THE IMPROVEMENT OF PHOTOSTABILITY AND ANTIOXIDANT ACTIVITY OF *trans*-RESVERATROL BY CYCLODEXTRINS

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The aim of this paper was to prepare the solid-state inclusion complexes of *trans*-resveratrol with β -cyclodextrin and (2-hydroxypropyl)- β -cyclodextrin from ethanol-water mediums in order to improve its physico-chemical properties. The structure characterization was performed using FTIR, XRD and NMR methods. It was confirmed that the complexed *trans*-resveratrol has higher photostability than free *trans*-resveratrol. The results of DPPH assay suggested that the complexes have enhanced the antioxidant activity compared with *trans*-resveratrol. The inclusion complex with (2-hydroxypropyl)- β -cyclodextrin showed a better antioxidant activity than the complex based on β -cyclodextrin. The prepared inclusion complexes represent potential pharmaceutical active substances for a new products design.

Keywords: *trans*-resveratrol, β -cyclodextrin, (2-hydroxypropyl)- β -cyclodextrin, antioxidant activity, photostability.

Introduction

Resveratrol (3,5,4'-trihydroxy-*trans*-stilbene) is a natural polyphenol compound which is composed of two aromatic rings bonded by an unsaturated alkene bridge (Figure 1). The presence of double bonds allows two geometrical isomers of resveratrol (*cis*- and *trans*-resveratrol). It can exist in the free form or in the form of glycoside.

Figure 1. Structure of: a) *trans*- and b) *cis*-resveratrol.

Resveratrol is a very efficient antioxidant [1,2] and can be used in the prevention of cardiovascular disease and cancer. It helps to slow the aging process and protects the body's immune system. In addition, it has anti-inflammatory [3] and antimicrobial properties [4]. However, its use in pharmacy is limited due to their poor aqueous solubility (about 0.03 g dm⁻³ at room temperature), low oral bioavailability and stability [5]. Although it is absorbed about 70% after oral administration, the bioavailability of resveratrol is very small (less than 1%) due to its rapid metabolism and excretion. Numerous studies showed that resveratrol is an unstable substance either in the pure form or in the plant extracts [6-8]. Under the effect of light [9] and high pH value, *trans*-resveratrol is subjected to isomerization and transitions in the *cis*- form,

which is less pharmacologically active [10]. Different approaches were applied in order to improve the drug stability, increase bioavailability and minimize side-effects of resveratrol. Due to low bioavailability and stability, the structure of resveratrol was modified to give a series of analogs thereof, which may be promising candidates for the future oncology treatment [11]. Today, more and more attention is paid to the development of novel drug delivery systems available to encapsulate, protect and release resveratrol [2, 12-16]. Cyclodextrins (CDs) and their derivatives are also used in the modification of resveratrol properties [17-21]. Apparent formation constants of resveratrol complexes with CDs were determined using HPLC, enzymatic, solubility and fluorimetric assays [22-24]. In the literature, there are numerous reports on the antioxidant activity of resveratrol:CD inclusion complexes [25-28].

Until now, the preparation of resveratrol complexes with β -CD and HP- β -CD was commonly conducted by wet technologies, where usually highly amorphous products are got. Due to this way of preparation and loss of the inclusion complexes crystallinity, wrong conclusions can be derived during solid-state characterization. Therefore, Trollope et al. [19] prepared resveratrol inclusion complexes with methylated CDs (permethylated α -CD, permethylated β -CD and 2,6-dimethylated β -CD) in the crystalline form using various preparative methods such as physical mixing, kneading or co-crystallization from different solutions by co-evaporation or exposure to microwave radiation.

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Due to the lack of information about the structure of solid-state inclusion complexes between resveratrol and β -CD or HP- β -CD in the literature, the aim of this study was to prepare the corresponding complexes. The inclusion complexes were prepared by co-evaporation. The structural characterization of the complexes was achieved using FTIR, XRD and NMR methods. The photostability and antioxidant activity of free and complexed *trans*-resveratrol were defined in order to analyze the advantages of inclusion into the cavity of CDs.

Experimental

Reagents

Trans-resveratrol (>99,4%) was purchased from Dr. Ehrenstorfer GmbH (Augsburg, Germany). β -CD (purity 98%, Mr ~1,135), HP- β -CD (purity 97%, Mr ~1,540) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) were supplied by Sigma Aldrich (Taufkirchen, Germany). Potassium bromide was FTIR grade and obtained from Merck (Darmstadt, Germany). Ethanol (96%, v/v) was purchased from Zorka Pharma (Šabac, Serbia), while butylated hydroxytoluene (BHT) was supplied by Centrohem (Stara Pazova, Serbia). All other used reagents and solvents were analytical grade.

