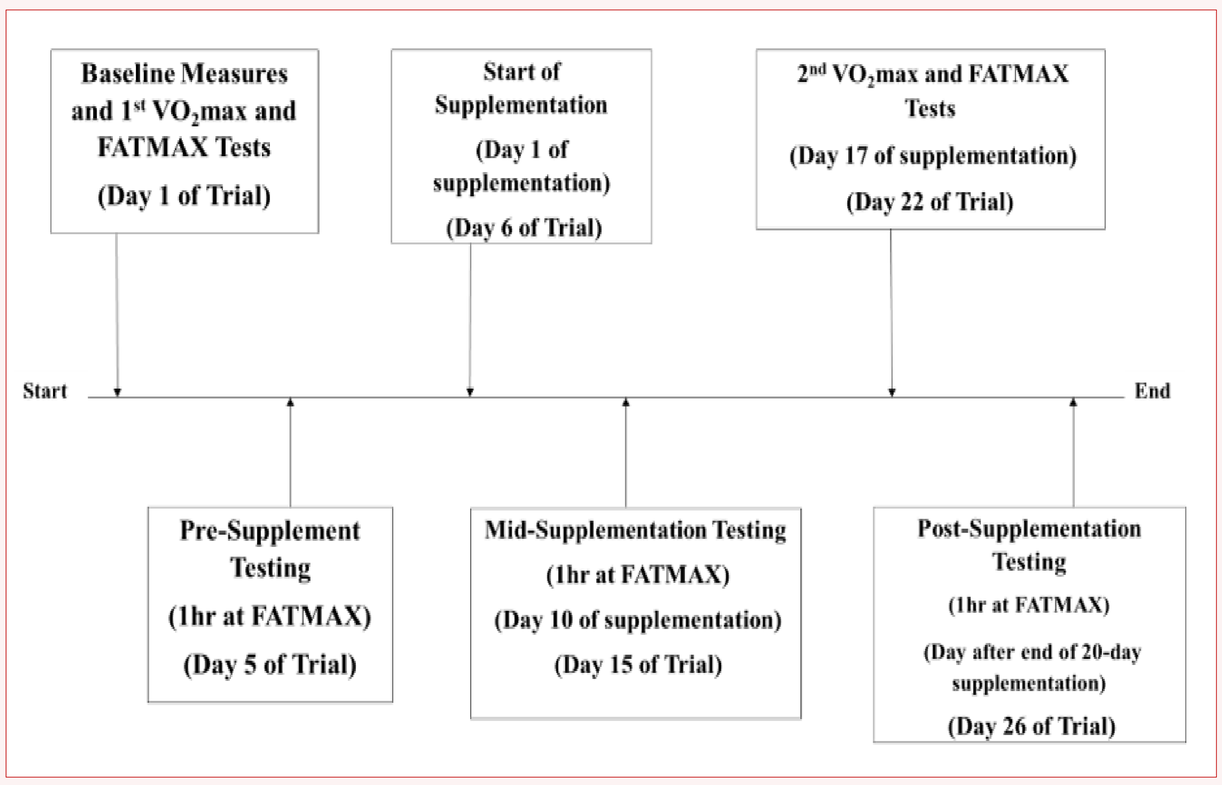

Figure 2. Schematic of testing protocol.

Results

No significant interactions or differences between conditions or supplementation for fat (Fig 3) and carbohydrate oxidation rates during exercise and rest (Table 1), BP, waist circumference, body composition or any blood-based cardio-metabolic markers (*P*>0.05) (Table 2).

RER at FATMAX was significantly greater (*P*=0.02) during the second test with MTCJ compared to PLA. Change in resting EE from mid- to post-supplementation was significantly different between conditions (*P*=0.03) where MTCJ increased by 98.49 ±213.03 kJ.day^{-1} and PLA decreased by 120.39 ±289.14 kJ.day^{-1}, suggesting different responses between conditions during days 10-20 of supplementation. This is likely due to the high CHO content within MTCJ, thus promoting glycolytic flux.

