

# FORMALDEHYDE: IS AN AIR CONTAMINANT IN RURAL AREA?

## Introduction

Formaldehyde (HCHO) is ubiquitous in the environment: it is an important endogenous chemical that occurs in most life forms, including humans with an estimated Bioaccumulation Factor (BCF) of 3 calculated for formaldehyde, using a log Kow of 0.35 and a regression-derived equation.

HCHO production and use in the manufacture of resins, disinfectants, preservatives, and a variety of other chemicals may result in its release to the environment through various waste streams.

It is naturally formed by:

- decomposition of plant residues in the soil, a well-known source of HCHO;
- decomposition of linalool in the atmosphere by ozone and/or OH and NO<sup>3</sup> radicals; the yields of linalool atmospheric decomposition into HCHO lies into the 30-40 % range;
- atmospheric decomposition of other biogenic VOCs such as isoprene and terpenes (like pinenes), the major VOCs naturally emitted by vegetation foliage (crops, trees, odoriferous plants, etc...); they react with hydroxyl radicals, forming HCHO as an intermediate product.

HCHO in rural areas could be also introduced in air through anthropic activities as soil working and/or fertilization, soil sterilisation or plastic film use (greenhouses, soil mulching, etc).

The main objective of this investigation was to enlighten the air level of HCHO in eight representative rural areas in North Italy and additional four sites in South Spain where human agricultural activities could play an additive role respect natural basal air concentration.

## Formaldehyde

Structure	Chemical name (IUPAC):	CAS number:	EC Nr (from EINECS):	Formula:	Molecular weight:	Mp/Bp:	Vapour Pressure:	Solubility in water:	Density:	US health exposure limits (NIOSH):
	methanal	50-00-00	200-001-8	HCHO	30.03	-92 / -19 °C	> 1 atm at 20 °C	400 g/100 mL	0,8153 g/mL at 20 °C	- PEL (Permissible) - REL (Recommended) - IDLH (Immediate Danger)
										TWA 0.75 ppm (921,2 µg/m <sup>3</sup> ) TWA 0.016 ppm (19,7 µg/m <sup>3</sup> ) 20 ppm (24,56 mg/m <sup>3</sup> )

Table 1. HCHO chem/physical and tox characteristics

## Material and methods: 8 rural sites monitored in Italy in May 2015, every third day for 5 times

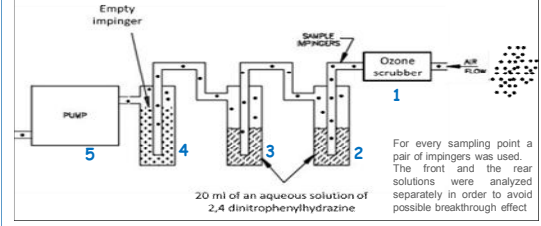
Site	Location	Crops commonly grown in the area
CAN	Canneto MN	Open air Cereals, tree nursery, tomato, poplar
CER	Cervesina PV	Open air Cereals, poplar, tomato
LAG	Lagosanto FE	Open air Strawberry nursery, carrots, barley
RAV	Ravenna RA	Open air Strawberry nursery, carrots, celery
SAN	Santena TO	Protected Tomato, zucchini, pepper
VIN	Vinovo TO	Protected Tomato, zucchini, pepper
SCA	Scalenghe TO	Protected Tomato, zucchini, pepper
PEV	Peveragno CN	Open air & protected Cereals (open air), vegetables (protected), strawberry fruits (both)

## Four additional rural sites monitored in Spain in April 2016

Site	Location	Crops commonly grown in the area
LPV	Los Palacios	Open air & protected: Zucchini, tomato, orchards, olive
UTR1	Utrera	Open air & protected: Zucchini, tomato, orchards, citrus, olive
UTR2	Utrera	Open air & protected: Zucchini, tomato, orchards, citrus, olive
CDR	Coria del Rio	Open air: Tomato, cotton, carrots, rice, maize

## Sampling procedure and analysis

1. Air, drawn through an ozone scrubber KI cartridge at 100 mL/min;
2. Front and (3) rear impingers (acid solution of derivatizing agent 2,4-dinitrophenylhydrazine [2,4-DNHP], 20 mL);
4. Trap;
5. Calibrated air sampling pump;
6. Samples were collected over 8 hours, 3 replicates per sampling event;



- Impinger solution quantitatively transferred into a flask and filled with water to a final exact volume of 25 mL
- Sample aliquot extracted twice with diethyl ether
- Extract taken to dryness and then reconstituted with acetonitrile
- Sample injected in LC-MS/MS system for qual/quantification of 2,4-dinitrophenylhydrazine

Presence of "background" level of HCHO (glassware and chemicals contributions)

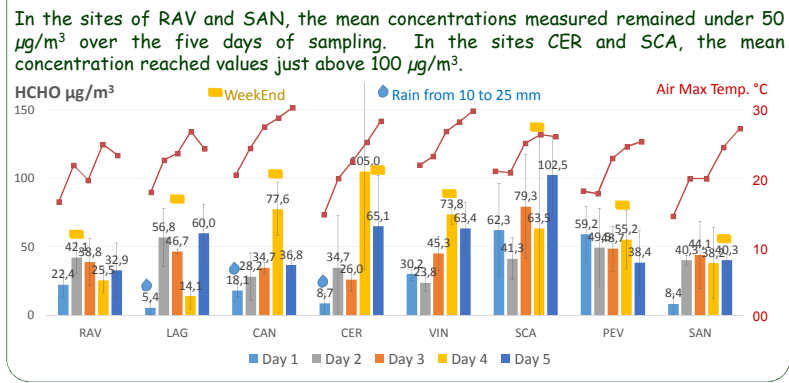
Importance of control blank sample for every set of samples

Samples results corrected by subtracting control blank

## Results

Quantification of HCHO was observed in all the sampling events except once, in site UTR1 (Spain, 2016) ranging from 5.4 to 105 µg/m<sup>3</sup>. When measured in one site during one sampling time with 3 or 4 replicates, a significant standard deviation of concentrations was observed between replicates: this confirms the high fugacity of volatile chemicals and the need to avoid using single individual results for risk assessment purposes. Additional variability of concentrations was observed between sites, time and local climate condition. A statistical analysis of concentrations obtained in a single site (site RAV, Italy summer 2015, results not presented on this poster) over a period of 45 days indicated a high level of correlation between the atmospheric HCHO concentrations and climatic conditions.

## Italian sites



## Spanish sites

