METALLOMICS 2011

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3rd International Symposium on Metallomics

Westfälische Wilhelms-Universität Münster

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ArbeitsKreis Separation Science

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TBS08 **Synthesis of Stable Silver Nanoparticles Using Aqueous Solutions of Pullulan and its Polyaldehydes**
Stefanovic, J., Belgrade/SRB, Ilic, D. D., Belgrade/SRB, Jakovljevic, D. M., Belgrade/SRB, Gojgic-Cvijovic, G. D., Belgrade/SRB, Vrvic, M. M., Belgrade/SRB

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TTM01 **The Application of Microwave Digestion for Improved Efficacy of Metalloprotein Identification**
Afton, S., Research Triangle Park/USA, Van Sant, C., Research Triangle Park/USA, Cargile, B. J., Research Triangle Park/USA, Bunger, M. K., Research Triangle Park/USA, Essader, A. S., Research Triangle Park/USA, Levine, K. E., Research Triangle Park/USA, Grohse, P. M., Research Triangle Park/USA

TTM02 **Electrospray Ionization Mass Spectrometry (ESI-MS) of Benzoylthiourea (BTU) Complexes of Palladium and Platinum**
Aggarwal, S. K., Mumbai/IND, Kumar, P., Mumbai/IND, Jaison, P. G., Mumbai/IND, Telmore, V. M., Mumbai/IND

TTM03 **Identification and Quantification of Selenoproteins in Human Serum and Plasma Standard Reference Materials**
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TTM04 **Speciation of Biologically Important Metal Chelate Systems Using Hyphenated Techniques: CE-MS Study of the Distribution of Ni (II)-Histidine in Solution**
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TTM06 **Monitoring the Synthesis of Metal Glycinates by LC-ESI-MS**
Egressy-Molnár, O., Budapest/H, Németh, A., Budapest/H, Dernovics, M., Budapest/H

TTM07 **Exploration of Target Molecules for Molecular Imaging of Ulcerative Colitis**
Higashikawa, K. H., Okayama/J, Higashikawa, K., Okayama/J, Akada, N., Okayama/J, Yagi, K., Okayama/J, Watanabe, K., Okayama/J, Kamino, S., Kobe/J, Hiromura, M., Kobe/J, Kanayama, Y., Kobe/J, Enomoto, S., Okayama/J

TTM08 **Micro-XRF Imaging and X-ray Absorption Fine Structure Analysis Utilizing High-energy Synchrotron Radiation to Investigate the Accumulation Mechanism of Cd in Plants**
Hokura, A., Tokyo/J, Yamaoka, W., Tokyo/J, Hayashi, Y., Wako/J, Terada, Y., Sayo-cho/J, Abe, T., Wako/J, Nakai, I., Tokyo/J

Synthesis of stable silver nanoparticles using aqueous solutions of pullulan and its polyaldehydes

Jovana R. Stefanović, Belgrade/SRB, D. D. Ilić, Belgrade/SRB, D. M. Jakovljević, Belgrade/SRB, G. Đ. Gojgić-Cvijović, Belgrade/SRB, M. M. Vrvić, Belgrade/SRB,
IChTM - Department of Chemistry, University of Belgrade, Njegoševa 12, Belgrade/SRB

Pullulan is one of the extracellular polysaccharides produced by the "black yeast" *Aureobasidium pullulans* that is widely spread in different ecological sites, including forest, soil and peat [1]. Pullulan is a linear α-D-glucan which structure consists of a series of maltotriose units connected by α-D-(1→6) glycosidic bonds. However, some of the maltotriosyl residues are replaced by higher oligosaccharide units, most frequently with maltotetraosyl units [2]. In the earlier work we reported structure of the pullulan produced by *Aureobasidium pullulans*, strain CH-1 [3].

Silver nanoparticles have been synthesized by using linear polysaccharide pullulan and its polyaldehyde that served to cross-link the individual polymeric chains of this polysaccharide. Obtained solutions of polymers were used as both the reducing and stabilizing agents. Reactions were carried out in two different conditions: in the microwave and in the autoclave. Nanoparticles thus prepared are found to be stable in aqueous solution over a period of one month at room temperature, without any aggregation of the particles. UV-Vis spectra of the investigated solutions showed a characteristic absorption peak at 424 nm.

The morphology of the samples was analyzed using scanning electron microscopy (SEM), which showed polydispersity of the particle size.

Antimicrobial activity testing was carried out at agar plates with different concentrations of the investigated solutions, against various strains of bacteria and fungi. Results showed that the microbial growth was gradually reduced as the concentration of the silver increased.