Preparation of the inclusion complexes

Inclusion complexes between *trans*-resveratrol and CDs were prepared in 1:1 molar ratio. *Trans*-resveratrol (30 mg) was mixed with β -CD (149.18 mg) or HP- β -CD (202.42 mg) and dissolved in the 35 cm³ mixture of distilled water and 96% (v/v) ethanol. Water and 96% (v/v) ethanol were mixed in 5:2 volume ratio, which represents the 23.3% (v/v) ethanol solution. Thus prepared mixture was equilibrated using a magnetic stirrer (HANNA HI300) at the stirring speed of 600 rpm and room temperature for 24 h. The samples were protected from the effect of daylight using aluminium foil. The solutions of inclusion complexes were evaporated under vacuum at 60 °C using a rotavapor.

Structural characterization of the inclusion complexes

Infrared spectroscopy with Fourier transformation (FTIR)

Infrared spectra of *trans*-resveratrol, β -CD, HP- β -CD and appropriate inclusion complexes were recorded by a technique of KBr transparent pellets. Firstly, 150 mg of KBr and 1 mg of the sample were ground in a mortar in order to homogenize the mixture, and then it was compressed at the pressure of 200 MPa under vacuum. The spectra were measured in the wavelength range of 4000-400 cm⁻¹ with the resolution of 4 cm⁻¹ using FTIR spectrophotometer (Bomem Hartmann & Braun MB-series) and processed using the software Win-Bomem Easy.

X-ray Powder Diffraction (XRD)

XRD spectra of the samples were recorded using

XRD diffractometer. The samples were irradiated by monochromatic Cu- α radiation and analyzed in the range of 2θ angle between 3 and 60°. The increment of 2θ angle was 0.05° with recording time of 2 s. The used voltage was 40 kV, while the current was 12 mA, respectively.

Nuclear Magnetic Resonance (NMR)

¹H-NMR spectra of the inclusion complexes of *trans*-resveratrol with CDs were recorded on a Bruker Avance III NMR spectrophotometer equipped with a glass cuvette of 5 mm diameter. The recording was performed by the pulse method with multiple pulse repetitions under the operating frequency of 250 MHz at room temperature. The heavy water (D₂O) was used as a solvent.

Analysis of *trans*-resveratrol by UV method

A series of solutions were prepared by dissolving the methanol solution of *trans*-resveratrol (50 µg cm⁻³) in the concentration range of 1-8 µg cm⁻³. The calibration curve was constructed by measuring the absorbance of the samples at 303 nm in quartz cuvettes (1×1×4.5 cm) on UV spectrophotometer (Varian Cary-100 Conc.). The equation of the calibration curve can be shown as follows $A_{303} = 0.092 C (\mu\text{g cm}^{-3}) - 0.0256$ ($R^2 = 0.9958$). The proposed regression model was used to determine the content of *trans*-resveratrol during the photostability studies. The control solutions consisted of the equivalent amount of CDs. Absorbance of the samples was measured at room temperature. Methanol was used as a blank sample. The percentage of *trans*-resveratrol degradation was calculated in the following way (Equation 1):

$$\text{degradation of trans-resveratrol (\%)} = \frac{C_0 - C_t}{C_0} \times 100 \dots \dots \dots (1)$$

where are, C_0 – the initial concentration of *trans*-resveratrol, C_t – the concentration of *trans*-resveratrol after irradiation.

Photostability experiments of the inclusion complexes

In order to investigate the photostability of *trans*-resveratrol and inclusion complexes in methanol, the initial concentrations of the samples were prepared as equivalent to 8 µg cm⁻³ of *trans*-resveratrol. The samples were sonicated for 15 min, and then exposed to UVA and UVB irradiation in different intervals (0-600 s). The radiation of the samples was performed in the photochemical reactor "Rayonet" with ten symmetrically UVA or UVB lamps. The maximum emission of UVA and UVB lamps was at 350 and 300 nm, respectively. During irradiation, the samples were kept in quartz cuvettes (1×1×4.5 cm) mounted on a circular rotating bracket. The total energy flux of UVA and UVB radiation was 11.5 and 14.5 W m⁻², respectively. The irradiated samples were further analyzed using the UV spectrophotometry method.

