OBTAINING BIO-STIMULANTS PRODUCTS FOR LAND APPLICATION FROM SEWAGE SLUDGE IN SMALL POPULATIONS

García-Martínez A.M.2, Rodríguez-Morgado B.1, Revilla E.1 Santa-Maria C.1
Bautista J.1., Tejada M.2, Aragón Cruz, C.3, Parrado. J1.1

1Departamento de Bioquímica y Biología Molecular, Facultad de Farmacia, Universidad de Sevilla. C/Profesor García González, 2. Sevilla. (E-mail: parrado@us.es)
2Departamento de Cristalografía, Mineralogía y Química Agrícola, Escuela Superior de Ingeniería Técnica Agrícola, Universidad de Sevilla. Carretera Utrera-Sevilla, Km.1. Sevilla. (E-mail: amgarcia@us.es)
3Foundation Centre for New Water Technologies (CENTA). Avda. Américo Vespucio, 5-A, 2ª Planta, Módulo 9-10, 41092. Seville. Spain. (E-mail: caragon@centa.es)

WFD4 / MDG4 Smallwat11 3rd INTERNATIONAL CONGRESS

INTRODUCTION

During sewage treatment a residual sludge is generated. The treatment and management of that solid waste result really important because it concentrates all the pollutants that are removed from wastewater. The EU has promulgated the protection of the environment and in particular of the soil, when sewage sludge is used in agriculture (Directive 2006/12/EC; Council Directive 86/278/EEC). In Spain, the National Plan on Sewage Sludge (2001-2006) was promulgated in this sense. The objectives of this plan were to improve the management of sewage sludge, and especially optimize the agricultural application, protecting the environment and, specially, the quality of the soil. Plan considered that the recycling of nutrients and organic matter by agricultural land application was the most sustainable option for these residues. Recently, a Second National Plan on Sewage Sludge for the period 2007-2015 has been established as a part of the Integrated National Plan of Residues (PNIR).

Sewage sludge (SS) can be used as fertiliser (high N and P content and low C/N ratio) (Boyd *et al*., 1980; Iakimenko *et al*., 1996). SS also has a high content of organic matter which makes both a quantitative and qualitative contribution to the soil organic matter so that it acts as an organic amendment for both agricultural purposes and for the rehabilitation of degraded areas. Positive effects have been reported for soil physical, chemical, nutrient and biological properties (Navas *et al*., 1998; Wong *et al*., 1998). The direct use of these wastes may cause problems (presence of heavy metals, pathogenic microorganisms, bad odours or phytotoxicity). Composting is the main biological approach to stabilize the SS. However, the composting of SS has several problems (long time of production, low control of the process, low value of the final products, presence of large size solids that avoid some kind of agronomic applications, slow assimilation by soil microorganisms and plants.

In this study, a hydrolytic process has been applied for obtaining a bio-stimulant product from the sewage sludge generated in small wastewater treatment plants.

METHODS

SS was collected from the Experimental Plant of the Foundation Centre for New Water Technologies (CENTA) at Carrión de los Céspedes (Seville), concretely from the waste sludge line of an extended aeration unit. The SS was then introduced in a bioreactor where the hydrolysis took place, according to the pH-stat test (Adler-Nissen, 1977). Finally, the hydrolysed mass was centrifuged obtaining two products: the hydrolysed sludge and an insoluble waste. Both the fresh sludge and the hydrolysed product were characterised (organic matter content, total nitrogen, total phosphorous and proteins). For analysing the potential use of the sewage and the hydrolysed sludge as an agricultural bio-stimulant, the dehydrogenase, phosphatase and β-glucosidase enzyme activity were measured in a pilot plot.

Figure 1. Experimental Plant of the Foundation Centre for New Water Technologies (CENTA) Carrión de los Céspedes (Seville)

RESULTS AND DISCUSSION

A) CHEMICAL CHARACTERISATION (SEWAGE SLUDGE AND THE HYDROLYSED PRODUCT)

Parameter	*Sewage Sludge*	*Hydrolysed sludge*
Organic matter	**39.20**	**55.51**
Total Nitrogen	**2.70**	**2.93**
Total Phosphorous	**2.08**	**0.22**
Proteins	**170 g/kg**	**190 g/kg**

Table 1. Results of the chemical characterisation of the Sewage Sludge and the hydrolysed product n de LDH

As observed in table 1, the hydrolysis of the sewage sludge increased the content of organic matter, total nitrogen and proteins but reduced the phosphorous concentration. It is supposed that phosphorous is removed with the insoluble waste during the centrifugation. The observed solubilisation of both the total nitrogen and proteins shall improve the bioavailability of them to plants and other organisms in the soil.

