

## COMPARATIVE BIBLIOMETRIC STUDY ON THE APPLICATION OF PRINCIPLES OF GREEN AND SUSTAINABLE PHARMACY IN PUBLICATIONS FROM SERBIA AGAINST SELECTED EUROPEAN COUNTRIES

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The problem of pharmaceutical pollution has motivated many researchers to contribute to identification and prevention of pollution, improvement of manufacturing and raw materials used in pharmaceutical industry. The area that unites such research is called the green pharmacy [1]. This study aims to compare the bibliometric parameters of research publications based on the principles of green pharmacy in Serbia against selected European countries. A literature search was conducted in September 2021, in the Web of Science database (Clarivate Analytics), using keywords Topic=(pharmac\*) AND ("water pollut\*" or "soil pollut\*" OR "waste management" OR "waste disposal" OR "green chemistry" OR "green pharmacy" OR "sustainable chemistry" OR "sustainable pharmacy" OR "environmental risk" OR "environmental impact"). The search was limited to period 2014 - 2018. Only literature indexed in the "Science Citation Index Expanded" was considered. Publications affiliated to institutions from Serbia were compared with those from Bulgaria and Denmark as reference countries selected due to comparable population, EU membership and, in case of Bulgaria, similar socio-economic environment. A total of 15038 publications contained the requested keywords, of which 5537 were published in the period 2014-2018. In that period, 62 publications were published in Denmark, 27 in Serbia and 5 in Bulgaria. The average citation and h-index of the selected papers are as follows: 43.24 and 23 for Denmark, 43.93 and 15 for Serbia and 17.6 and 5 for Bulgaria. The type of publications is predominantly original scientific paper (100% in Bulgaria, 93.5% in Denmark and 85.15% in Serbia). Review articles (Denmark - 4, Serbia - 3), book chapters (Serbia - 1) and editorial (Serbia - 1) are less represented. Researchers from Serbia have published in collaboration with scientists from 22 countries, most often from Germany and Portugal. Researchers from Denmark cooperated with researchers from 30 countries, while those from Bulgaria with five. "Water quality", "pharmaceutical residues", "pharmaceuticals", "analgesics" are the most common keywords in publications affiliated to Serbian institutions. Similarly, common keywords in Danish publications are "pharmaceuticals", "wastewater", "critical body residue", "seafood" and "immune suppression". Due to the small sample, the analysis of Bulgarian publications could not be conducted. Considering the number of research institutions, mobility opportunities and investment in science, significant difference in the number of publications between Serbia and EU countries was expected. This study showed that despite the smaller number of publications, qualitative indicators indicate that quality of studies conducted in Serbia is comparable to those from the selected EU countries.

### References

1. Green and Sustainable Pharmacy, Klaus Kummerer and Maximilian Hempel, eds. Springer-Verlag: Berlin Heidelberg, 2010, doi:10.1007/978-3-642-05199-9.

# KOMPARATIVNA BIBLIOMETRIJSKA ANALIZA PRIMENE PRINCIPA ZELENE I ODRŽIVE FARMACIJE U PUBLIKACIJAMA U SRBIJI U ODNOSU NA ODABRANE EVROPSKE ZEMLJE

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Problem zagađenja životne sredine uzrokovanog lekovima motivisao je mnoge istraživače da daju doprinos u identifikaciji i prevenciji zagađenja, unapređivanju industrijskih procesa i sirovina. Oblasť koja objedinjuje takva istraživanja nazvana je zelena farmacija (1). Cilj studije je da se uporede bibliometrijski parametri istraživanja zasnovanih na principima zelene farmacije u Srbiji u odnosu na odabrane evropske zemlje. Pretraživanje literature sprovedeno je u septembru 2021. godine, u bazi Web of Science (Clarivate Analytics), pomoću ključnih reči Topic = (pharmac\*) AND ("water pollut\*" or "soil pollut\*" OR "waste management" OR "waste disposal" OR "green chemistry" OR "green pharmacy" OR "sustainable chemistry" OR "sustainable pharmacy" OR "environmental risk" OR "environmental impact"). Pretraga je ograničena na period 2014-2018. godina na literaturu indeksiranu u Science Citation Index Expanded. Izdvojene su publikacije sa afilijacijama istraživačkih institucija u Srbiji, i poređene sa publikacijama istraživača iz Bugarske i Danske, koje su odobrene kao referentne zemlje na osnovu broja stanovnika, članstva u Evropskoj uniji i, u slučaju Bugarske, sličnog socio-ekonomskog okruženja.

Ukupno 15038 publikacija obuhvaćenih WoS sadrži tražene ključne reči, od kojih je 5537 objavljeno u periodu 2014-2018. U tom periodu, 62 publikacije su objavljene u Danskoj, 27 u Srbiji i 5 u Bugarskoj. Prosečna citiranost i h-indeks selektovanih radova iznose, redom: 43,24 i 23 za Dansku, 43,93 i 15 za Srbiju i 17,6 i 5 za Bugarsku. Tip publikacija dominantno je originalni naučni rad (100% Bugarska, 93,5% Danska i 85,15% Srbija). Manje zastupljeni su pregledni članci (Danska - 4, Srbija - 3), poglavlje u knjizi (Srbija - 1) i editorijal (Srbija - 1). Istraživači iz Srbije publikovali su radove u saradnji sa naučnicima iz 22 države, najčešće iz Nemačke i Portugala. U međunarodnoj saradnji prednjače istraživači iz Danske koji su saradivali sa istraživačima iz 30 država, dok su istraživači iz Bugarske ostvarili saradnju sa kolegama iz pet zemalja. Analizom ključnih reči u publikacijama iz Srbije, uočavaju se "water quality", "pharmaceutical residues", "pharmaceuticals", "analgesics" kao najčešće. Slično, česte ključne reči u danskim publikacijama su "pharmaceuticals", "wastewater", "critical body residue", "seafood" i "immune suppression". Zbog malog uzorka, analiza za publikacije istraživača iz Bugarske nije mogla biti sprovedena.

Imajući u vidu broj istraživačkih institucija, mogućnosti mobilnosti i ulaganja u nauku, značajna razlika u broju publikacija između Srbije i zemalja Evropske unije bila je očekivana. Ova studija je pokazala da uprkos manjem apsolutnom broju publikacija, kvalitativni pokazatelji ukazuju da je kvalitet studija sprovedenih u Srbiji uporediv sa studijama sprovedenim u izabranim zemljama Evropske unije.

## Literatura

1. Green and Sustainable Pharmacy, Klaus Kummerer and Maximilian Hempel, eds. Springer-Verlag: Berlin Heidelberg, 2010, doi:10.1007/978-3-642-05199-9.