Antioxidant activity

The antioxidant activity of *trans*-resveratrol and inclu-

sion complexes was determined using DPPH assay and compared with the synthetic antioxidant BHT. Exactly 1 cm³ of DPPH ethanol solution (3×10⁻⁴ mol dm⁻³) was added to 2.5 cm³ ethanol solution of *trans*-resveratrol (6.25–400 µg cm⁻³) or BHT (7.81–250 µg cm⁻³) or inclusion complexes of *trans*-resveratrol:β-CD (25–500 µg cm⁻³) and *trans*-resveratrol:HP-β-CD (25–300 µg cm⁻³). The control solution was prepared by the dilution of 1 cm³ of DPPH solution with 2.5 cm³ ethanol. In order to perform the reactions, the samples were incubated for 30 min. The absorbance of the samples was measured at 517 nm on UV spectrophotometer (Varian Cary-100 Conc.). The inhibition of DPPH radicals was calculated using the following Equation 2:

$$\text{inhibition of DPPH radicals (\%)} = \frac{A_c - A_s}{A_c} \times 100 \dots\dots\dots(2)$$

where are A_s – absorbance of the samples treated with DPPH radicals, A_c – absorbance of the control solution [29].

Results and discussion

Structural characterization of inclusion complexes FTIR analysis

The strong band characteristic for *trans*-resveratrol can be noticed at 3290 cm⁻¹, which originates from valence ν(OH) vibrations of phenols (Figure 2a). The band at 3021 cm⁻¹ is the result of the valence vibration of vinyl group νas (=C-H), while the bands at 2924 and 2852 cm⁻¹ originate from the valence vibrations of C-H bond from CH and CH₂ groups. The valence vibrations ν(C=C) of the benzene ring were noticed at 1606, 1587, 1512 and 1444 cm⁻¹. The in-plane deformational vibrations of OH group appeared at 1384 and 1325 cm⁻¹, which is expected because they usually occur in the range of 1500-1300 cm⁻¹. These bands are not of major importance for OH group identification. Additional bands of valence vibrations of C-C bond at 1248 cm⁻¹ and of C-O bond from the phenol group at 1154 cm⁻¹ were noticed in the spectrum. The deformational vibration of C-H bond substituted on C=C from *trans* orientation had a strong band at 966 cm⁻¹. The band at 831 cm⁻¹ originates from the deformational vibration of C-H bond of the benzene ring. The out-of-plane deformational vibration γ(OH) of OH group has the band at 675 cm⁻¹.

Broad bands at 3395 cm⁻¹ and 3411 cm⁻¹ are the result of the valence vibration of O-H bond in the FTIR spectrum of β-CD (Figure 2b) and HP-β-CD (Figure 3b), respectively. Valence vibrations of C-H bond from CH and CH₂ group have bands at 2926 cm⁻¹ for β-CD, i.e. 2976 and 2927 cm⁻¹ for HP-β-CD. Deformation vibrations of O-H bond for both molecules occurred at 1635 cm⁻¹. Characteristic bands at 1412 and 1334 cm⁻¹ or 1414 and 1378 cm⁻¹ correspond to the deformation vibrations of C-H bond in the structures of β-CD and HP-β-CD, respectively. The sharp band at 1156 cm⁻¹ indicates the presence of the valence vibration of C-C bond. The bands in the range of 1100-1030 cm⁻¹ originate from the valence vibration

of C-O bond and OH groups of β-CD or HP-β-CD. In the range of 950-700 cm⁻¹, deformational vibrations of C-H bond are present.