B) SOIL ENZYMATIC ACTIVITIES

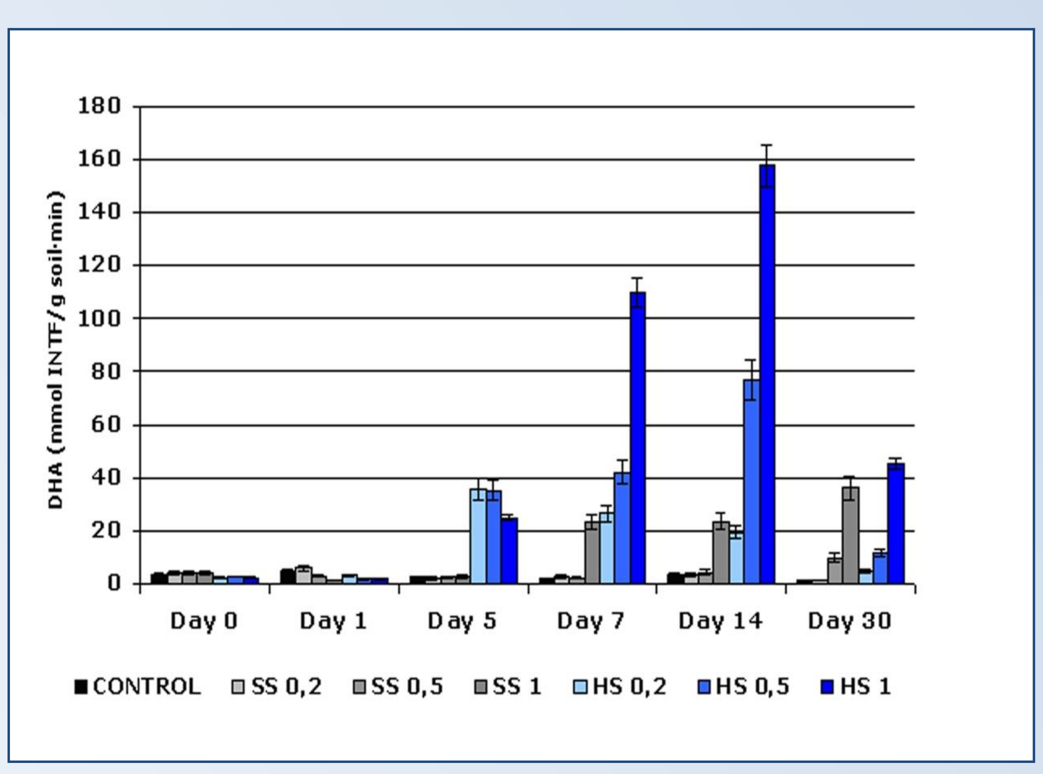

Figure.2. Dehidrogenase activity (DHA). (Mean + SD).

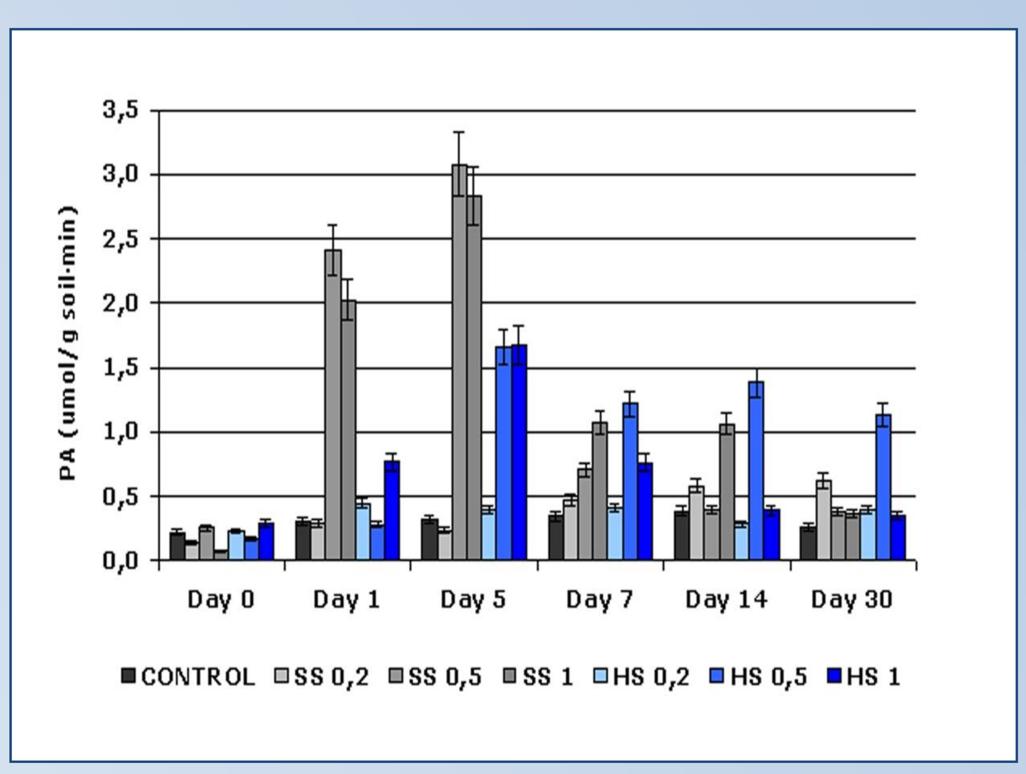

Figure.3. Phosphatase activity (PA). (Mean + SD).

