



6. KONGRES SLOVENSKEGA TOKSIKOLOŠKEGA DRUŠTVA

PREPOVEDANE SNOVI V ŠPORTU PRI LJUDEH IN ŽIVALIH

PROHIBITED SUBSTANCES IN HUMAN AND ANIMAL SPORT

Ljubljana, 26. 1. 2023



Univerza v Ljubljani
Fakulteta za farmacijo



Univerza v Ljubljani
Veterinarska fakulteta





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SPREMNA BESEDA

Spoštovani udeleženci 6. kongresa Slovenskega toksikološkega društva!

Poskusi povečanja fizične zmogljivosti pri športu so stari več tisočletij. Pravila antičnih olimpijskih iger so snovi, ki so povečale zmogljivost, prepovedovala enako strogo kot danes. Izraz doping se je pojavil konec 19. stoletja in sicer v povezavi z omamljanjem konj ("to dope horses") s pripravkom, ki je med drugim vseboval opij. Sicer je izraz "dope" zulujskega izvora in pomeni pijačo, ki so jo Zuluji uživali pred bitkami ali verskimi obredi.

Pred dvema letoma so stopila v veljavo nova protidopinška pravila na mednarodnem in nacionalnem nivoju. Pravila so sedaj medsebojno usklajena in veljajo za vse športe, katerih mednarodne zveze so podpisale Svetovni protidopinški kodeks in za 190 držav, ki so ratificirale Mednarodno konvencijo proti dopingu v športu (UNESCO). Tako sta bila tudi v Sloveniji posodobljena Protidopinški pravilnik SLOADO (Slovenska antidopinška organizacija) in Protidopinški pravilnik OKS-ZŠZ (Olimpijski komite Slovenije – Združenje športnih zvez).

Na mednarodnem nivoju so se poleg Svetovnega protidopinškega Kodeksa posodobili tudi obstoječi mednarodni standardi (MS za terapevtske izjeme, MS za testiranja in preiskave, MS za varovanje zasebnosti in osebnih podatkov, MS za laboratorije in MS za skladnost podpisnic s Kodeksom), na novo pa sta bila uvedena dva mednarodna standarda in sicer MS za izobraževanje in MS za upravljanje z rezultati. Vsako leto se tako v svetu, kot tudi pri nas, pojavi kar nekaj primerov uporabe ali poskusa uporabe prepovedane snovi ali prepovedanega postopka s strani športnikov. Ker je to lahko za njih povezano s številnimi neželenimi in toksičnimi učinki, poleg seveda kazni v skladu s kršenjem protidopinških pravil, postaja doping eno izmed pomembnih področij toksikološke znanosti, lahko celo rečemo eno najbolj "vročih" tako v raziskovalnem kot tudi nadzornem pogledu. Ne smemo pozabiti, da se doping uporablja tudi pri živalih, ki so tako še bolj ogrožene in so neprosto voljno izpostavljene snovem, ki so zanje lahko celo usodne. Vse to je bilo tudi vodilo, da letošnji kongres posvetimo tej tematiki.

Tako se bomo osredotočili predvsem na zgodovino uporabe prepovedanih snovi v športu pri ljudeh in živalih, na njihovo razširjenost in na nadzor zlorabe dopinga. Pri tem seveda ne moremo mimo farmakološko-toksikoloških značilnosti prepovedanih snovi v športu, pri čemer je potrebno dati poseben poudarek tudi laboratorijskemu določanju izpostavljenosti prepovedanim snovem. Na osnovi izbranih primerov pa se bomo seznanili s trenutnim stanjem zlorabe učinkovin in postopkov v športu tako doma, kot v svetu.

Upamo, da se bo v programu tega kongresa za vsakega izmed udeležencev našlo nekaj, kar ga bo še posebej pritegnilo, morda se s podobnim področjem, metodologijo tudi sam raziskovalno ali strokovno ukvarja. Tako je naša želja, da se znanja s tega področja povezujejo in dograjujejo tudi v slovenskem strokovnem in znanstvenem prostoru.