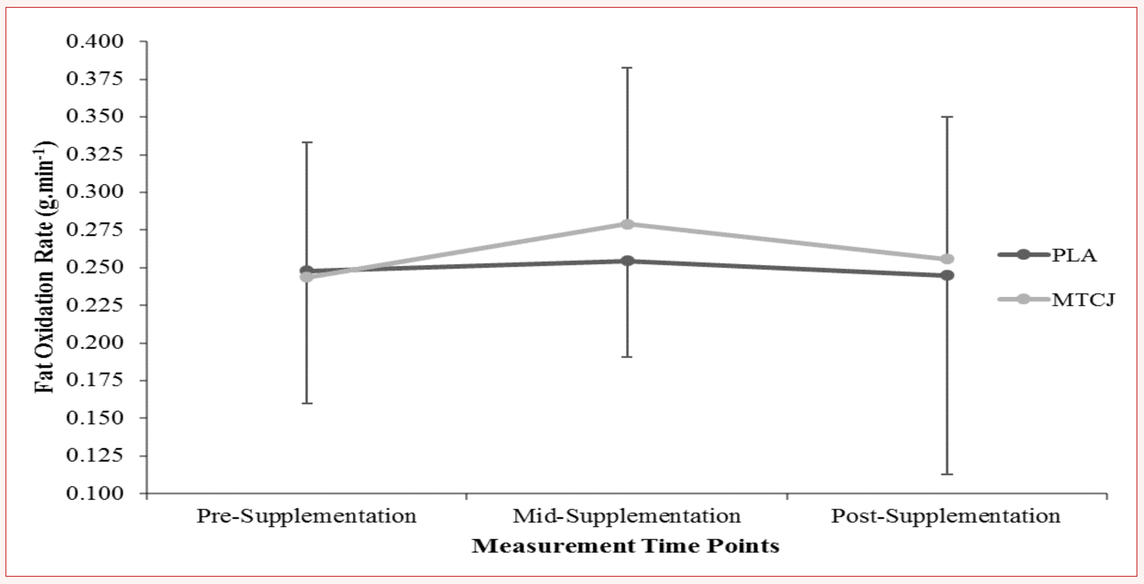

Figure 3. Mean (±SD) fat oxidation rates measured during final 50 minutes exercise at individual FATMAX for PLA and MTCJ.

Significantly lower TAS post-supplementation compared to mid-supplementation (*P*=0.04) (Fig 4). Similarly, pre-exercise HDL significantly reduced from mid-supplementation to post-supplementation with MTCJ (*P*=0.01) whereas no difference was found for PLA (*P*=0.49), suggesting MTCJ was ineffective at maintaining or increasing HDL concentrations after 10 days of supplementation (Fig 5).

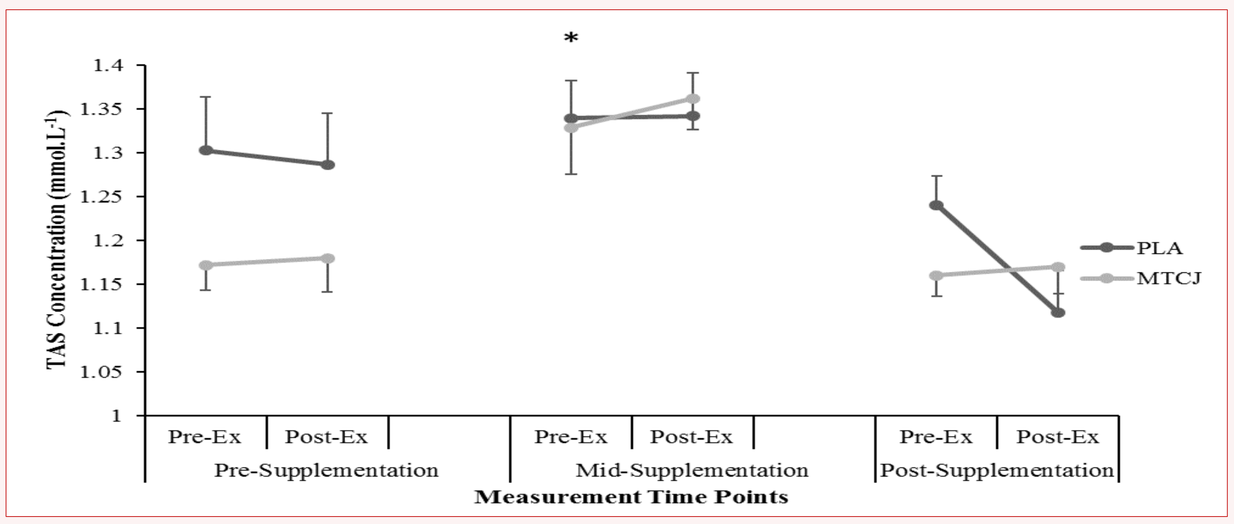

Figure 4. Mean (±SD) TAS concentrations presented at all measured time points for PLA and MTCJ. *Denotes significant difference between corresponding time point during post-supplementation for MTCJ.

