

# MAKE YOUR OWN ORANGE DRINK

## AN EXPERIMENT IN DETERMINING HOW ADDITIVES AFFECT OUR FOOD

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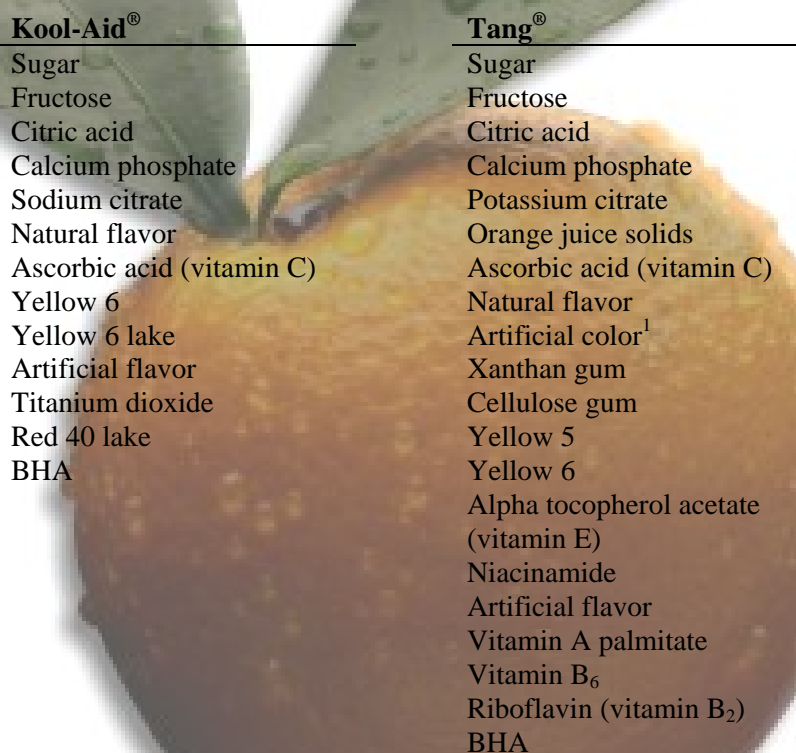
### Introduction

Artificial citrus and fruit drinks are readily available in grocery stores and supermarkets in powdered or liquid form. Some drinks are made from juice concentrates with added flavorings, colors, vitamins and minerals. Others are sold in the form of powdered drink mixes.

Two common fruit drink mixes are Kool-Aid® and Tang®. The Kool-aid® is a sugar-sweetened soft drink mix that has been traditionally aimed at youngsters, while the Tang® was originally marketed as an instant breakfast drink and touted as the drink that was developed for astronauts.

For this reason, the Tang® is fortified with a number of vitamins.

Both drink mixes contain similar basic ingredients, as listed in Table 1.



<u>Kool-Aid®</u>	<u>Tang®</u>
Sugar	Sugar
Fructose	Fructose
Citric acid	Citric acid
Calcium phosphate	Calcium phosphate
Sodium citrate	Potassium citrate
Natural flavor	Orange juice solids
Ascorbic acid (vitamin C)	Ascorbic acid (vitamin C)
Yellow 6	Natural flavor
Yellow 6 lake	Artificial color <sup>1</sup>
Artificial flavor	Xanthan gum
Titanium dioxide	Cellulose gum
Red 40 lake	Yellow 5
BHA	Yellow 6
	Alpha tocopherol acetate (vitamin E)
	Niacinamide
	Artificial flavor
	Vitamin A palmitate
	Vitamin B <sub>6</sub>
	Riboflavin (vitamin B <sub>2</sub> )
	BHA

**Table 1.** Ingredients in Kool-Aid® and Tang® orange flavored drink mixes, in order of decreasing quantity.

<sup>1</sup> Titanium dioxide, which is classified as an artificial color

Due to the different intended uses of the two drinks, there are differences in the nutritional values of the two drinks: (see Table 2)

	<b>Kool-Aid®</b>	<b>Tang™</b>
Serving size	8 fl oz (17 g)	2 tsp. (25 g)
Calories	60	90
Total fat	0 g	0 g
Sodium	5 mg	0 mg
Total carbohydrates	16 g	23g
Sugars	16 g	23g
Protein	0 g	0 g
Vitamin A		10%
Vitamin C	10%	100%
Calcium		8%
Vitamin E		10%
Riboflavin		10%
Niacin		10%
Vitamin B <sub>6</sub>		10%

**Table 2.** Nutritional values of Kool-Aid® and Tang™. Vitamin and mineral values are reported as percent daily values based on a 2,000 calorie diet.