Marija Sollner Dolenc
Jana Brankovič
Smiljana Milošev Tuševljak
Lucija Perharič

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PROGRAM / PROGRAMME

8.00 - 8.30	Registracija/Registration
8.30- 8.35	Pozdravni nagovor/Welcome address
8:35-10:35 Simpozij 1/Symposium 1 Zgodovina uporabe prepovedanih snovi v športu pri ljudeh in živalih, razsežnosti, nadzor/ History of prohibited substances use in human and animal sport its extent and regulation Predsedujoča/Chairs: Hugh P. Matheson in Lucija Perharič	
8.35-9.15	Mednarodna zgodovina in razsežnosti prepovedanih snovi v športu/History and international extent of prohibited substances in sport Hugh P. Matheson
9.15-9.55	Svetovni in nacionalni protidopinški program/World and National Anti-Doping program Janko Dvoršak, prof. športne vzgoje
9.55-10.15	Doping pri športnih konjih pod okriljem mednarodne konjeniške organizacije FEI (Federation Equestre International)/Doping in sport horses competing under FEI regulations asist. dr. Petra Kramarič, dr. vet. med.
10.15-10.35	Analiza pozitivnih izvidov v kasaškem športu v Sloveniji/Analysis of positive results in horse trotters in Slovenia asist. dr. Vesna Kadunc Kos, dr. vet. med
10.35 -11.00	Odmor: kava, čaj in ogled plakatov/Break: coffee, tea and poster viewing
11:00 - 13:00 Simpozij 2/Symposium 2 Farmakološko-toksikološke značilnosti prepovedanih snovi v športu/Pharmaco- toxicological characteristics of prohibited substances in sport Predsedujoča/Chairs: Marija Sollner Dolenc in Lovro Žiberna	
11.00-11.30	Lista prepovedanih snovi in postopkov v športu / List of prohibited substances and methods in sports doc. dr. Lovro Žiberna, mag. farm.
11.30-12.00	Zloraba psihostimulansov v športu / The psychostimulants abuse in sports prof. dr. Lucija Peterlin Mašič, mag. farm.
12.00-12.30	Agonisti adrenergičnih receptorjev beta-2: zdravljenje, prekomerna uporaba in doping / Beta-2 agonists: treatment, overuse and doping doc. dr. Robert Marčun, dr. med.
12.30-13.00	Peptidni hormoni in rastni dejavniki: uporaba kot doping v športu in nove metode odkrivanja / Peptide hormones and growth factors: use as doping in sports and novel detection methods prof. dr. Borut Štrukelj, mag. farm.
13.00-14.00	Kosilo/Lunch
14:00-16:30 Simpozij 3/Symposium 3 Laboratorijsko določanje in prikaz primerov/Laboratory determination and case studies Predsedujoča/Chairs: Janko Dvoršak in Guenter Gmeiner	
14.00-14.45	Forenzične in dopinške laboratorijske analize: Podobnosti, razlike, razširjenost /Forensic and doping laboratory analyses: similarities, dissimilarities, disseminations Dr. Guenter Gmeiner, tech. chem.
14.45-15.30	Krvni doping in športnikov biološki potni list / Blood doping and athlete's biological passport prof. dr. sc. Ozren Jakšič, dr. med.
15.30 -16.00	Mikrovzorčenje in uporaba posušenih krvnih madežev / Microsampling and use of dried blood spots

	prof. dr. Tomaž Vovk, mag. farm.
16.00-16.30	Primeri uporabe zeliščnih preparatov kot dopinga/Case studies of herbal substances used as doping prim. dr. Lucija Perharič, dr. med.
16.30-17.00	Odmor kava, čaj in ogled plakatov/Break: coffee, tea and posters viewing
17.00 -18.45	Okrogla miza/Round table: Pogled v prihodnost/A view ahead
17.00-17.45	Panelisti/Panelists: Janko Dvoršak (moderator), Guenter Gmeiner, Hugh P. Matheson, Luka Pengov, Lovro Žiberna, Petra Kramarič, Vesna Kos Kadunc
17.45-18.00	Zaključne misli/Final thoughts



POVZETKI VABLJENIH PREDAVANJ

Zgodovina uporabe prepovedanih snovi v športu pri ljudeh in živalih, razsežnosti, nadzor /

History of prohibited substances use in human and animal sport, its extent and regulation

History and international extent of prohibited substances in sport

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Keywords: sports doping, East Germany, GDR, resource asymmetry

This presentation gives a long historical overview of the sometimes life threatening treatments athletes have taken to enhance their performance in competition. The paper concerns only the 'support means' which are defined within the term sports doping and which are today prohibited by the World Anti Doping Agency (WADA).

Prior to the Helsinki Olympics of 1952 efforts to change competition results by use of drugs was haphazard and often more hindrance than help. Post 1952, led by East Germany (GDR), many national teams attempted deeply planned and tested doping regimes.

The presentation examines the GDR system closely because it is the best documented and because it produced the most spectacular results, lifting a new nation of 17 million people to second on the medal table and ahead of the United States, within four Olympiads.

