The zNose™ : Quantification of Diacetyl and Limonene Levels in Orange Juice

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For the first time there is an electronic nose, called the zNose™ (to distinguish it from sensor array types called eNoses), that can quantify the concentration of hydrocarbons (C4-C20) in orange juice in seconds. The zNose is designed to support quality control testing of aroma and flavor in virtually any food or beverage. Unlike an array of physical sensors, the zNose™ is able to speciate and quantify the individual chemicals present in any odor, smell, fragrance, vapor, or odor in 10 seconds with part per billion sensitivity using only a single sensor. Simultaneously, the zNose can produce high-resolution visual olfactory images, called VaporPrints™, and hundreds of virtual chemical sensors as well. The ability to perform over 300 measurements per day provides a cost effective quality control tool with a payback period under 30 days in most situations.

Quality control of food aroma and flavor as well as the elimination of tainting from food packaging, requires that an electronic nose be able to speciate and quantify chemical composition. In this paper, examples of zNose™ technology applied to the measurement of limonene and freshness (diacetyl) in fresh orange juice. Electronic nose problems can be grouped into three categories:

1. Needle in Haystack (e.g. ppb levels of diacetyl in orange juice)
2. Needle without Haystack (e.g. Clean water or containers)
3. Recipe (e.g. Principal chemical component concentrations)

How the zNose Works

The zNose is a very fast gas chromatograph with the ability to perform chemical analysis of any vapor over the range C4-C20 using a 1 meter db-624 capillary column. Speed is achieved by using temperature programming at rates as high as 18^{o}C/second. Full hydrocarbon spectrum viewing C4-C20 is achieved by ramping the db-624 column temperature from 40 ^{o}C to 140 ^{o}C in 10 seconds. Conversely, maximum resolution is achieved using isothermal column conditions (40 ^{o}C to 150 ^{o}C).

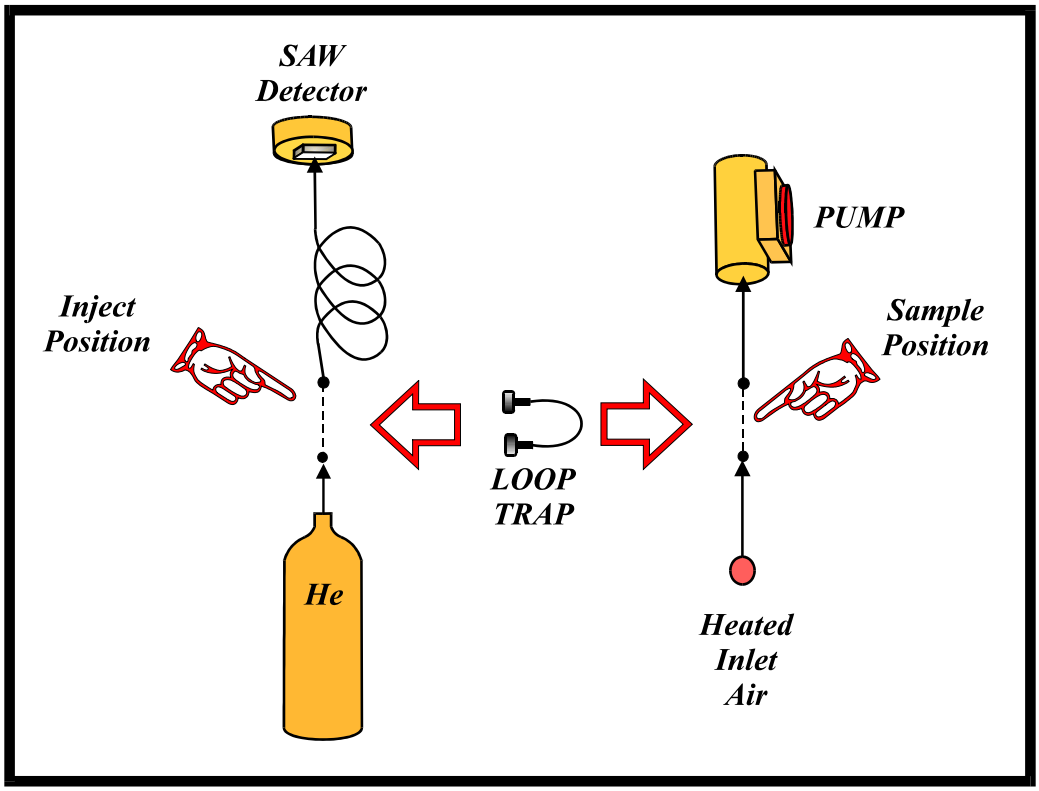


Figure 1-

Testing Limonene in Orange Juice

Step 1- Clear zNose using Air Blank and 10ps-0

Step 2- Create orange juice standard

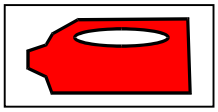
Step 3- Preconcentrate headspace vapors from orange juice standard

Step 4- Analyze orange juice with zNose and 10ps-0 method

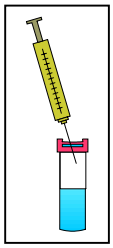
Step 5- Clear zNose using Air Blank and 10ps-0 method

Testing for Diacetyl in Orange Juice

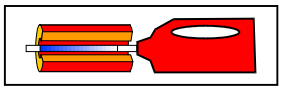
Step 1- Air Blanks using 10ps-0 method (initialization of zNose)



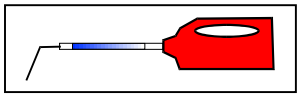
Step 2- Create diacetyl/orange juice standards



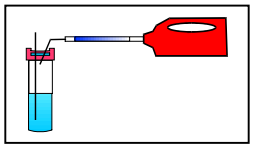
Step 3- Tenax absorber air blanks (170^{o}C) using 10ps-0 method



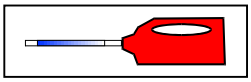
Step 4- Cool Tenax absorber to room temperature



Step 4- Preconcentrate headspace vapors from diacetyl/orange juice standard

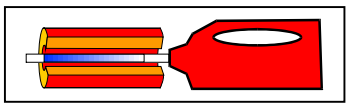


Step 5- Dry tenax absorber



Step 6- Raise tenax absorber to 170^{o}C

Step 7- Analyze tenax vapors with zNose and 0ps-0 method



Step 8- Tenax absorber air blanks (170^{o}C) using 10ps-0 method