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A SUMMARY OF PROCEDURES USED IN PHOSPHORUS DETERMINATION FROM ORGANIC INPUTS

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Introduction

Nowadays, it has been observed an intensive effort to employ ecological farming practices, this trend being related with restriction to apply chemicals and pesticides and which, consequently, will minimize pollution effects. Beside the environmental benefits, the importance of ecological agriculture increased due to the demand in order to provide healthy food products even if the prices are higher.

The challenge is to find and to use accepted inputs, to adopt or to develop strategies that assure environmental sustainability and high yields. The accepted inputs for ecological agriculture are listed by Commission Regulation (EC) No 889/2008 and by Regulation (EC) No 2003/2003 of the European Parliament and of the Council.

Lately, many types of inputs have been promoted, in some cases the quality of them being questionable. As these products have to obey strict standards, development of analysis methods for inputs' chemical characterization is an important step which will assure providing high quality organic products.

Methods used for phosphorus quantification from organic inputs

Ecological agriculture principles require natural sources of phosphorus fertilizers (phosphate rock, compost, manure, bone meal, biofertilizers etc).

Due to necessity to conform to environmental quality standards and also to obey to the rules of ecological agriculture, accurate determination of phosphorus in various inputs has gained importance. Accurate analysis of phosphorus beside quality control of the ecological input is associated with its' effective use in the field.

The methods used for total phosphorus contents from inputs destined to ecological agriculture are:

a) *spectrophotometric method* after digestion with acids (HNO_3/$HClO_4$), mixture of H_2SO_4 and H_2O_2 or after dry combustion as reported for compost from food market waste and urban gardening, fresh and composted manures, animal manure compost, compost from fish waste and seaweed;

b) *ICP-OES* *(inductively coupled plasma - optical emission spectrometry)* after mineralization in aqua regia or using acids (HNO_3/$HClO_4$) for compost from municipal waste, inorganic phosphorus fertilizers;

c) *ICP-MS* (*inductively coupled plasma mass spectrometry*) after digestion with different mixtures (H_2O_2 with HNO_3 or H_2SO_4 with $HClO_4$) for vegetable waste and sewage sludge;

d) *XRF* (*X-ray fluorescence*) for phosphorus from biomass ashes;

e) *AAS* (*atomic absorption spectrometry*) using nitrous oxide-acetylene flame has been reported for quantification of phosphorus in commercial phosphorus fertilizers;
f) *MP-AES* (*microwave plasma atomic emission spectrometry*) is a relatively new analytical technique that use microwave assisted acid digestion for phosphorus input and provide results comparable with those obtained by ICP-OES and AAS.
Total phosphorus determination does not provide information regarding chemical forms of phosphorus found in inputs, which in certain circumstances provide useful information for agronomists.
The speciation of phosphorus in complex matrices as agricultural inputs it could be performed by using X-ray absorption near-edge structure (XANES), this technique presenting great advantages in comparison with other methods, being nondestructive and low time consuming.
Literature studies report characterization of organic and inorganic species of phosphorus found in different inputs (manure) by employing XANES and conjunction with X-ray powder diffraction (XRD) allow quantifying the distribution of inorganic species in inputs.
Beside XANES, ^{31}P-NMR spectroscopy has been reported the simultaneous identification of phosphorus species (both organic and inorganic) from complex matrices, as manure.

Results and Conclusions
Consequently, evaluation of phosphorus (total form or after speciation) from inputs used in ecological agriculture it could be performed through different methods and procedures chosen in accordance with their advantages and disadvantages, time of analysis, financial possibilities of the laboratory. Also, in many cases reported analysis protocols must be amended and adapted since new formulations of organic inputs with various compositions and matrices are produced all the time.

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