The first list of prohibited drugs was published in 1963. It had been anticipated with parallel research on purging and masking the banned substances. In several disciplines, with large numbers competing, like swimming and rowing, where they had most success, no GDR athlete was ever sanctioned for testing positive.

After the disbandment of the Warsaw Pact and the reunification of Germany, although some national plans persisted, notably in Russia and China, the focus shifted to the sports with most money at the disposal of the competitors. The paper describes four cases of high profile individuals who were caught and disgraced. It suggests that until the budgets of the anti doping agencies, national and supranational, are comparable to the resources of the athletes they are obliged to monitor, potentially dangerous drugs will be used to enhance performance.

The presentation closes by hinting, without evidence, that sports which run on limited funding and without large sponsorships tend to be largely clean, but that where asymmetrical resources weigh against the authorities the battle is usually lost.

Svetovni in nacionalni protidopinški program

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Ključne besede: WADA, protidopinški program, čist šport, športnik

Način, kako se je moderna družba spopadla z nepravilnostmi na področju zlorabe dopinga v športu, je unikaten. Ne gre samo za boj proti dopingju, temveč gre za poseben način, kako zaščititi integriteto športa, s katerim se ukvarja na milijone ljudi po vsem svetu.

Šport je nacionalen, globalen, brezmejen in zato univerzalen. Če ga želimo ohraniti čistega, ga moramo vsi skupaj varovati. Zato je bil oblikovan Svetovni protidopinški program, ki ga podpira Svetovni protidopinški kodeks in katerega glavni namen je zaščititi temeljno pravico športnikov, da sodelujejo v športu brez dopinga, ter s tem spodbujati zdravje, poštenost in enakopravnost športnikov po vsem svetu. Ob tem je potrebno zagotoviti enotne, usklajene in učinkovite protidopinške programe, ki se nanašajo na preprečevanje dopinga, tako na mednarodni kot na nacionalni ravni, kar vključuje: izobraževanje, odvracanje, odkrivanje, izvrševanje in pravno državo.

World and National Anti-Doping program

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Keywords:

The way modern society has dealt with irregularities in the field of doping in sports is certainly unique. It is not only about the fight against doping, but it is about a special way to protect the integrity of the sport, which is played by millions of people around the world.

Sport is national, global, borderless and therefore universal. If we want to keep it clean, we all have to protect it together. This is why the World Anti-Doping Program was created, supported by the World Anti-Doping Code, whose main purpose is to protect the fundamental right of athletes to participate in doping-free sport, thereby promoting the health, fairness and equality of athletes worldwide. At the same time, it is necessary to ensure uniform, coordinated and effective anti-doping programs related to the prevention of doping, both at the international and national level, which includes: education, deterrence, detection, enforcement and the rule of law.

Doping pri športnih konjih pod okriljem mednarodne konjeniške organizacije FEI (Federation Equestre International)

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Ključne besede: mednarodna konjeniška organizacija FEI, športni konji, doping

V svetu ni enotne organizacije, ki bi povezovala in regulirala vse konjeniške športne discipline. Mednarodna konjeniška organizacija FEI (Fédération Equestre Internationale) je vodilno telo za konjeniški šport z izjemo nekaterih jahalnih (western) in dirkalnih disciplin (galopske in kasaške dirke) in je tudi članica mednarodnega olimpijskega komiteja.

Kodeks ravnanja FEI je nedvoumno formuliran v smislu zaščite in dobrobiti konj in pravi: *»... v vseh okoliščinah mora biti dobrobit konja najvažnejša in ne sme biti nikoli podrejena tekmovalnim ali komercialnim vplivom.«*

Nadzor uporabe raznih substanc pri tekmovalnih konjih je mnogo več kot zagotavljanje pravičnosti tekmovanja in nivoja, ki zagotavlja sponzorska sredstva in pozitivno mnenje javnosti, čeprav je oboje pomembno. Človek športnik se sam odloči ali bo uporabil neko substanco ali ne, konji pa ne odločajo sami. Dajanje substanc živalim ima torej tudi moralno in etično razsežnost.

FEI pravila zahtevajo, da mora biti vsak konj, ki potrebuje zdravljenje, le-tega deležen. Potrebno pa je ločiti med zdravljenjem, ki je namenjeno zagotavljanju zdravja in dobrobiti živali in dopingom kot namernim vplivanjem na delovno sposobnost konja ali prikrivanjem njegovega bolezenskega stanja. FEI lista prepovedanih substanc za konje se deli na dve kategoriji: prepovedane substance (tiste, ki nimajo zakonite uporabe v medicini konj) in nadzorovane substance (tiste, ki se običajno utemeljeno uporabljajo v medicini konj). Nekatera zdravila se pri tekmovalnih konjih lahko uporabljajo, večine pa v času tekmovanj ne sme biti prisotne v telesu konja. Filozofija FEI je, da mora konj tekmovati po svojih sposobnostih brez kakršnekoli nepoštenih prednosti zaradi uporabe zdravil.

