Biogenic contribution to particulate matter in Northern Italy

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Introduction

Aerosol particulate matter carbonaceous fraction contains organic tracers that are characteristic of the sources, the formation and the transformation during atmospheric processes.
Biogenic organic matter consists mainly of lipids, humic and fulvic acids, sterols, triterpenoids, sugars, n-alkanes, n-alkanols and n-alkanoic acids (Simoneit, 1999).
PM10 aerosol samples were collected during spring and summer in six sites placed in the Lombardy region (Northern Italy) having different geographical characteristics.
In this study we compare some approaches in order to estimate biogenic sources contribution using different bio-aerosol tracers: n-alkanes, fatty acids, sugars (levoglucosan and arabitol) and OC/EC ratios.
GC-MS analysis is a useful tool for the identification, characterization and quantification of homologous series (like n-alkanes, fatty acids and sugars) and it provides relevant information on organic compounds in complex mixtures.

The sites object of this study are shown in figure 1, the sampling period is reported in table 1. In table 2 we report the main results of organic material chemical characterization.

Figure 1

	April 2005	May 2005	June/July 2005
S. Colombano	4 - 5	16 - 19	27 - 29
Sondrio	4 - 10	16 - 22	27 - 3
Cantù	4 - 10	16 - 23	
Milano	4 - 10		27 - 3
Mantova	4 - 10	16 - 22	27 - 3
Bosco Fontana	4 - 10	16 - 22	27 - 3

Table 1

	PM (µg/m³)	OC (µg/m³)	EC (µg/m³)	OC/EC	Σ Alkanes (ng/m³)	(Σ Alkanes/OC) ‰	CPI	CPI 25	WNA	LG (ng/m³)	AR (ng/m³)	(LG-C/OC) ‰	(AR-C/OC) ‰	Σfatty acids (ng/m³)*	(Σfatty acids/OC)x1000*
April '05															
S. Colombano	23.4	3.9	0.5	7.8	202.3	51.9	1.3	1.3	22%						
Sondrio	48.5	9.8	2.3	4.3	69.5	7.1	1.5	1.6	0%	63		2.9		28.2	2.9
Cantù	44.2	8.8	2.3	3.8	98.9	11.2	1.3	1.2	8%						
Milano	46.3	8.4	3.4	2.5	122.1	14.5	1.2	1.1	9%	22	1	1.2	0.04	43.9	5.2
Mantova	68.2	9.6	1.9	5.1	26.7	2.8	1.1	1.1	3%	21	1	1.0	0.05	45.5	4.7
Bosco Fontana	50.3	8	1.1	7.3	53.5	6.7	1.4	1.4	2%	23	1	1.3	0.07	52.7	6.6
May '05															
S. Colombano	9.4	2.1	0.1	21.0	116.2	55.3	1.1	1.1	17%						
Sondrio	26.6	7.6	1.7	4.5	93.7	12.3	1.3	1.3	5%						
Cantù	28.9	6.5	1.2	5.4	77.5	11.9	1.4	1.4	5%						
Mantova	58.3	7.3	2.3	3.2	74.9	10.3	1.3	1.3	7%						
Bosco Fontana	39.4	5.6	1.1	5.1	65.0	11.6	1.3	1.2	6%	4	3	0.3	0.24	71.6	12.8
June/July '05															
S. Colombano	12.6	2.6	0.4	6.5	152.3	58.6	1.1	1.1	19%						
Sondrio	17.1	6.7	1.4	4.8	78.0	11.6	1.3	1.3	7%	3	5	0.2	0.30	32.8	4.9
Milano	25.8	6.3	1.5	4.2	125.5	19.9	1.3	1.3	11%						
Mantova	52.4	8.8	2	4.4	58.1	6.6	2.0	2.1	0%	3	14	0.2	0.62	44.2	5.0
Bosco Fontana	34.2	6.5	1	6.5	65.1	10.0	1.5	1.6	4%	3	7	0.2	0.41	40.1	6.2

LG: levoglucsan, AR: arabitol, *in the fatty acids sum was excepted C16 and C18

Table

Alkanes

For the urban background sites (Cantù, Milano, Mantova) the CPI index increases from spring to summer samples.
Considering for instance the pattern distribution of the n-alkanes (figure 2) of three months in Mantova, we note that in the summer season the samples are richest in biogenic compounds (C27, C29, C31). In the April samples (figure 3) of Sondrio (traffic site) and Milano we note that the concentrations of n-alkanes < C26 are high: this is an indication of anthropogenic contribution to organic material in the particulate matter.
The WNA index (table 2) shows very high biogenic contribution (from 17% to 22%) in S.Colombano, an alpine site where the sampler is located at 2.300 m a.s.l.

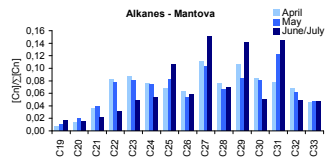

Figure 2

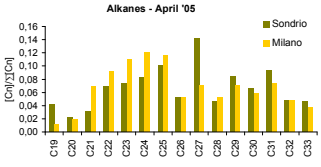

Figure 3

Sugars

Following the results of Piazzalunga et al. (2009) demonstrating that the concentration of Levoglucosan (LG), a marker of wood burning, in Lombardy region is high during the cold season, in this poster we show (figure 4 and 5) that in the warm and cold season the concentrations of this sugar are very low; in these periods the Arabitol (AR), a marker of fungal spores, concentrations increase.
According to Bauer et al., (2008) Arabitol and Mannitol are the source tracers for quantifing the spore-OC in the atmosferic aerosol, corrently no other emission sources for these compuounds have been reported in the literature works. Here we present the first data available in Italy.

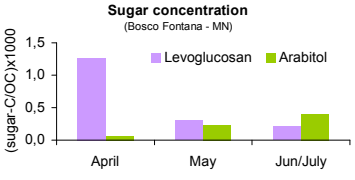

Figure 4

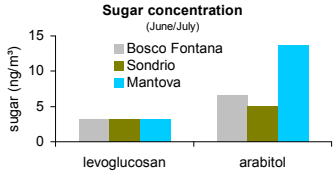

Figure 5

Fatty Acids

In this work we quantified only even acids (C14-C28), C16 and C18 concentration values are not reported here because of high blank value.
The distribution pattern shows that, in all samples, the most abundant compounds are those with C>22.
In figure 6 we show the distribution pattern in the different sites during April. The comparison between April and June/July samples in Mantova is shown in figure 7.

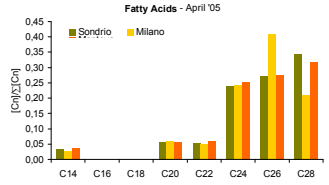

Figure 6

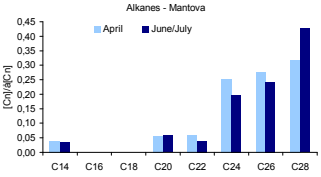

Figure 7

Conclusion

The chemical characterization of organic material in the particulate matter samples shows that there are biogenic compounds (i.e . Odd n-alkanes, arabitol). The concentration of these compounds increases from spring to summer.
The biogenic contribution of particulate matter could not be negligible so in the future we would like to quantify the contribution of this source to PM level.

References:
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Simoneit, B.R.T., (1999) Environ. Sci. & Pollut. Res. 6 (3) 159-169.