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Small daily doses of orange heirloom tomatoes (Moonglow) dose-dependently increase plasma and liver lycopene concentrations in rats

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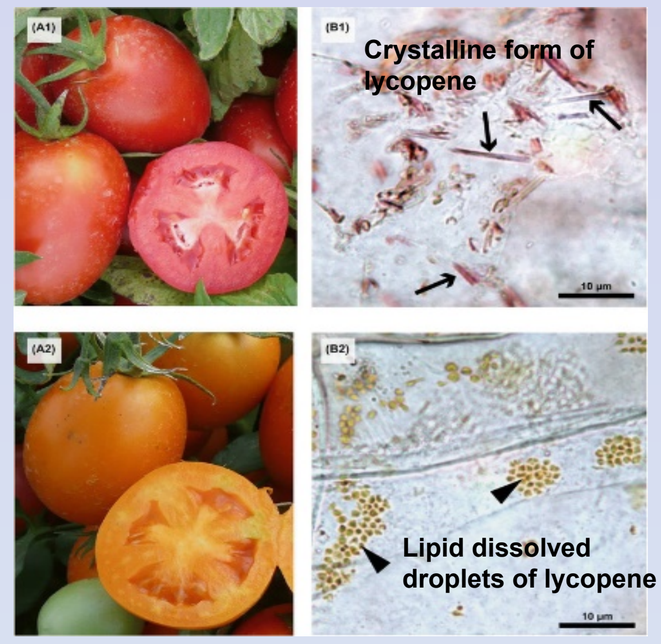
Background

Cis-isomers of lycopene have been reported to be more bioavailable than all-trans-lycopene. However, lycopene in red tomatoes is primarily found in its all-trans isomeric form. In raw tomatoes, the all-trans form of lycopene tends to occur in a crystalline state and an adult human would need to consume unreasonably high amounts of red tomatoes to generate physiologically beneficial plasma lycopene concentrations (>0.2 µmol/L). 'Moonglow', an orange heirloom tomato, is said to be a good source of cis-lycopene isomers (tetra-cis + other-cis isomers). Therefore we hypothesized that the consumption of smaller daily doses of 'Moonglow' tomatoes could produce the levels of lycopene in plasma of rats that have been reported to be associated with a reduction in some cancers, cardiovascular disease and osteoporosis.



(Cooperstone *et al.*, 2015)

Objective

To evaluate dose-dependent and time-course appearance of lycopene in plasma and liver after consumption of 'Moonglow' tomatoes by rats.

Material and methods

Female Sprague-Dawley rats (9 week old; n=12) were fed a small treat of honey + peanut butter + freeze-dried 'Moonglow' tomato powder containing total lycopene at 0 (control), 0.05 (low dose), 0.35 (medium dose) or 2.6 (high dose) mg/kg body weight (BW) once daily for 1 – 6 days. These doses would equate to an adult human eating 0 g, 3 g, 25 g and 180 g of Moonglow tomatoes per day, respectively. Plasma and liver samples were tested for total and cis/trans isomers of lycopene using ultra-high performance liquid chromatography (uHPLC).

Results

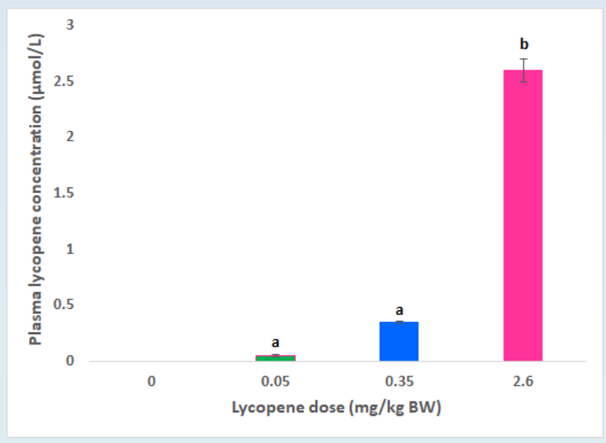


Figure 1: Dose-dependent effect of 'Moonglow' tomato on total lycopene concentration in plasma after 6 days.