Broad bands can be noticed at 3399 cm⁻¹ and 3423 cm⁻¹, respectively, as the result of valence vibrations of O-H bonds in the FTIR spectra of *trans*-resveratrol:β-CD complex (Figure 2c) and *trans*-resveratrol:HP-β-CD complex (Figure 3c). These bands of inclusion complexes were significantly shifted to high values of the wavenumber in comparison with the same band of free *trans*-resveratrol. In the case of *trans*-resveratrol:β-CD complex, the band was shifted for 109 units while in the case of *trans*-resveratrol:HP-β-CD complex the band was shifted for 133 units. If these bands are compared in relation to the bands from the spectra of β-CD and HP-β-CD, they are shifted for 4 and 12 units, respectively. The band of νas (=C-H) was shifted to the lower wavenumber for about 40 units compared with the same band in the spectrum of *trans*-resveratrol. The band of the valence vibration of C-H bond occurred at 2928 cm⁻¹ in the spectra of both inclusion complexes. It was shifted for 4 units to higher values of the wavenumber compared with the spectrum of *trans*-resveratrol. Unlike the FTIR spectrum of *trans*-resveratrol, the presence of deformational vibrations of O-H bonds was noticed at 1636 or 1640 cm⁻¹ in the spectra of inclusion complexes. This fact indicates that O-H bonds of CDs are included in complexing of *trans*-resveratrol. The bands at 1606 and 1587 cm⁻¹, originating from valence vibrations of C=C bond from the benzene ring, were not identified in the spectra of complexes, while the band at 1512 cm⁻¹ had a significantly low intensity. The band at 1444 cm⁻¹ for both inclusion complexes was shifted to higher wavenumbers (1451 and 1459 cm⁻¹). These changes in the spectra indicate that C=C bond of the ring probably participated in the complex formation. The lower intensity of deformational vibrations in plane δ(OH) were confirmed at 1382 cm⁻¹ for both complexes. In the spectrum of the complex, the presence of the valence vibration of C-C bond was noticed at 1269 cm⁻¹. In addition to that, the valence vibrations of C-O bond from the phenolic group at 1158 or 1156 cm⁻¹ were also noticed. Sharp bands at 1082 and 1050 cm⁻¹ or at 1083 and 1044 cm⁻¹ correspond to the valence vibrations of ether bond C-O and hydroxyl groups of β-CD or HP-β-CD, respectively.

Based on the aforementioned changes in the FTIR spectra, it can be assumed that the Van der Waals interactions between *trans*-resveratrol and CDs are formed, i.e. that the inclusion complexes are probably prepared.

Figure 2. FTIR spectra: a) *trans*-resveratrol; b) β -CD; c) *trans*-resveratrol: β -CD inclusion complex.

Figure 3. FTIR spectra: a) *trans*-resveratrol; b) HP- β -CD; c) *trans*-resveratrol:HP- β -CD inclusion complex

Figure 4. XRD diffractogram of: a) *trans*-resveratrol, b) β -CD c) *trans*-resveratrol: β -CD complex, d) HP- β -CD, e) *trans*-resveratrol:HP- β -CD complex.

XRD analysis

XRD diffractograms of *trans*-resveratrol, complexing agents (β -CD, HP- β -CD) and inclusion complexes are shown in Figure 4.

Trans-resveratrol diffractogram has the peaks at 7.1°; 13.3°; 16.5°; 19.2° and 22.1° which indicate its highly

crystalline structure (Figure 4a). On the diffractogram of β -CD (Figure 4b), the peaks that occurred on 2θ of 6.2°, 8.9°, 10.7°, 11.8°, 12.6°, 15.5°, 17.2°, 19.6°, 20.9° and 22.8° indicate that β -CD has a typical crystal structure. In the diffractogram of *trans*-resveratrol: β -CD complex (Figure 4c), the change in the intensity and position of

individual peaks can be noticed. The peaks of *trans*-resveratrol at 7.1° and 19.2° were shifted to 6.9° and 18.6°, respectively, in the spectrum of the inclusion complex. In the diffractogram of the complex there is a certain change in comparison with the spectrum of β -CD. The peaks of β -CD at 11.5°, 17° and 22.5° are not present in the XRD spectrum of the complex with β -CD. The analysis of these diffraction patterns indicates that the inclusion complex was formed between *trans*-resveratrol and β -CD. A great number of clear defined peaks in the XRD

spectrum of the complex with β -CD also suggest that the newly created structure is of crystalline type. In the diffractogram of HP- β -CD (Figure 4d), the absence of crystalline peaks indicate its amorphous structure. XRD spectrum of the *trans*-resveratrol:HP- β -CD complex (Figure 4e) has shown that the structure of this complex is also amorphous. Based on that, it can be concluded that there is the formation of the inclusion complex between *trans*-resveratrol and HP- β -CD.

Figure 5. Structure of *trans*-resveratrol (a), β -CD and HP- β -CD (b) with marked positions of atoms.

¹H-NMR analysis

The structures of *trans*-resveratrol, β -CD and HP- β -CD with clearly marked positions of atoms are given in Figure 5.

Chemical shifts of signals in the ¹H-NMR spectra of β -CD and *trans*-resveratrol: β -CD complex previously dissolved in D₂O at 25 °C are presented in Table 1. H-1 proton has a chemical shift at 5.091 ppm in the spectrum of β -CD, while chemical shifts of other protons are in the range of δ 3.5-4.0 ppm. Similar chemical shifts with some changes for given protons can be noticed in the spectrum of the inclusion complex. The greatest changes in chemical shifts $\Delta\delta$ +0.030, +0.035 and +0.068 for H-6, H-3 and H-5 protons, respectively, indicate that these protons participated in the intermolecular interaction with the molecule of *trans*-resveratrol. So, H-5 proton is mainly included in forming hydrogen bonds due to the highest change in chemical shifts.

