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The role of hydrothermal gasification on the fate of pesticides in OMWW

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INTRODUCTION

Pesticides constitute natural or synthetic substances that are used both for the prevention and the elimination of any parasites, insects and weeds that contribute negatively the plant growth (Ahmad et al., 2024). On the contrary, despite their contribution to the protection of plant growth, the excessively uncontrolled use of these substances led in environmental pollution and became an environmental and public human health threat due to their toxicity (Ahmad et al., 2024). Pesticide residues are detected in both foods, air, water and soils so their treatment constitute a crucial issue. Hydrothermal Gasification (HTG) is a thermochemical process that occurs in high temperatures and pressures and converts wet biomasses into high energy value materials especially gases such as hydrogen. The novel of this study is the investigation of the fate of pesticide residues from Olive mill wastewater during HTG conditions with Gas Chromatography (GC).

METHODS

HTC reactor experiments: OMWW collected from a 2-phase olive mill from Lesvos Island and submitted to Hydrothermal Gasification (HTG) processing to evaluate its included pesticide residue fate. Three experiments took place in a 1L Parr 4570A Hydrothermal reactor with 3 different temperature rates (300 °C, 350 °C, 400 °C), % fillings (4%, 6%, 8%). The residence time of each experiment was 1 hour. .

GC analysis: To determine the fate of the residual pesticides during the HTG experiments, Gas Chromatography applied to the pretreated with Ultrasonic Bath Extraction liquid samples in a Shimadzu Nexis GC - 2030 (GC - BID) with a Rtx – OPPesticides2 column (0.32mm, 30m). Other measurements for the characterization of the HTG liquid products included Chemical Oxygen Demand (COD), Total Phenolic Content (TPC) and pH – Conductivity.

3 experiments of HTG		
Experiment #	Description	Short name
Experiment 1	80ml OMWW, HTG @ 300 at °C /82,4 bar/1 hour	HTG1
Experiment 2	60ml OMWW, HTG @ 350 at °C/ 93.7 bar/1 hour	HTG2
Experiment 3	40ml OMWW, HTG @ 400 at °C/ 66.3 bar/1 hour	HTG3