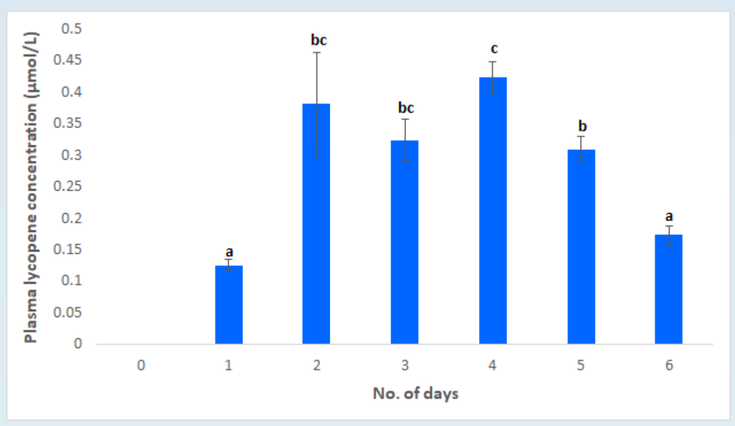


Figure 2: Kinetic effect of medium dose (0.35 mg/kg BW) 'Moonglow' tomato on total lycopene concentration in plasma daily over a 6-day period.

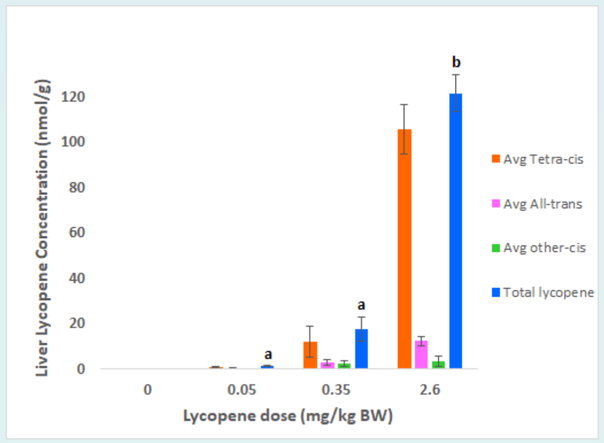


Figure 3: Dose-dependent effect on final concentration of total and individual isomers of lycopene in liver of rats fed 'Moonglow' daily over a 6-day period.

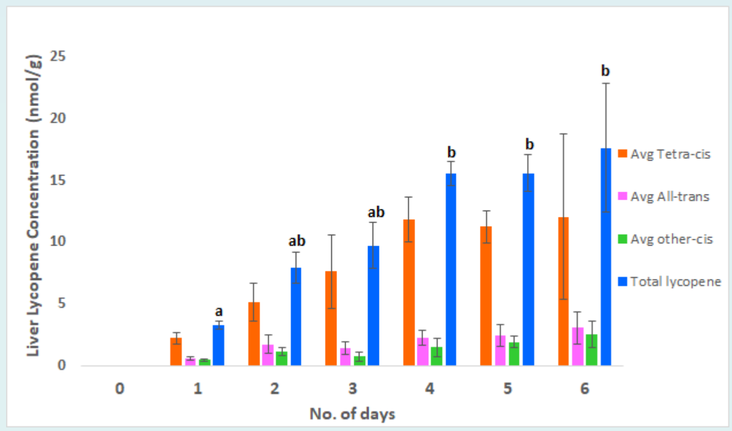


Figure 4: Kinetics of total and isomeric lycopene accumulation in liver of rats fed a medium dose (0.35 mg/kg BW) of 'Moonglow' tomato daily over a 6-day period.

In all four graphs, data shown as mean ± SE (N=3). Bars with a different letters (a, b) are significantly different ($P < 0.05$) as determined by one way ANOVA and post hoc Tukey test.

Discussion

The medium dose (0.35 mg/kg BW) resulted in a peak plasma concentration of 0.42 µmol/L after four days of feeding, which is similar to the reported physiological beneficial concentration in humans (Rao *et al.,* 2007).

By comparison, matching studies in which all-trans lycopene from red tomatoes was fed to rats required a dose of 25 mg/kg BW over a 1 – 6 week period to achieve a similar plasma concentration. This would equates to a human eating approximately 1.6 kg red tomatoes per day (Zaripheh *et al.*, 2003; Zaripheh & Erdman, 2005).

Conclusions

In conclusion, these findings show that the lycopene from 'Moonglow' tomatoes is significantly more bioavailable than the reported bioavailability from red tomatoes, and that consumption of 'Moonglow' by humans to achieve a physiologically beneficial plasma concentration should be feasible with a small, reasonable intake of tomatoes.

References

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