

***EVALUATION OF SODIUM ACID SULFATE  
IN A MODEL CARBONATED BEVERAGE***

***A Report Prepared for Jones-Hamilton Co.***

***August 2002***

## **INTRODUCTION**

*Jones-Hamilton Co. wishes to explore the benefits of their acidulant, Sodium Acid Sulfate (SAS), in soft drink formulations. Eureka has undertaken to conduct an initial evaluation of the overall performance of this acid in a model carbonated beverage compared to citric acid, the most commonly employed acidulants in beverages, and report the findings accordingly.*

*A range finding exercise was conducted to establish the concentration of SAS required to produce a carbonated lemon flavored beverage @ a pH of 3.2 as a standard pH used by beverage manufacturers to ensure microbiological and keeping qualities in the final drink. A standard citric acidified formulation was used as the reference for this exercise.*

*Once an equivalent acid level was arrived at a range of equi-sweet drinks were produced sweetened with a number of sweetener systems. As this study was directed at the European market a number of sweetener combinations in common use in different territories within the European community were selected.*

*The following sweetener systems were compared at 9% sweetness equivalence:*

*Sucrose*

*Aspartame*

*Aspartame: Acesulfame K*

*Aspartame: Saccharin*

*The flavor profiles of citric acid and SAS acidified beverages were then compared. This report contains the details of the findings from this experimental program.*

## **RESULTS**

### **pH range finding**

*The following range of acid levels was evaluated. Levels expressed ready to drink.*

	<b>Reference</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<i>Citric</i>	<i>0.1400</i>	-	-	-	-	-	-
<i>SAS</i>	-	<i>0.0600</i>	<i>0.0800</i>	<i>0.1000</i>	<i>0.1200</i>	<i>0.1400</i>	<i>0.1600</i>
<i>Citrate</i>	<i>0.0400</i>	<i>0.0400</i>	<i>0.0400</i>	<i>0.0400</i>	<i>0.0400</i>	<i>0.0400</i>	<i>0.0400</i>
<b>pH</b>	<b>3.2</b>	<b>3.8</b>	<b>3.2</b>	<b>3.0</b>	<b>2.9</b>	<b>2.7</b>	<b>2.6</b>

*The level of 0.0800%w/v SAS gave a comparable pH to the citric acid reference and this was selected for further work.*

### **Sensory assessment of beverages**

*Sets of beverages acidified with citric acid and SAS were prepared with a number of different sweetener systems. A trained panel of Food Technologists then compared each of these sets of drinks. The tasters are skilled at generating descriptive terms to characterize the sensory properties of products.*

*The formulations used for this exercise are given in the appendix. A summary of the sweetener levels is given here with the acid levels. All intense sweetener formulations are formulated to be equi-sweet to the 9%w/v sucrose beverage.*

### **Sweetener systems**

#### **Sucrose**

*9% w/v*

*0.14%w/v citric compared to 08%w/v SAS*

*The 2 beverages compared very favorably and were considered equally acceptable but with distinctly different flavor characters. Both drinks had a good lemon flavor with a clean aftertaste. The SAS beverage had a slightly more acidic aftertaste and lemon sherbet style of flavor; the citric acid beverage had a zesty lemon flavor.*

## **Aspartame**

540ppm

0.14%w/v citric compared to 08%w/v SAS

*The citric acidified reference had a bright lemon flavor profile with a zesty lemon character. It had what is considered to be a characteristic aspartame flavor with the initial impact being slightly delayed and the aftertaste lingering and very sweet. The SAS acidified beverage had a softer overall character and was again described as having a lemon sherbet style flavor. It had a more syrupy mouthfeel and the aftertaste had a less lingering sweetness and left a clean freshness on the palate. This SAS acidified beverage was considered much preferred to the citric reference for mouthfeel and aftertaste.*

## **Aspartame: Acesulfame K**

Aspartame 135ppm with Acesulfame K 135ppm

0.14%w/v citric compared to 08%w/v SHS

*Both the drinks with this sweetener blend had a flatter flavor than the aspartame only sweetened beverage, as was expected. There was a slightly metallic, bitterness to the aftertaste and some lingering sweetness in the reference drink with citric acid and a zesty lemon flavor. The SAS sweetened beverage had a softer lemon sherbet style flavor profile with a fuller mouthfeel and an improved aftertaste with the bitter/astringent notes masked. This SAS acidified beverage was considered much preferred to the citric reference for mouthfeel and aftertaste.*

## **Aspartame: Saccharin**

Aspartame 160ppm with Saccharin 80ppm (as imide)