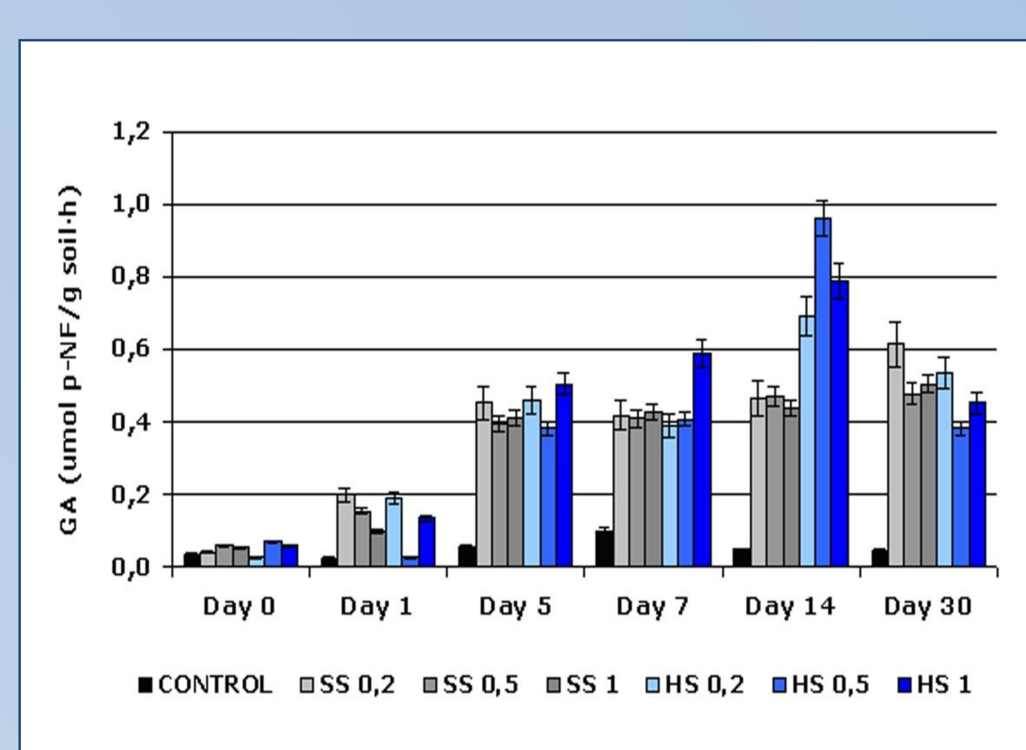

Figure.4. Glucosidase activity (GA). (Mean + SD).

The application of the hydrolysed sludge in the pilot plot produced an increase of the dehydrogenase activity (up to 78 times greater than the control) (see Figure 2) and β-glucosidase (2-4 times greater). The fresh sewage sludge also produced an increase of both enzymatic activities but not as notic eable as the ones obtained for the hydrolysed one. However, the phosphatase activity was larger promoted when the fresh sludge was applied.

CONCLUSIONS

The hydrolysis of sewage sludge generated in small WWTP is an alternative process to composting for land application of those wastes. The hydrolysed product obtained presents a high stability and bioavailability thus enhancing the enzymatic activities of the soil's microbial community.

REFERENCES

Adler-Nissen, J. (1977). Enzymatic hydrolysis of food protein Process. Biochemical 12: 15-32.
Boyd S.A., Sommers L.E. and Nelson W. (1980). Change in the humic acid fraction of soil resulting from sludge application. Soil Sci. Soc. Am. J. 44, 1179–1186.
Iakimenko O., Otabbong E., Sadovnikova L., Persson J., Nilsson I., Orlov D. and Ammosova Y. (1996). Dynamic transformation of sewage sludge and farmyard manure components. 1. Content of humic substances and mineralization of organic carbon and nitrogen in incubated soils. Agric. Ecosyst. Environ. 58, 121–126.
Navas A., Bermùdez F. and Machìn J. (1998). Influence of sewage sludge application on physical and chemical properties of Gypsisols, Geoderma 87, 123–135.
Wong J.W.C., Lai K.M., Fang M. and Ma K.K. (1998). Effect of sewage sludge amendment on soil microbial activity and nutrient mineralization, Environ. Int. 24 (8), 935–943.

WFD4 / MDG4 Smallwat11 3rd INTERNATIONAL CONGRESS