Antidopinški program v FEI izvaja neodvisen veterinarski oddelek, ki izbira tekmovanja, na katerih se testiranja izvajajo in število testiranih konj. Vsako leto se v odobrenih laboratorijih testira vzorce približno 5000 konj, ki so bili odvzeti na okoli 400 različnih prireditvah.

Doping in sport horses competing under FEI regulations

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Keywords: FEI (Fédération Equestre Internationale), competition horses, doping

There is no single organisation in the world that links and regulates all equestrian disciplines. The FEI (Fédération Equestre Internationale) is a leading body for equestrian sport with the exception of certain riding and racing disciplines (galloping and trotting racing) and is also a member of the International Olympic Committee.

The Code of Conduct FEI is clearly worded in terms of the protection and welfare of horses and states that "*... at all times the welfare of the horse must be paramount and must never be subordinated to competitive or commercial influences.*"

Controlling the use of various substances in competition horses is far more than ensuring the fairness of the competition and the level that secures sponsorship and positive public opinion, although both play a role. As opposed to athletes, the horse has no decision power on the administration of doping. The administration of substances to animals therefore also has a moral and ethical dimension.

The FEI rules stipulate that any horse that needs treatment must receive it. However, it is difficult to distinguish between treatment intended to ensure the health and welfare of the animal and doping as an intentional interference with a horse's ability to work or to disguise its health condition. The FEI publishes the Equine Prohibited Substances List, which is divided to: Banned substances (those that have no legitimate use in equine medicine) and Controlled medication (those normally used in equine medicines). Some drugs can be used in competition horses, but most of them should not be present in the horse's body during competition. The Federation's philosophy is that a horse must compete according to its ability without being given an unfair advantage from the use of drugs. FEI's anti-doping programme is run by an independent veterinary department, which selects the competitions where the tests are carried out and the number of horses tested. Every year, samples from around 5000 horses taken at around 400 different events, are tested in approved laboratories.

Analiza pozitivnih izvidov v kasaškem športu v Sloveniji

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Ključne besede: prepovedane substance, Slovenija, doping

Kasaška zveza Slovenije (KZS) je bila dne 29. 01. 2005 v Parizu, s soglasnim sklepom Generalne skupščine Evropskega združenja kasačev (UET), sprejeta v članstvo UET, tako da je Pravilnik o kasaških dirkah v Sloveniji skladen z internacionalnim dogovorom o kasaških dirkah UET-a.

V seznamu, prepovedanih snovi za kasače, tega pravilnika, so vse snovi, ki lahko delujejo na vse organske sisteme seselcev (živčni, kardiovaskularni, dihalni, prebavni, urinarni, mišično skeletni itd.), vsi izločki endokrinih žlez ter njihovi sintetični nadomestki ter vse snovi, ki prikrivajo prisotnost in delovanje prepovedanih snovi. Sodniški zbor na dan dirke določi, kateremu konju bo odvzet vzorec za doping kontrolo. Vzorec mora biti odvzet v prisotnosti sodnika ter lastnika konja ali njegovega pooblaščenca. Odvzem krvi se opravi sterilno v dve označeni epruveti iz zaprtega seta za doping kontrolo. Odvzem urina se opravi sterilno v posodo ter prelije v dve označeni posodi iz seta. Ves pribor mora biti pred odvzemom zapečaten v setu za odvzem dopinga in pokazan lastniku oz. pooblaščenču, ki mora po pečatenju vzorcev podpisati izjavo o pravilnosti odvzema ali podati pripombe. Če konj po 45 minutah po začetku odvzema ne urinira, se v analizo pošlje samo kri.

V Sloveniji je bilo v skladu s pravili UET opravljenih povprečno 40 odvzemov doping kontrole tekmovalnim konjem letno od leta 2005 dalje. Vsi odvzeti vzorci (okrog 680) so bili analizirani v laboratoriju, akreditiranem po ISO/IEC 17025 standardu. Od leta 2005 je bila v RSloveniji v okviru KZS dokazana zloraba prepovedanih substanc pri 20 konjih (3 %) na dan tekmovanja. Največkrat so bili zlorabljeni nesteroidna protivnetna zdravila (NSAID), steroidi, lokalni anestetiki, ksantinski alkaloidi in diuretiki ter le 1 x anabolni steroid. Od leta 2005 je bila pri kasačih v Sloveniji dokazana uporaba kofeina, diklofenaka, ketamina, eltenaka, prokaina, ksilokaina, kapsiacina, betametasona, triamkinolona, torasemida, teobromina, kobalta, klenbuterola in testosterona na dan tekmovanja. Vsi trenerji teh konj ter konji so bili v skladu s pravilnikom kaznovani. Obstaja velika verjetnost, da vseh zlorab pri odvzetih vzorcih v laboratoriju niso dokazali. Razlogi za to so različni. Zelo verjetno bodo v bodoče vse zlorabe prepovedanih substanc zaradi napredovanja laboratorijske analitike dokazane.