Using the list of ingredients and nutritional information on the labels, a formulation of an orange-flavored drink can be prepared using readily available ingredients. (See Table 3)

<u>Home-Made Drink Ingredient</u>	<u>Quantity</u>	<u>Source</u>
Sugar (sucrose)	1 Tbs. (12 g)	Supermarket
Fructose	½ Tbs. (7 g)	Natural food store
Citric acid	¼ tsp. (1 g)	Supermarket or pharmacy
Potassium citrate (or sodium citrate)	1/3 of 1/8 tsp. (0.023 g)	Pharmacy, natural food store, or chemical supply co.
Orange extract	¾ tsp. (4 mL)	Supermarket
Ascorbic acid (Vitamin C)	¼ of 1/8 tsp. (0.08 g)	Natural food store or pharmacy
Yellow 5	2 drops	Supermarket
Red 40	1 drop	Supermarket

**Table 3.** Ingredients and quantities used to prepare 8 ounces (250 mL) of orange-flavored drink. Sources of ingredients are also listed. (All substances are U.S.P. grade or better. To prepare larger quantities of drinks multiply quantities by number of 8 ounce servings being prepared.)

## Object

The object of this investigation is to learn about the ingredients used to prepare an artificial drink mix and to determine the function of each major ingredient.

## Materials Needed

### Chemicals Needed:

Sucrose (cane sugar),  $C_{12}H_{22}O_{11}$

Fructose (fruit sugar),  $C_6H_{12}O_6$

Citric acid,  $CO_2HCH_2COH(CO_2H)CH_2CO_2H$

Potassium citrate (or sodium citrate),  $C_6H_5K_3O_7$

Ascorbic acid (vitamin C),  $C_6H_8O_6$

Orange extract

Yellow 5 (bright yellow food color). Available in sets of food colors in the supermarket.

Red 40 (red food color). Available in sets of food colors in the supermarket.

### Materials Needed:

10 pitchers, plastic or glass, with lids

measuring spoons

stirring rods or wood or large plastic spoons

paper cups, 3 ounce

permanent marker

## Safety

Safety glasses or goggles must be worn to protect the eyes from any splashes.

All materials used in this experiment must be reserved for food use only and cannot be used for any other purpose. These materials must be cleaned in an area that is free from any possible contamination from laboratory chemicals. After the experiment, materials must be stored in an area that is free from laboratory chemical contamination.

If this experiment is performed in a chemistry laboratory, all work surfaces must be cleaned and free from laboratory chemicals. After cleaning the work surfaces, it is advised to cover all work areas with aluminum foil or a food-grade paper covering.

If this experiment is performed as a classroom activity, all work surfaces must be cleaned and free from any contamination. After cleaning, it is advised to cover all work areas with aluminum foil or a food-grade paper covering.

There are no safety hazards associated with the materials used in this experiment.

## Disposal

All waste materials can be disposed in the trash or poured down the drain with running water.

## Procedure

This experiment should be performed as a class activity.

Wash all work surfaces with soapy water and dry them using clean paper towels before starting this experiment.

Cover the work area with aluminum foil or clean food-grade paper.

Prepare the following solutions in separate pitchers:

Kool-Aid<sup>®</sup>: Prepare according to label directions. Calculate a quantity of approximately 2 fl. oz. per person

Tang<sup>™</sup>: Prepare according to label directions. Calculate a quantity of approximately 2 fl. oz. per person

Sucrose (sugar): 1 Tbs. (12 g) for each 8 fl oz. Calculate a quantity of 1 fl oz per person.