0.14%w/v citric compared to 08%w/v SHS

*The drinks with this sweetener blend had a slightly flatter flavor than the aspartame only sweetened beverage as was expected. The flavor of the citric acid reference had a zesty character. Its aftertaste had an aspirin note along with a bitterness and lingering sweetness. The SAS sweetened beverage had a less zesty flavor profile and a fuller mouthfeel and a much-improved aftertaste. The aftertaste was described as fresh and clean with the aspirin/bitter/ sweet flavors being masked. This SAS acidified beverage was considered much preferred to the citric reference for mouthfeel and aftertaste.*

## **CONCLUSIONS**

*SAS is considerably more effective than citric acid at reducing the pH of this type of beverage. The work conducted in this program suggests that 0.14% w/v citric acid can be replaced by 0.08% w/v SAS and produce the same pH in the final beverage. This indicates that there can be substantial cost savings by substituting SAS for citric acid.*

*SHS has also been shown to have a completely different acid flavor release and this generates a different sweetness and flavor profile in the final beverage.*

*The flavor profile of the SAS beverages was consistently described as softer and more sherbet lemon style compared to the zesty lemon flavor of the citric acidified beverage. The citric acid acidified beverage produced a flavor profile more in keeping with that expected of a lemon-flavored beverage.*

*The difference in the acid release profile appeared to affect the sweetness profiles when with intense sweetener systems. These all tend to have associated lingering aftertastes. Aspartame has a characteristic sweet lingering aftertaste, Acesulfame K a bitter metallic aftertaste and saccharin has an astringent, bitter, aspirin like aftertaste. The acid flavor release of SAS is more delayed compared to that of citric acid and this has a masking affect on the lingering notes of the intense sweeteners. This is of particular value to diet and sugar free beverage manufacturers.*

## **RECOMMENDATIONS**

*It is recommended that this information can be used to demonstrate the overall performance characteristics of SAS to beverage manufacturers.*

*The focus of presentations should be:*

- *Cost in use*
- *Difference in flavor profile*
- *Benefits to sweetness profile with intense sweeteners*

*It is clear from this evaluation that if a zesty fresh lemon flavor is the target then this is not achieved with SAS. It is, therefore, recommended that SAS be evaluated with other flavor types to establish those that are most compatible with its acid release characteristics.*

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***APPENDIX***

***FORMULATION DATA SHEETS***

## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Citric acid/ Sucrose Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Sucrose</i>	<i>58.500</i>
2. <i>Anhydrous Citric Acid</i>	<i>0.910</i>
3. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
4. <i>Tri-sodium Citrate</i>	<i>0.260</i>
5. <i>Washed lemon oil</i>	<i>0.650</i>
6. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add sucrose, citric acid, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
2. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.14%w/v*

*pH 3.2*

*Sucrose 9%w/v*

### **Ingredient Suppliers:**

*2 Direct Food Ingredients*  
*3 & 4 Fiske Food Ingredients*  
*5 Synergy Flavours 2SX 73875*

### **Telephone Number:**

*+44(0) 1625618617*  
*+44(0) 1908362200*  
*+44(0) 1189321489*

## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Sodium Acid Sulfate/Sucrose Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Sucrose</i>	<i>58.500</i>
2. <i>Sodium Acid Sulfate</i>	<i>0.520</i>
3. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
4. <i>Tri-sodium Citrate</i>	<i>0.260</i>
5. <i>Washed lemon oil</i>	<i>0.650</i>
6. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add sucrose, sodium acid sulfate, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
2. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.08 %w/v*

*pH 3.2*

*Sucrose 9%w/v*

### **Ingredient Suppliers:**

*2 Jones Hamilton Co  
3 & 4 Fiske Food Ingredients  
5 Synergy Flavours 2SX 73875*

### **Telephone Number:**

*(419) 666 9838  
+44(0) 1908362200  
+44(0) 1189321489*



## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Citric acid/ Aspartame Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.351</i>
2. <i>Anhydrous Citric Acid</i>	<i>0.910</i>
3. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
4. <i>Tri-sodium Citrate</i>	<i>0.260</i>
5. <i>Washed lemon oil</i>	<i>0.650</i>
6. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add aspartame, citric acid, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
3. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.14%w/v*

*pH 3.2*

*Aspartame 540ppm*

### **Ingredient Suppliers:**

*1& 2 Direct Food Ingredients*  
*3 & 4 Fiske Food Ingredients*  
*5 Synergy Flavours 2SX 73875*

### **Telephone Number:**

*+44(0) 1625618617*  
*+44(0) 1908362200*  
*+44(0) 1189321489*

## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Sodium Acid Sulfate/Aspartame Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.351</i>
2. <i>Sodium Acid Sulfate</i>	<i>0.520</i>
3. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
4. <i>Tri-sodium Citrate</i>	<i>0.260</i>
5. <i>Washed lemon oil</i>	<i>0.650</i>
6. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add sucrose, sodium acid sulfate, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
2. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.08 %w/v*

