

Project Concluded: Final Report
Potential Human Perchlorate Exposures from Citrus Irrigated with Contaminated Water

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Citrus produced in the southwestern United States is often irrigated with perchlorate-contaminated water. Irrigation water may include Colorado River water and ground water from wells in Riverside and San Bernardino counties. Uptake and distribution of perchlorate in citrus irrigated with contaminated water were used to estimate potential human exposures from lemon (*Citrus limon*), grapefruit (*Citrus paradise*), and orange (*Citrus sinensis*). Perchlorate concentrations ranged from less than 2 to 9 $\mu\text{g/L}$ for Colorado River water and from below detection to approximately 18 $\mu\text{g/L}$ for water samples from wells not in commerce.

Destructive sampling of lemon trees produced with Colorado River water show perchlorate concentrations larger in the leaves (1835 $\mu\text{g/kg}$ dry weight (dw)) followed by the fruit (128 $\mu\text{g/kg}$ dw). Leaves may be a useful means of sampling the perchlorate exposure potential. Mean perchlorate concentrations in roots, trunk, and branches were all less than 30 $\mu\text{g/kg}$ dw.



Fruit pulp contained perchlorate from below detection limits to 38 µg/kg fresh weight (fw), related to the perchlorate concentration of irrigation water. Potential exposures (µg/person/day) of children and adults from lemons (0.005 and 0.009), grapefruit (0.03 and 0.23), and oranges (0.51 and 1.20) were estimated. In much larger amounts, perchlorate has the potential to alter thyroid function of men, women, and children.

In conclusion, the study showed virtually no harmful potential of perchlorate exposures of from citrus in the southwestern United States in accord with the reference dose (no observed adverse effect level; NOAEL, µg/kg person-day) of the National Academy of Sciences. Estimated dosages for a reference 70 kg adult from oranges would be 0.02 µg/kg bw which is less than 5% of the reference dose of 0.7 µg/kg recommended by the National Academy of Sciences (NAS).

A complete manuscript has been prepared for publication and can be used for formal risk assessment.

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