Fructose: 1 Tbs. (14 g) for each 8 fl oz. Calculate a quantity of 1 fl oz per person. (Note: This concentration is twice that used in the orange drinks, but approximately the same as the sucrose solution. This is to allow a comparison of sweetness between the two sugars.

Citric acid:  $\frac{1}{4}$  tsp. (1 g) for each 8 fl oz. Calculate a quantity of 1 fl oz per person.

Citric acid-potassium citrate:  $\frac{1}{4}$  tsp. (1 g) citric acid and  $\frac{1}{3}$  of  $\frac{1}{8}$  tsp (0.023 g) of potassium citrate for each 8 fl oz. Calculate a quantity of 1 fl oz per person.

Ascorbic acid:  $\frac{1}{4}$  of  $\frac{1}{8}$  tsp. (0.08 g) for each 8 fl oz. Calculate a quantity of 1 fl oz per person.

Orange extract:  $\frac{3}{4}$  tsp. (4 mL) for each 8 fl oz. Calculate a quantity of 1 fl oz per person.

Home-made drink: prepare using quantities as listed in Table 3 for each 8 fl oz. Calculate a quantity of 2 fl oz per person.

Use a permanent marker to mark the paper cups to identify the solutions used. Suggested markings are *K* for Kool-Aid<sup>®</sup>, *T* for Tang<sup>™</sup>, *HM* for home-made drink, *S* for sucrose, *F* for fructose, *C* for citric acid, *CK* for citric acid-potassium citrate, *A* for ascorbic acid, and *O* for orange extract.

Obtain small quantities of the drink mixes and different ingredients. Use the data table to record your observations of the appearance and describe the taste of these materials. All solutions contain the same amount of that ingredient that would be found in a commercial drink mix except for the fructose solution which was made at approximately the same concentration as sucrose to allow for a comparison of sweetness between the sugars.

Take a small taste of Kool-Aid<sup>®</sup> and a small taste of Tang<sup>™</sup> to compare their flavors. Save some of these for a later comparison.

Taste the sucrose and fructose solutions. How do the tastes of these sugars compare?

Taste the citric acid and citric acid-potassium citrate solutions. Does the potassium citrate affect the taste of the citric acid?

Taste the ascorbic acid solution.

Taste the orange extract solution.

Taste the home-made orange drink. Compare it to the Kool-Aid<sup>®</sup> and Tang<sup>™</sup>.

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## Data Table

	<u>Color and appearance</u>	<u>Taste</u>
Kool-Aid®		
Tang™		
Sucrose (sugar)		
Fructose		
Citric acid		
Citric acid- potassium citrate		
Ascorbic acid (Vitamin C)		
Orange extract		
Home-made drink		

## Questions

1. Which drink did you prefer, Tang<sup>®</sup>, Kool-Aid<sup>™</sup>, or the home-made drink? Why?
2. What are the functions of the main ingredients (the ones we tasted) in the orange-flavored drinks?
3. What are the functions of the minor ingredients (omitting added vitamins) in the Kool-Aid<sup>®</sup> and Tang<sup>™</sup> ?
4. Why does Kool-Aid<sup>®</sup> only provide 10% of the Daily Values of Vitamin C per serving as opposed to Tang<sup>™</sup> containing 100% ?
5. Kool-Aid<sup>®</sup> contains calcium in the form of calcium phosphate (as does Tang<sup>™</sup> ), but it is not reported in the nutritional information on the label. Why not?

6. Survey your classmates (your food "tasters") as to their reactions to the home-made orange drink. How would you modify the home-made drink to achieve maximum product acceptance from your "tasters"?
  
7. Assuming that your product tasting tests are successful, develop a prototype of a label for your product's packaging and describe your marketing strategy for the product (i.e., how would you advertise it?)
  
8. Your marketing team suggests that you consider making a low-calorie version of your orange drink? Describe how you would modify your formulation to make a low-calorie orange drink?

#### **NOTES AND OPTIONAL PROJECTS**

1. Fructose has a relative sweetness of 173 as compared to sucrose at 100
2. As an extension project, formulate and test a low-calorie version of the orange drink using an artificial sweetener.
3. Try making other fruit flavored drinks using artificial and natural fruit flavors obtained from supermarkets or natural food stores.