*pH 3.2*

*Aspartame 540ppm*

### **Ingredient Suppliers:**

- 1 *Direct Food Ingredients*
- 2 *Jones Hamilton Co*
- 3&4 *Fiske Food Ingredients*
- 5 *Synergy Flavours 2SX 73875*

### **Telephone Number:**

- +44(0) 1625618617
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- +44(0) 1189321489

## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Citric acid/ Aspartame: Acesulfame K Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.088</i>
2. <i>Acesulfame K</i>	<i>0.088</i>
3. <i>Anhydrous Citric Acid</i>	<i>0.910</i>
4. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
5. <i>Tri-sodium Citrate</i>	<i>0.260</i>
6. <i>Washed lemon oil</i>	<i>0.650</i>
7. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add aspartame, citric acid, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
4. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.14%w/v*

*pH 3.2*

*Aspartame 135ppm with Acesulfame K 135ppm*

### **Ingredient Suppliers:**

*1& 3 Direct Food Ingredients*  
*2 Nutrinova*  
*4&5 Fiske Food Ingredients*  
*6 Synergy Flavours*

### **Telephone Number:**

*+44(0) 1625618612*  
*+44(0) 870608820*  
*+44(0) 1908362200*  
*+44(0) 1189321489*

## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Sodium Acid Sulfate/ Aspartame: Acesulfame K Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.088</i>
2. <i>Acesulfame K</i>	<i>0.088</i>
3. <i>Sodium Acid Sulfate</i>	<i>0.520</i>
4. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
5. <i>Tri-sodium Citrate</i>	<i>0.260</i>
6. <i>Washed lemon oil</i>	<i>0.650</i>
7. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add sucrose, sodium acid sulfate, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
2. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.08 %w/v*

*pH 3.2*

*Aspartame 135ppm with Acesulfame K 135ppm*

### **Ingredient Suppliers:**

1. *Direct Food Ingredients*
2. *Nutrinova*
3. *Jones Hamilton Co*
- 4&5. *Fiske Food Ingredients*
6. *Synergy Flavours 2SX 73875*

### **Telephone Number:**

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## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Citric acid/ Aspartame: Saccharin Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.104</i>
2. <i>Saccharin</i>	<i>0.068</i>
3. <i>Anhydrous Citric Acid</i>	<i>0.910</i>
4. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
5. <i>Tri-sodium Citrate</i>	<i>0.260</i>
6. <i>Washed lemon oil</i>	<i>0.650</i>
7. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

1. *Place sodium benzoate into volumetric flask.*
2. *Add a portion of the water to the flask.*
3. *Add aspartame, citric acid, tri-sodium citrate and flavor.*
4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
5. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.14%w/v*

*pH 3.2*

*Aspartame 160ppm with Saccharin 80ppm (as imide)*

### **Ingredient Suppliers:**

*1,2 & 3 Direct Food Ingredients*

*4&5 Fiske Food Ingredients*

*6 Synergy Flavours 2SX 73875*

### **Telephone Number:**

*+44(0) 1625618612*

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## **Product Data Sheet**

**Flavor:** *Lemon*

**Product:** *Sodium Acid Sulfate/ Aspartame: Saccharin Sweetened*

### **Formulation:**

<i>Syrup Ingredients</i>	<i>% w/v</i>
1. <i>Aspartame</i>	<i>0.104</i>
2. <i>Saccharin</i>	<i>0.068</i>
3. <i>Sodium Acid Sulfate</i>	<i>0.520</i>
4. <i>Sodium Benzoate - 20% Solution</i>	<i>0.488</i>
5. <i>Tri-sodium Citrate</i>	<i>0.260</i>
6. <i>Washed lemon oil</i>	<i>0.650</i>
7. <i>Water</i>	<i>To volume</i>

### **Syrup Preparation:**

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4. *Make up to volume with water ensuring all ingredients are dissolved.*

### **Finished Product Preparation:**

1. *Dilute 1 part syrup with 5.5 parts carbonated water. (to 3.5 vols.)*
2. *Cap and invert.*

### **Final Product Characteristics**

*Acid concentration 0.08 %w/v*

*pH 3.2*

*Aspartame 160ppm with Saccharin 80ppm (as imide)*

### **Ingredient Suppliers:**

- 1 & 2 *Direct Food Ingredients*
3. *Jones Hamilton Co*
- 4&5 *Fiske Food Ingredients*
6. *Synergy Flavours 2SX 73875*

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