



# Application of carbonized hemp fibers as a new solid-phase extraction sorbent for analysis of pesticides in water samples

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## HIGHLIGHTS

- Production of cheap pesticides sorbents using the waste hemp fibers as raw material.
- Production parameters affect the materials morphology and sorption properties.
- Carbonized and activated carbons from hemp fibers were successfully used for pesticide preconcentration.
- Efficiency of activated hemp fibers comparable with commercial cartridges.

## ARTICLE INFO

### Article history:

Received 11 July 2012

Received in revised form 10 September 2012

Accepted 12 September 2012

Available online 29 September 2012

### Keywords:

Pesticides

Sorption

Solid-phase extraction

Short hemp fibers

Carbonization

Surface characteristics

## ABSTRACT

There is a growing interest in utilization of abundantly available materials, bio-mass or industrial byproducts, as precursors for the preparation of carbon materials. Short hemp fibers, acquired as waste from textile production, were used as low-cost precursor for production of carbon materials as a sorbent in the solid-phase extraction, for pesticide analysis in water samples. Different carbon materials were prepared by carbonization of unmodified and chemically modified hemp fibers. Activation of carbonized materials with potassium hydroxide improves sorption properties of carbonized hemp fibers by increasing the specific surface area (up to 2192 m<sup>2</sup>/g) and the amount of surface oxygen groups. The following parameters that may affect the solid-phase extraction procedure efficiency were optimized: different elution solvents and the pH value of pesticide solution. Extracts were analyzed by liquid chromatography–tandem mass spectrometry technique. For this study pesticides belonging to the different chemical classes were chosen. Obtained results indicate that carbonized and activated hemp fibers could be successfully applied as a solid-phase sorbent for the pesticide analysis in water samples.

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## 1. Introduction

Activated carbons with high surface area and pore volumes can be prepared from variety of carbonaceous materials such as coal, coconut shell, wood, agricultural or industrial wastes. In the recent years, there is a growing interest in utilization of the low-cost and abundantly available waste materials as precursors for the preparation of carbon materials [1]. The usage of the waste materials represents a special way of recycling and producing useful products. At the same time the cost of waste disposal are minimized. The possibility of using different type of biomass has already been

tested for production of the carbon materials [1–11]. Among other biomass types, Reed and Williams [12] have used hemp fibers for obtaining activated carbon. Hemp fibers are lignocellulosic materials, traditionally used for textile production. In our previous work we have shown that, due to their specific structure and presence of the surface functional groups, hemp fibers have good sorption characteristic, especially toward heavy metals [13,14]. For that investigation we have used short hemp fibers that represent a waste in textile industry.

The possibility of producing carbon materials with high specific surface areas, microporous structure, high adsorption capacity and degree of surface reactivity brings the variety of application for these materials. Different carbon materials have been widely used as sorbents in the solid phase extraction (SPE) which is an efficient and economical sample preparation technique for preconcentration of the target analyt. This method has been previously applied to the determination of many pesticides in natural water and crops

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