Table 1. Experimental conditions - HTG

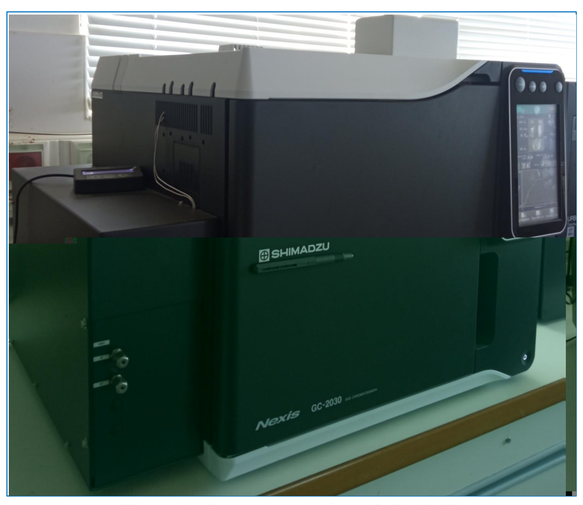

Fig. 1. Image of the GC-BID

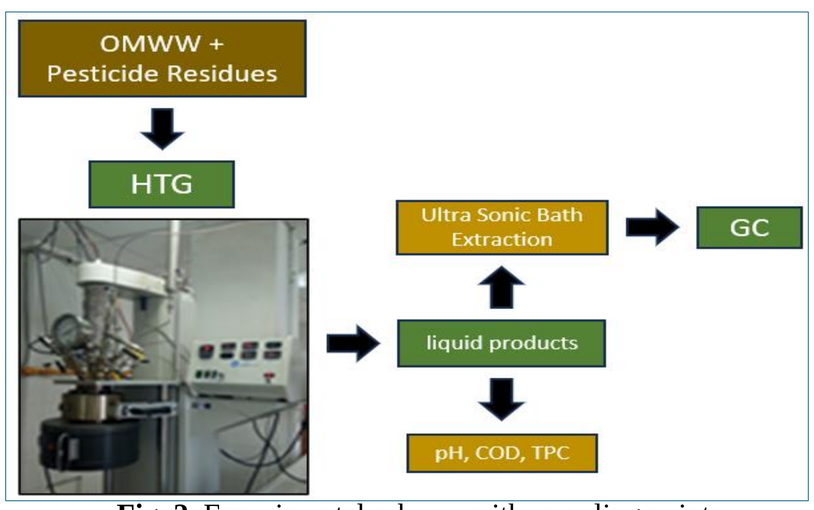

Fig. 2. Experimental scheme with sampling points

RESULTS AND DISCUSSION

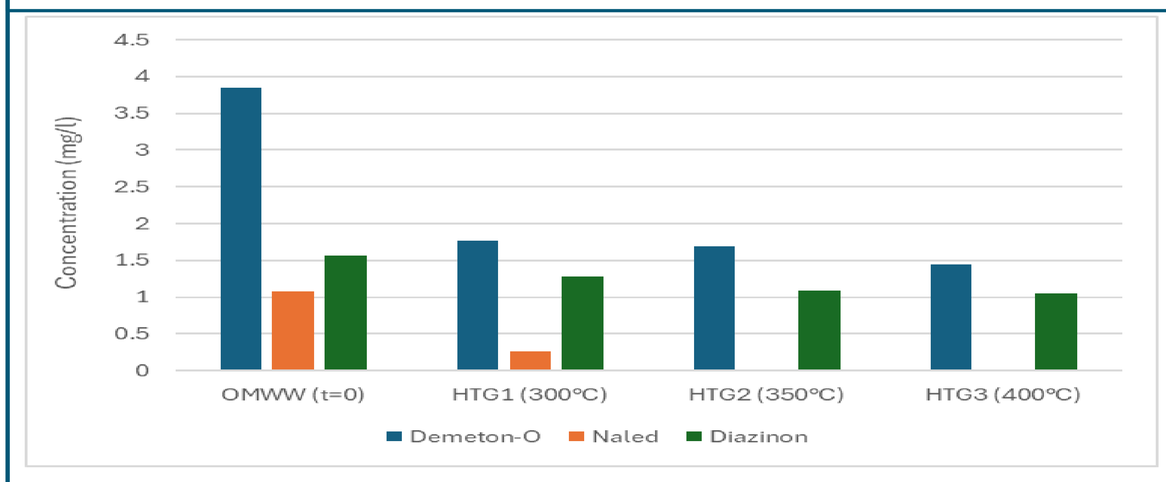

Fig. 2. Pesticides concentration in liquid products of HTC

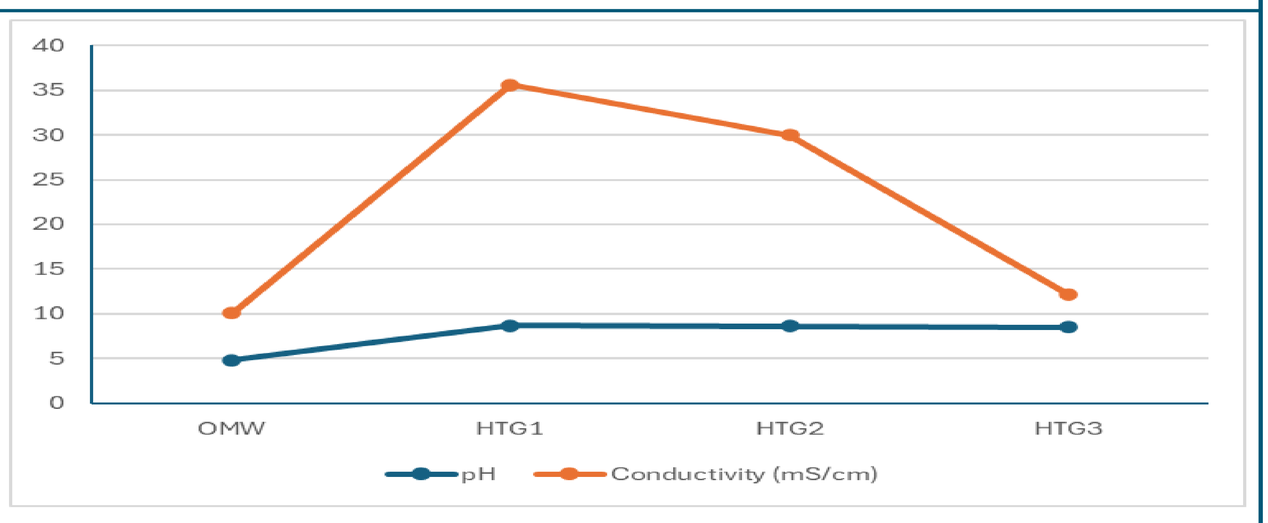

Fig. 4. pH/ conductivity values of liquid products of HTC

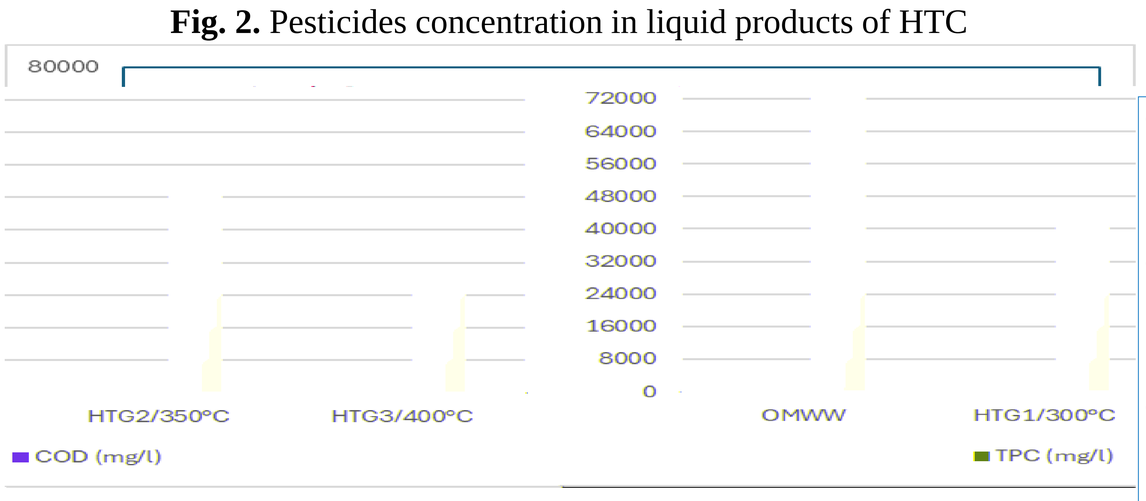

Fig. 3. COD/ TPC concentration in liquid products of HTC

- Pesticide residues in the liquid products. The results showed in **Fig.2** that the increasing temperature affects positively the destruction of these 3 pesticide substances, and especially Naled that almost removed entirely from the liquid fraction.
- pH and Conductivity. pH rates increased during all HTG experiments, but Conductivity noted an increasing during HTG1 with a following decreasing in the other two experiments as it presented in **Fig.4**
- COD and TPC. The COD of the liquid products generally decreased in **Fig.3** but there was a slight increase during the experiment that conducted under 350°C followed by a decreasing again in the experiment of 400°C. In addition, Total Phenols increased during the experiment of 300°C and then increased in the following two experiments.

CONCLUSIONS

- Pesticide substances such as Demeton-O, Naled and Diazinon seem to be vulnerable to deconstruction in high temperatures and pressures that HTG processing occurs.
- The increasing of the pH may also constitute an important factor that affected the pesticide destruction as it is reported to many studies that pesticides are more persistent in acidic environments than in alkaline.
- Next studies will focus on the fate of more pesticide substances and under more complex experimental conditions.

References:

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