Table 1. Mean (±SD) for fat and carbohydrate oxidation rates measured at rest and during exercise.

		Pre-Supplementation	Mid-Supplementation	Post-Supplementation
Exercise Fat Oxidation (g.min^{-1})	PLA	0.25 ± 0.09	0.26 ± 0.06	0.25 ± 0.13
	MTCJ	0.24 ± 0.09	0.28 ± 0.1	0.26 ± 0.09
Exercise CHO Oxidation (g.min^{-1})	PLA	0.85 ± 0.33	0.84 ± 0.27	0.89 ± 0.25
	MTCJ	0.98 ± 0.25	0.88 ± 0.29	0.99 ± 0.19
Resting Fat Oxidation (g.min^{-1})	PLA	0.08 ± 0.03	0.07 ± 0.02	0.07 ± 0.03
	MTCJ	0.07 ± 0.02	0.08 ± 0.03	0.08 ± 0.02
Resting CHO Oxidation (g.min^{-1})	PLA	0.14 ± 0.03	0.15 ± 0.05	0.15 ± 0.06
	MTCJ	0.16 ± 0.05	0.14 ± 0.05	0.17 ± 0.06

Table 2. Mean (±SD) for selected cardio-metabolic variables measured before and after 1 hour exercise at FATMAX.

		Pre-Supplementation		Mid-Supplementation		Post-Supplementation	
		Pre-Exercise	Post-Exercise	Pre-Exercise	Post-Exercise	Pre-Exercise	Post-Exercise
SBP (mmHg)	PLA	116.85±15.59	115.42±10.02	114.58±12.80	121.24±17.55	115.58±11.03	114.30±11.50
	MTCJ	117.64±11.78	121.27±13.49	119.48±11.20	117.06±11.93	117.02±11.73	115.73±12.41
DBP (mmHg)	PLA	72.82±9.54	73.15±6.62	72.33±10.48	75.39±8.63	72.45±8.14	72.15±10.38
	MTCJ	73.55±9.72	75.21±9.67	71.61±8.88	75.36±8.15	72.39±9.51	74.27±7.46
Whole-body Fat (%)	PLA	21.91±10.48		21.14±10.45		21.37±10.05	
	MTCJ	20.41±10.05		21.23±10.5		21.47±10.43	
Glucose (mmol.L^{-1})	PLA	5.15±0.56	5.47±0.77	5.01±0.57	5.33±0.7	5.13±0.86	5.52±0.65
	MTCJ	5.22±0.86	5.33±0.52	5.21±0.73	5.39±0.56	5.07±0.68	5.24±0.82
Triglycerides (mmol.L^{-1})	PLA	0.48±0.02	0.5±0.02	0.67±0.11	0.65±0.1	0.54±0.01	0.55±0.04
	MTCJ	0.6±0.02	0.55±0.05	0.58±0.06	0.61±0.08	0.74±0.02	0.61±0.01
HDL (mmol.L^{-1})	PLA	1.68±0.07	1.69±0.07	1.69±0.05	1.76±0.12	1.65±0.05*	1.56±0.13
	MTCJ	1.7±0.08	1.68±0.1	1.84±0.19	1.77±0.05	1.56±0.05	1.55±0.08

Conclusion

Twenty days of MTCJ supplementation did not significantly increase fat oxidation rates at rest or during FATMAX exercise, nor did it alter waist circumference, body composition or change cardio-metabolic biomarkers compared to PLA, thus rejecting the CRM role of MTCJ in healthy subjects. Consequently, it is unnecessary for healthy participants to supplement MTCJ to reduce body fat and improve both functional and blood-based cardio-metabolic markers associated with MetS. Significant effects of tart cherry supplementation on cardio-metabolic function in animals and humans only occurred when initial values were abnormal, thus further research is warranted in pathological populations. A possible mechanism of action may be via epigenetic changes. Results were likely confounded by the high carbohydrate content of MTCJ., thus capsules may be a suitable alternative. Any effect of anthocyanin supplementation on fat oxidation seems to be short-term thus providing a rationale to incorporate acute supplementation of Montmorency tart cherry anthocyanins in future studies.

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Acknowledgments

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