Analysis of positive results in horse trotters in Slovenia

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Keywords: prohibited substances, Slovenia, doping

On 29 January 2005 in Paris, by unanimous decision of the European Trotting Union (UET) General Assembly, the Trotting association of Slovenia, was accepted as a member of the UET and their Rules on trotting races in Slovenia are prescribed in accordance with the International Agreement on trot races of UET.

The list of prohibited substances for trotters, of this agreement, includes all substances that can affect all organ systems of mammals (nervous, cardiovascular, respiratory, digestive, urinary, musculoskeletal), all secretions of endocrine glands and their synthetic substitutes, and all substances which conceal the presence and action of prohibited substances. On the day of the race, the jury determines which horse will be sampled for doping control. The sample must be taken in the presence of the judge and the owner of the horse or his representative. Blood sampling is performed sterily in two marked test tubes from a closed kit for doping control. Urine collection is performed sterily into a container and poured into two marked containers from the kit. All equipment must be sealed in the doping collection kit before collection and shown to the owner or to the authorized representative, who must sign a statement on the correctness of the collection or make comments after sealing the samples. If the horse does not urinate after 45 minutes after the start of the collection, only blood is sent for analysis.

In Slovenia, in accordance with the rules of the UET, an average of 40 doping controls were taken from competition horses annually, from 2005 onwards. All the samples taken (around 680) were analyzed in a laboratory accredited according to the ISO/IEC 17025 standard. Since 2005, abuse of prohibited substances has been proven in Slovenia in 20 horses (3%) on the competition day. Non steroidal anti-inflammatory drugs (NSAID), steroids, local anesthetics, xanthine alkaloids and diuretics were most often abused. Only once an anabolic steroid was confirmed/abused. Since 2005, the use of caffeine, diclofenac, ketamine, eltenac, procaine, xylocaine, capsiacin, betamethasone, triamcinolone, thorasemide, theobromine, cobalt, clenbuterol and testosterone on the competition day has been proven in trotter races in Slovenia. All the trainers of these horses and the horses were fined according to the rules. There is a high probability that not all abuses in the samples taken have been proven in the laboratory. The reasons for this are various. It is very likely that in the future all abuses of prohibited substances will be proven with advanced technique in laboratory analysis.



POVZETKI VABLJENIH PREDAVANJ

Farmakološko-toksikološke značilnosti prepovedanih snovi v športu / Pharmaco-toxicological characteristics of prohibited substances in sport

Lista prepovedanih snovi in postopkov v športu

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Ključne besede: antidoping, doping, lista prepovedanih snovi, šport

Lista prepovedanih snovi in postopkov (LPSP) je mednarodni standard Svetovne protidopinške organizacije (WADA), ki identificira snovi in postopke, prepovedane v športu. Leta 1968 ga je prvič izdal Mednarodni olimpijski komite, od leta 2004 pa je za pripravo in izdajo odgovorna WADA, ki vsako leto 1. oktobra objavi LPSP za naslednje leto, ki vstopi v veljavo 1. januarja. LPSP se razvija tako, da vključuje nove trende dopinga, razlikuje med prepovedanimi in dovoljenimi načini aplikacije zdravil ter se hkrati prilagaja novim analitičnim in farmakološkim odkritjem.

Lista, ki je trenutno v veljavi, razvršča prepovedane snovi po farmakoloških skupinah (kategorije S, angl. substances), kot so anabolične snovi, peptidni hormoni, rastni dejavniki, β 2-agonisti, antagonisti hormonov, diuretiki, psihostimulansi, narkotiki, kanabinoidi in glukokortikoidi. Hkrati prepoveduje tudi določene postopke (kategorije M, angl. methods), kot so manipulacije krvi, kemične in fizične manipulacije ter genski doping. Nekatere snovi so vedno prepovedane, določene pa le na tekmovanjih. Pomembno je poudariti, da so prepovedane tudi snovi, ki niso nujno s svojim imenom navedene na LPSP, vendar imajo podobno kemično zgradbo ali podoben biološki učinek kot navedene snovi. Ta ukrep je bil uveden, da se prepreči sintezno spreminjanje zdravilnih učinkovin za uporabo kot doping.