Table 1. Chemical shifts (δ) of the signal in the ¹H-NMR spectra of β -CD and *trans*-resveratrol: β -CD complex dissolved in D₂O at 25 °C

	β -CD	res: β -CD complex	$\Delta\delta$
H-1	5.091	5.100	+0.009
H-2	3.650	3.660	+0.010
H-3	3.956	3.991	+0.035
H-4	3.610	3.612	+0.002
H-5	3.814	3.882	+0.068
H-6	3.870	3.900	+0.030
res - resveratrol			

The chemical shifts which refer to HP- β -CD and resveratrol:HP- β -CD inclusion complex, as well as the change in the chemical shifts in the spectrum of HP- β -CD after complexation are given in Table 2. The largest changes in the chemical shifts $\Delta\delta$ +0.033, +0.034 and +0.068 were noticed for H-6, H-3 and H-5 protons, respectively. The forming interactions between these protons are expected since they are located in the CD cavity. If the change in chemical shifts of CD after complexation is compared with *trans*-resveratrol, it can be observed that the change has almost the same order. In other words, the intermolecular interactions formed between the guest and host molecules are realized through the same protons.

Table 2. Chemical shifts (δ) of the signal in ¹H-NMR spectra of HP- β -CD and *trans*-resveratrol:HP- β -CD complex dissolved in D₂O at 25 °C

	HP- β -CD	res:HP- β -CD complex	$\Delta\delta$
H-1	5.227	5.250	+0.023
H-1'	5.091	5.102	+0.011
H-2	3.659	3.670	+0.011
H-3	3.943	3.977	+0.034
H-4	3.614	3.615	+0.001
H-5	3.807	3.875	+0.068
H-6	3.864	3.897	+0.033
CH ₃ hydroxypropyl	1.159	1.182	+0.023
res - resveratrol

Figure 6. Photodegradation of *trans*-resveratrol and inclusion complexes with β -CD and HP- β -CD at: a) 350 b) 300 nm.

Photostability of the inclusion complexes

In order to examine photostability, methanol solutions of complexes and *trans*-resveratrol were exposed to irradiation at 350 and 300 nm in the photochemical reactor. The stability of these complexes and *trans*-resveratrol in methanol was compared at the concentration of 8 mg cm^{-3} . The concentration of *trans*-resveratrol in the pure and complexed form was monitored by UV method. The influence of complexing agents β -CD and HP- β -CD on photostability of *trans*-resveratrol is shown in Figure 6.

Based on the photodegradation profile of *trans*-resveratrol and its complexes, it can be concluded that CDs have a significant impact on the level of *trans*-resveratrol degradation. After UVA irradiation (350 nm) of the samples during 600 s, the content of *trans*-resveratrol was decreased for 56.11%, while its content in the complexes of *trans*-resveratrol: β -CD and *trans*-resveratrol:HP- β -CD was decreased for 52.4% and 53.24%, respectively. For UVB radiation (300 nm), the content of *trans*-resveratrol was decreased for 62.62%. In the complexes of *trans*-resveratrol: β -CD and *trans*-resveratrol:HP- β -CD, the content of *trans*-resveratrol was decreased for 42.95% and 35.92%, respectively. The analysis of the obtained results indicates that the content reduction of *trans*-resveratrol in the pure and complexed form is less when exposed to UVA radiation for the same period, in comparison with UVB radiation. These results are expected, considering that UVA radiation has lower intensity compared to UVB. Also, in both types of radiation it was noted that the incorporation of *trans*-resveratrol in the CDs cavity leads to the reduction of its photodegradation.

Determination of the antioxidant activity of inclusion complexes

Due to the presence of two phenolic rings resveratrol can donate hydrogen atoms which are directly responsible for its antioxidant activity [30]. In the reaction with DPPH radicals, the donation of protons is possible over monophenolic hydroxyl groups. The antioxidant activity of *trans*-resveratrol, *trans*-resveratrol: β -CD and *trans*-

resveratrol:HP- β -CD inclusion complexes, as well as BHT is shown in Figure 7.

