VOLATILE ORGANIC COMPOUNDS INVESTIGATION IN MÜLLER THURGAU WINES OBTAINED FROM VINEYARD TREATED WITH BIOCHAR

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Abstract:

Context and purpose of the study – Volatile Organic Compounds (VOCs) are responsible for the flavor and aroma of a wine. The sensory qualities of the wines depend not only on grape intrinsic characteristics, but also on extrinsic factors including the soil composition. Previous studies have shown that the application of pyrogenic carbon (biochar) can lead to a change in soil parameters. For that reason, one of the goals of the ERDF funded project «WoodUp» is the characterization and reutilization of the locally produced biochar for agricultural purposes. In this study wine quality is investigated to better understand how the chemical and physical modification of the soil can influence the wine VOCs profile from Müller-Thurgau, after biochar application.

Material and methods – Wines obtained from vineyard treated with different amounts of biochar were analyzed (3.9 kg/ m² dry matter compost, 2.5 kg/m² dry matter biochar, 5 kg/m² dry matter biochar, 2.5 kg/m² dry matter biochar plus 3.9 kg/ m² dry matter compost, 5 kg/m² dry matter biochar plus 3.9 kg/ m² dry matter compost and the untreated as control). Samples, 1.5 ml of each wine, were placed into 20 ml glass vial with the addition of 0.45 g of NaCl and 5 µl of 2-octanol (123 ppm) as internal standard. The volatile composition of wines was determined by using headspace solid phase microextraction (HS-SPME) coupled with gas chromatography–mass spectrometry (GC–MS) in full scan mode. The headspace was sampled using a DVB/CAR/PDMS 50/30 µm fibre; chromatography was performed on either a 30 m ×0.25 mm id×0.25 µm ZB-WAX column (Phenomenex, UK). Samples were analyzed in triplicate.

Results – Preliminary data analysis of the full scan acquisition allowed the identification of 47 volatile compounds in wine samples. Tentative compound identification was based on at least 70% quality match with NIST 17 database information for each compound. In addition, experimental Retention Indexes were calculated and compared with the theoretical ones. Among the identified compounds we find acids, esters, alcohols and some terpenes. More detailed data analysis is necessary to identify the differences on wines aroma compounds produced starting from different treated vineyard and to understand the influence of the soil composition on wine characteristics.

Keywords:Grapevine, biochar, pyrogenic carbon, VOCs, GC-MS

1. Introduction.

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Introduction ①

Volatile Organic Compounds (VOCs) are responsible for the flavor and aroma of a wine. The sensory qualities of the wines depend not only on grape intrinsic characteristics, but also on extrinsic factors including the soil composition.

The usage of pyrogenic carbon (or biochar) has been carried out since many centuries and previous studies have shown that its application can lead to a change in soil parameters.

In the "WoodUp" project one of the goal is to investigate the wine aroma to better understand how the chemical and physical modification of the soil can influence the vine VOCs profile, after biochar application.

Field Experiment ②

In an existing vineyard of Müller Thurgau 5 different soil treatments plus a control have been carried out.

Treatments:

B 2.5: 2.5 kg/m² dry matter biochar

B 2.5 + COMP: 2.5 kg/m² dry matter biochar plus 3,9 kg/ m² dry matter compost

B 5: 5 kg/m² dry matter biochar

B 5 + COMP: 5 kg/m² dry matter biochar plus 3.9 kg/ m² dry matter compost

COMP: 3.9 kg/ m² dry matter compost

CTR: untreated

Fig 1: The biochar was incorporated between the rows with the use of a spade plough and a rotating harrow at approx. 30 cm depth.

Volatiles Profile GC-MS ③

Grapes from grapevines with different biochar-treatment and control were harvested in 2017 and subject to microvinification, after fermentation and aging of 8 months VOCs form the obtained wines were analyzed

• 1 ml of wine
• 0.3g NaCl
• IS (2-Octanol, 1-Heptanol)

HS-SPME GC-MS with 2-cm DVB/CAR/PDMS 50/30 µm fibre

GCMS-QP2010 SHIMADZU

Gas Chromatography Run: 44 min
Column: ZB-WAX (30 m x 0.25 mm i.d. x 0.25 µm)
Mass Spectrometry: FullScan (mass range 35-350 m/z)
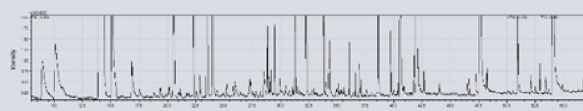
Rusults and Discussion ④

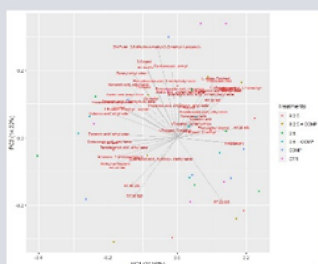Fig 2: Chromatogram of a Quality Control created as a pool of samples.

Full scan acquisition (Fig 2) allowed us to identify 47 volatile compounds in wine samples. Tentative compound identification was based on at least 70% quality match with NIST 17 database information for each compound. In addition, experimental Retention Indexes were calculated and compared with the theoretical ones. Among the identified compounds we find acids, esters, alcohols and some terpenes.

Scores and loadings from the principal component analysis (PCA) are presented considering all putative compounds. Using the first and second components the 50% of the total variance is explained; the PCA doesn't show a clear separation based on the treatments and considering all the metabolites (Fig 3).

Fig 3: Principal component analysis of 47 volatile organic compounds
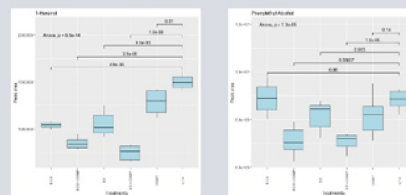

Fig 4: Boxplots of the most interesting compound. Numbers represent p-value obtained by Student t-test comparing control and treatment.

To evaluate the effect of the treatments on the VOCs wine profile, a Student *t-test* was applied comparing each treatment with the control. In Fig 4 are reported two compound which shown significant differences (*p-value<0.05*).

Soil treatments with biochar show a minimal effect on wines VOCs profile compared with the control. In fact, only few compounds have a significant statistical difference. A second year investigation is necessary to evaluate the potential of biochar application.

AUTONOME PROVINZ BOZEN - SÜDTIROL   PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE

PROVINZIA AUTONOMA DE BULSAN - SÜDTIROL