Da je določena snov ali postopek prepovedana v športu, morata biti zagotovljena vsaj dva od treh kriterijev:

- dokaz, da ima potencialni vpliv na izboljšanje telesnih zmogljivosti;
- dokaz, da predstavlja dejansko ali potencialno tveganje za zdravje športnika;
- določbo s strani WADA, da uporaba snovi ali postopka krši športni duh.

Včasih pri določenih snoveh zaradi neopravljenih raziskav ni možno znanstveno preveriti veljavnosti vseh treh zahtevanih kriterijev, zato nimamo podatkov o vplivu na telesno zmogljivost kot tudi ne o njihovi varnosti. Zato vse nepreverjene in neodobrene snovi obravnavamo kot potencialno tveganje za zdravje in hkrati tudi kršitev etičnih načel – izpolnjena sta dva pogoja za uvrstitev na LPSP.

List of prohibited substances and methods in sports

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Keywords: antidoping, doping, list of prohibited substances, sports

The List of Prohibited Substances and Methods (LPSM) is an international standard of the World Anti-Doping Agency (WADA) that identifies substances and methods prohibited in sport. It was first issued by the International Olympic Committee in 1968, and WADA has been responsible for its preparation since 2004. WADA publishes the LPSM on October 1, which becomes effective on January 1 of the following year. The LPSM is constantly evolving to include new doping trends, to distinguish between prohibited and permitted methods of drug application, and to adapt to new analytical and pharmacological discoveries.

The LPSM classifies prohibited substances by pharmacological groups (categories S), such as anabolic steroids, peptide hormones, growth factors, β 2-agonists, hormone antagonists, diuretics, psychostimulants, narcotics, cannabinoids, and glucocorticoids. The list also includes certain prohibited methods (categories M), such as blood manipulations, chemical and physical manipulations, and gene doping. Some substances are always prohibited, others only in competition. Importantly, some substances that are not listed by name on the LPSM are also prohibited if they have a similar chemical structure or pharmacological effect to the listed substances. This measure was introduced to prevent the synthetic modification of active substances for doping purposes.

For a particular substance or method to be prohibited in sport, at least two of the three criteria must be met:

- evidence that it has a potential effect on improving physical performance;
 - evidence that it poses an actual or potential risk to the athlete's health;
 - a determination by WADA that the use of a substance or procedure violates the spirit of sport.
- For certain substances, it is not possible to scientifically test the validity of all three required criteria due to lack of research. Thus, we have no data on effects on physical performance or their safety. Therefore, we consider all untested and unapproved substances to be a potential health risk and a violation of ethical principles; thus, two inclusion criteria for the LPSM are met.

Zloraba psihostimulansov v športu

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Ključne besede: psihostimulansi, poživila, doping, skupina S6, varnost

Psihostimulansi (poživila) so prepovedani na tekmovanjih in so v listi prepovedanih snovi in postopkov vključeni v skupino S6. Vse prepovedane snovi v tem razredu so specificirane snovi, razen 30 nespecificiranih snovi iz skupine S6.A. Prepovedani so vsi optični izomeri, kjer je to relevantno, ter druge snovi s podobno kemijsko strukturo ali podobnimi biološkimi učinki. Med izjeme se šteje klonidin in derivati imidazolina za dermatološko, nazalno ali oftalmološko uporabo (npr. brimonidin, klonazolin, fenoksazolin, indanazolin, nafazolin, oksimetazolin, ksilometazolin), tetrizolin in poživila, vključena v program spremljanja za leto 2023 (bupropion, kofein, nikotin, fenilfrin, fenilpropanolamin, pipradrol in sinefrin).

WADA dovoljuje uporabo kofeina, katerega vsebnost je lahko do 500 mg na pločevinko oz. steklenico. Energijske pijače poleg kofeina pogosto vsebujejo vrsto drugih snovi, kot so taurin in L-karnitin, glukuronolakton, ginko biloba, ginseng in druge. Psihostimulans katin je prepovedan, če je njegova koncentracija v urinu večja od 5 µg/mL. Efedrin in metilefedrin sta prepovedana, kadar je koncentracija enega ali drugega v urinu večja od 10 µg/mL. Epinefrin (adrenalin) ni prepovedan pri lokalni uporabi, npr. nazalno, oftalmološko ali sočasno z lokalnimi anestetiki. Pseudoefedrin je prepovedan, če je njegova koncentracija v urinu večja od 150 µg/mL.