Application of pullulan and its derivatives in nanochemistry extends the application of this polysaccharide, which is already widely present in various fields, such as medicine, biotechnology, food, pharmaceutical, cosmetic and many other industries [4].

References:

[1] M. Đ. Radulović, O. G. Cvetković, S. D. Nikolić, D. S. Đordević, D. M. Jakovljević, M. M. Vrvić, *Biores. Technol.* **99** (2008) 6673-6677
[2] D. D. McIntyre and H. J. Vogel, *Starch*, **45** (1993) 406-410
[3] D. M. Jakovljević, M. M. Vrvić, M. Đ. Radulović, M. S. Hranisavljević - Jakovljević, *J. Serb. Chem. Soc.* **66** (2001) 377-383
[4] R. S. Singh, G. K. Saini, J. F. Kennedy, *Trends Biomater. Artif. Organs*, **20** (2007)

SYNTHESIS OF STABLE SILVER NANOPARTICLES USING AQUEOUS SOLUTIONS OF PULLULAN AND ITS POLYALDEHYDES

J. R. Stefanović [1], D. D. Ilić [2], D. M. Jakovljević [1], G. Đ. Gojgić-Cvijović [1], M. M. Vrvić [2]

[1] IChTM - Department of Chemistry, University of Belgrade, Njegoševa 12, P.O. Box 473, 11000 Belgrade, Serbia (jovana_stefanovic@chem.bg.ac.rs)

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Pullulan is one of the extracellular polysaccharides produced by the "black yeast" *Aureobasidium pullulans* that is widely spread in different ecological sites, including forest, soil and peat [1]. Pullulan is a linear α-D-glucan which structure consists of a series of maltotriose units connected by α-D-(1→6) glycosidic bonds. However, some of the maltotriosyl residues are replaced by higher oligosaccharide units, most frequently with maltotetraosyl units [2]. In the earlier work we reported structure of the pullulan produced by *Aureobasidium pullulans*, strain CH-1 [3].

Silver nanoparticles have been synthesized using pullulan and its polyaldehydes that served to cross-link the individual polymeric chains of this polysaccharide and 100 mM $AgNO_3$. Obtained solutions of polymers were used as both the reducing and stabilizing agents. Reactions were carried out in two different conditions: in the microwave and in the autoclave. Nanoparticles thus prepared are found to be stable in aqueous solution over a period of one month at room temperature, without any aggregation of the particles (Figure 1). UV-Vis spectra of the investigated solutions showed a characteristic absorption peak at 424 nm (Figure 2).

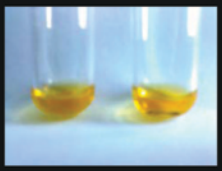

Figure 1: Solutions of silver nanoparticles, one day after experiment (left) and one month later (right)

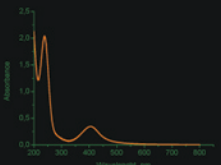

Figure 2: UV-Vis spectrum of the silver nanoparticles

The morphology of the samples was analyzed using scanning electron microscopy (SEM), which showed polydispersity of the particle size (Figures 3, 4).

Antimicrobial activity testing was carried out at agar plates with different concentrations of the investigated solutions, against various strains of bacteria and fungi. Results showed that the microbial growth was gradually reduced as the concentration of the silver increased. Figure 5 represents some experiments against *Micrococcus lysodeikticus* ATCC 4698.

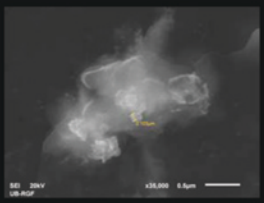

Figure 3: Scanning electron micrography of obtained silver nanoparticles

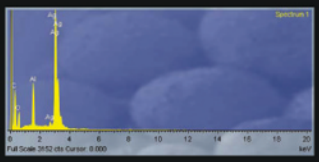

Figure 4: Energy-dispersive spectroscopy spectrum of silver nanoparticles prepared from 100 mM $AgNO_3$ solution

Figure 5: Antimicrobial test against Micrococcus lysodeikticus

Application of pullulan and its derivatives in nanochemistry extends the use of this polysaccharide, which is already widely present in various fields, such as medicine, biotechnology, food, pharmaceutical, cosmetic and many other industries [4].

REFERENCES:

[1] M. Đ. Radulović, O. G. Cvetković, S. D. Nikolić, D. S. Đorđević, D. M. Jakovljević, M. M. Vrvić, *Biores. Technol.* **99** (2008) 6673-6677

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[4] R. S. Singh, G. K. Saini, J. F. Kennedy, *Trends Biomater. Artif. Organs*, **20** (2007)

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