THE AMOUNTS OF LIMONENE FROM DIFFERENT SPECIES OF ORANGES

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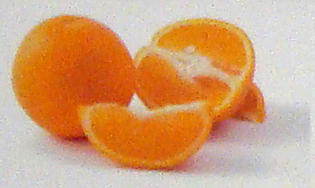
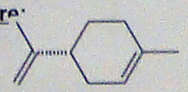


ABSTRACT
The purpose of this study was to explore whether the concentration of limonene on orange peels is affected by the species of the oranges. Extraction of limonene from oranges sampled with the respect to species was achieved via refluxing of the well-divided orange peels in hexane and the amounts of limonene from the crude extract determined using gas chromatographic technique (GC). This study (ongoing) will offer insights as to how the species of oranges affect the amount of limonene on the orange peels.

BACKGROUND
Citrus production in the United States was 14.85 million metric tons (National Agricultural Statistics Service), with about a third of that being used for juice production which yields approximately 4-5 billion pounds of peels as a byproduct. Many of the constituents found within these peels have an industrial purpose, specifically in this research, limonene.

Limonene structure:



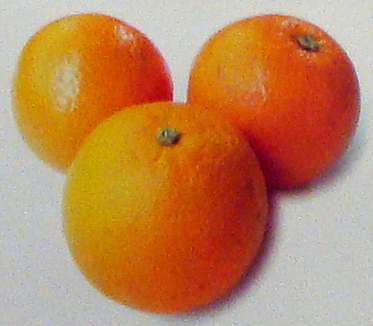
Practical Uses of Limonene:
Limonene is a highly useful organic compound, used in industrial purposes for its quality as a safe organic solvent. Limonene is also responsible for the citrus smell from oranges and many other citrus fruit, which means its highly valuable in the perfume industry. Other uses of limonene include using limonene as a starting material for the synthesis of carvone. Other uses include, biological pesticide, household cleaning solvents, medicinal uses, and its use in cosmetic products.

HYPOTHESIS
By isolating the extract from various orange peels and then analyzing it by GC, it will be possible to determine if breed of oranges plays an important part in how much limonene can be found in specific oranges.

PROCEDURE
-Prepare orange peels, by peeling oranges and then separating as much of the white flesh from the rind leaving only the colored rind part.
-Place 50g of orange rind into a round bottom flask with 100mL of hexane.
-Reflux the orange rind and hexane solution for 3 hours.
-Separate orange rinds from the extract product, by washing the orange rinds three times with hexane.
-Boil off excess hexane using a rotary evaporator at 85˚C.
-Analyze a fraction of the orange extract by GC to determine limonene percentage.
-Separate limonene from other orange extracts by using a silica gel column with a 1:1 THF and hexane solvent.
-Analyze the limonene extract by GC.

RESULTS

Orange Breed	Product Weight (g)	Percent of Orange	Percent of Product that is Limonene
93107	0.212	0.424%	3.29%
4381	0.152	0.304%	14.14%
4012	0.230	0.460%	10.21%
3107	0.489	0.978%	10.12%



SUMMARY
Based upon the results from the amount of limonene extracted from various species of oranges, it is possible to give the preliminary conclusion that species of oranges do play an important part in the amount of limonene from orange peels. Specifically that oranges designated from the 4381 contain the most limonene in the possible orange extract where as the 93107 breed contains the least limonene out of the four tested breeds.

FUTURE WORK
Future research into limonene would entail possible variations of geographical region, and how that affects the amount of limonene that is possible to be extracted from those oranges. As well as additional study into whether specific growing seasons play an effect into the amount of limonene that can be extracted from an orange.

ACKNOWLEDGEMENT
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