Stimulansi izboljšajo vzdržljivost, povečajo anaerobno zmogljivost, zmanjšajo občutek utrujenosti, izboljšajo reakcijski čas, povečajo budnost in povzročijo izgubo teže. Pri nizkih odmerkih se lahko pojavijo neželeni učinki, kot so tresenje, potenje, nezadostna koncentracija, izguba spomina, zmanjšan apetit in dehidracija. Pri višjih odmerkih pa povečana frekvenca bitja srca, povečan krvni tlak, s kombinirano aktivnostjo se lahko pojavijo aritmije in zastoj srca. Opozorilni znaki izčrpanosti so pri psihostimulansih zatrti, kar lahko pri nadaljnjih naporih vodi do popolne izčrpanosti, motenj v delovanju srca, vročinske kapi in v končni fazi smrti. Število športnikov na najvišjih tekmovalnih ravneh, za katere poročajo uporabo psihostimulansov, se je v zadnjih letih izrazilo povečalo. Veliko športnikov tudi pridobi izjemo za njihovo terapevtsko uporabo. Problem predstavljajo tudi prehranska dopolnila, ki so lahko kontaminirana s prepovedanimi psihostimulansi (na primer metilheksanaminom).

The psychostimulants abuse in sports

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Keywords: psychostimulants, doping, group S6, safety

Psychostimulants (stimulants) are prohibited in competitions and are included in group S6 of the list of prohibited substances and methods. All prohibited substances in this group are specified substances, with the exception of 30 non-specified substances in group S6.A. All optical isomers, where relevant, and other substances with similar chemical structure or similar biological effects are prohibited. Excluded are clonidine and imidazoline derivatives for dermatological, nasal, or ophthalmic use (e.g., brimonidine, clonazoline, phenoxazoline, indanazoline, naphazoline, oxymetazoline, xylometazoline), tetrizoline, and stimulants listed in the 2023 Monitoring Program (bupropion, caffeine, nicotine, phenylephrine, phenylpropanolamine, pipradrol, and synephrine).

WADA allows the use of caffeine, which can contain up to 500 mg per can or bottle. In addition to caffeine, energy drinks often contain a number of other substances such as taurine and L-carnitine, glucuronolactone, ginkgo biloba, ginseng and others. The psychostimulant cathine is banned if its concentration in urine exceeds 5 µg/mL. Ephedrine and methylephedrine are prohibited if the concentration of one or the other substance in urine is more than 10 µg/mL. Epinephrine (adrenaline) is not prohibited for topical use, such as nasal, ophthalmic, or concomitant with local anesthetics. Pseudoephedrine is prohibited if its concentration in urine is more than 150 µg/mL.

Stimulants improve endurance, increase anaerobic capacity, reduce fatigue, improve reaction time, increase alertness, and lead to weight loss. At low doses, side effects may include tremors, sweating, poor concentration, memory loss, decreased appetite, and dehydration. At higher doses, on the other hand, increased heart rate, increased blood pressure, and if combined with physical activity, cardiac arrhythmias and cardiac arrest may occur. The warning signs of exhaustion are suppressed by psychostimulants, which can lead to complete exhaustion, heart failure, heat stroke and, in the final stages, death. The number of elite athletes reporting taking psychostimulants has increased significantly in recent years. Many athletes also receive therapeutic use exemptions for these compounds. Dietary supplements, which may be contaminated with prohibited psychostimulants (e.g., methylhexanamine), are also a problem.

Agonisti adrenergičnih receptorjev beta-2: zdravljenje, prekomerna uporaba in doping

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Ključne besede: beta-2 agonisti, astma, bronhokonstrikcija

Dva najpogostejša klinična sindroma, kjer je indicirano zdravljenje z agonisti adrenergičnih receptorjev beta-2, sta astma in z naporom sprožena bronhokonstrikcija (EIB). S telesnim naporom sprožena bronhokonstrikcija je opredeljena kot prehodno, reverzibilno zoženje spodnjih dihalnih poti, ki sledi fizični aktivnosti. Zgodi se v prisotnosti ali odsotnosti klinično prepoznane astme.

Cilja zdravljenja astme sta ureditev simptomov bolezni in zmanjšanje tveganja za poslabšanje bolezni, trajno okvaro dihalne poti in smrt zaradi astme. Tudi blage oblike z občasnimi simptomi imajo lahko epizode hudih, tudi življenje ogrožajočih poslabšanj, ki nastanejo zaradi opustitve preprečevalcev. Nova priporočila zato odsvetujejo predpisovanje in jemanje monoterapije s kratkodelujočimi beta agonisti. Nabor predpisanih zdravil naj vselej vsebuje preprečevalno zdravilo, najbolje inhalacijski glukokortikoid.