Figure 7. Antioxidant activity of BHT ($7.81\text{--}250 \text{ } \mu\text{g cm}^{-3}$), *trans*-resveratrol ($6.25\text{--}400 \text{ } \mu\text{g cm}^{-3}$), *trans*-resveratrol: β -CD (equivalent to $4.2\text{--}83.7 \text{ } \mu\text{g cm}^{-3}$ *trans*-resveratrol) and *trans*-resveratrol:HP- β -CD (equivalent to $3.2\text{--}38.7 \text{ } \mu\text{g cm}^{-3}$ *trans*-resveratrol) inclusion complexes.

After the complexation of *trans*-resveratrol with β -CD and HP- β -CD, its ability to “scavenge” DPPH radicals was significantly increased. The interaction of *trans*-resveratrol and CDs leads to the formation of hydrogen bonds between hydroxyl groups of *trans*-resveratrol and electronegative CDs atoms. The calculated IC_{50} value of *trans*-resveratrol was $66 \text{ } \mu\text{g cm}^{-3}$, while the IC_{50} values of *trans*-resveratrol: β -CD and *trans*-resveratrol:HP- β -CD inclusion complexes were found to be 197.6 and $129 \text{ } \mu\text{g cm}^{-3}$, respectively. The concentration of $197.6 \text{ } \mu\text{g cm}^{-3}$ for *trans*-resveratrol: β -CD complex was equivalent to $33.1 \text{ } \mu\text{g cm}^{-3}$ of *trans*-resveratrol, and the concentration of $129 \text{ } \mu\text{g cm}^{-3}$ for *trans*-resveratrol:HP- β -CD complex was equivalent to $16.7 \text{ } \mu\text{g cm}^{-3}$ of *trans*-resveratrol. BHT showed a slightly higher antioxidant activity compared with *trans*-resveratrol, because its IC_{50} value was

36.6 $\mu\text{g cm}^{-3}$. Having in mind that IC_{50} value of *trans*-resveratrol:HP- β -CD complex is almost two times lower than the value obtained for the *trans*-resveratrol: β -CD complex, it can be concluded that *trans*-resveratrol:HP- β -CD complex showed a better antioxidant activity.

Conclusion

The results of FT-IR, NMR and XRD analyses have shown that the complexation between *trans*-resveratrol and β -CD, *i.e.* HP- β -CD was successfully achieved in 5:2 (v/v) ethanol-water mediums at room temperature for 24 h. Based on the photostability studies of complexed and noncomplexed *trans*-resveratrol in methanol, it was confirmed that CDs have a big influence on the *trans*-resveratrol degradation. Also, it was concluded that prepared inclusion complexes are more stable under UVA irradiation compared with UVB light. The antioxidative activity of *trans*-resveratrol in the pure and complexed form was analyzed by using DPPH assay. The *trans*-resveratrol-HP- β -CD complex showed a better antioxidative activity compared with the standard of *trans*-resveratrol, as well as the *trans*-resveratrol: β -CD complex. The prepared *trans*-resveratrol complexes with improved photostability and antioxidative activity can be found on the list of potential therapeutic agents for the production of new dermal and oral formulations for the treatment of human diseases.

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Izvod

POBOLJŠANJE FOTOSTABILNOSTI I ANTIOKSIDATIVNE AKTIVNOSTI *trans*-RESVERATROLA PRIMENOM CIKLODEKSTRINA

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Cilj ovog rada bio je priprema inkluzionih kompleksa *trans*-resveratrola sa β -ciklodekstrinom i (2-hidroksipropil)- β -ciklodekstrinom u čvrstom stanju iz vodenometanolnog medijuma radi poboljšanja njegovih fizičko-hemijskih svojstava. Strukturna karakterizacija pripremljenih kompleksa izvršena je primenom FTIC, XRD i NMR metoda. Utvrđeno je da kompleksirani oblik *trans*-resveratrola ima veću fotostabilnost od slobodnog *trans*-resveratrola. Rezultati DPPH testa pokazali su da kompleksi imaju poboljšanu antioksidativnu aktivnost u odnosu na *trans*-resveratrol. Inkluzioni kompleks sa (2-hidroksipropil)- β -ciklodekstrinom pokazuje bolju antioksidativnu aktivnost od kompleksa na bazi β -ciklodekstrina. Pripremljeni inkluzioni kompleksi predstavljaju potencijalne farmaceutске aktivne supstance za dizajniranje novih proizvoda.

Ključne reči: *trans*-resveratrol, β -ciklodekstrin, (2-hidroksipropil)- β -ciklodekstrin, antioksidativna aktivnost, fotostabilnost.