Zdravila za zdravljenje astme delimo na:

- Preprečevalce IGK (inhalacijski glukokortikoidi, antagonisti levkotrienskih receptorjev), ki so temeljno zdravljenje in jih bolnik prejema vsak dan. Imajo protivnetni učinek in se uporabljajo v najnižjem odmerku, ki drži astmo urejeno.
- Olajševalce SABA (kratko delujoči beta agonisti), ki se uporabljajo po potrebi ob nastopu respiratorne simptomatike.
- Dolgodelujoče bronhodilatatorje LABA (beta agonisti) in LAMA (antiholinergiki), ki jih bolnik NIKOLI ne sme prejemati v monoterapiji, temveč vedno v kombinaciji z inhalacijskimi glukokortikoidi. LAMA samo kot dodatek k predhodno uvedeni IGK/LABA.

Hitrodelujoči simpatikomimetiki beta-2 v pršilu so izbirna zdravila za akutne simptome bronhospazma (olajševalci). V to skupino zdravil sodita kratkodelujoča simpatikomimetika salbutamol in fenoterol in dolgodelujoči simpatikomimetik formoterol, ki ga nekateri tudi uvrščajo med olajševalce. Učinkovati začnejo v nekaj minutah, največjo bronhodilatacijo dosežejo v 10 do 15 minutah in učinkujejo 2 do 6 ur (formoterol preko 12 ur). Njihova takojšnja stranska učinka sta tremor in tahikardija s palpitacijami. Previdnost je potrebna pri starejših ljudeh, pri bolnikih z okvaro srčne mišice, pri tistih s sočasno predpisanimi zdravili (teofilin, diuretiki) ter onih z bolezenskimi stanji, ki povzročajo hipokaliemijo. Zdravil te vrste načeloma ne predpisujemo v obliki tablet ali sirupov. Pretirana raba simpatikomimetikov povzroči tahifilaksijo za njihove učinke. Ta je med kratko in dolgodelujočimi simpatikomimetiki beta-2 navzkrižna in morda klinično pomembna.

V skupino dolgodelujočih simpatikomimetikov beta-2 (LABA) spadata salmeterol in formoterol. Delujeta več kot 12 ur. Pri astmi ju nikoli ne predpišemo kot monoterapijo, ampak samo ob sočasni rabi inhalacijskega glukokortikoida. Cilj zdravljenja EIB je preprečevnje nastanka in zdravljenje, če do simptomatike EIB pride. Vendar obstaja previdnost pri uporabi inhalacijskih agonistov adrenergičnih receptorjev beta-2. Ob redni uporabi se zmanjša njihov učinek zaradi zmanjšanja števila beta-2 receptorjev. Inhalacijske beta-2 agoniste s kratkim delovanjem bi morali zato uporabljati redko, torej manj kot trikrat na teden. Temeljno zdravljenje so preventivni ukrepi in inhalacijski kortikosteroidi, ko so indicirani. Če ne dosežemo nadzora z majhnim odmerkom IGK, lahko v terapijo dodamo še dolgo delujoči beta-2 agonist ali antagonist levkotrienskih-receptorjev, kar tudi lahko pomaga zmanjšati z naporom sproženo bronhokonstrikcijo.

Beta-2 agonists: treatment, overuse and doping

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Keywords: beta-2 agonists, asthma, bronchoconstriction

The two most common clinical syndromes for which treatment with beta-2 agonists is indicated are asthma and exercise-induced bronchoconstriction (EIB). Exercise-induced bronchoconstriction is defined as a transient, reversible narrowing of the lower airways that follows physical activity. It occurs in the presence or absence of clinically recognized asthma.

The goals of asthma treatment are to control the symptoms of the disease and reduce the risk of worsening of the disease, permanent impairment of the airways and death due to asthma. Even mild forms with intermittent symptoms can have episodes of severe, even life-threatening, exacerbations that result from the abandonment of preventive medications. The new recommendations therefore advise against prescribing and taking monotherapy with short-acting beta agonists. The set of prescribed medicines should always contain a preventive medicine, preferably an inhaled glucocorticoid.

Medicines for the treatment of asthma are divided into:

- Preventives ICS (inhaled glucocorticoids, leukotriene receptor antagonists), which are the main treatment and which the patient receives daily. They have an anti-inflammatory effect and are used in the lowest dose that keeps asthma under control.
- Facilitators SABA (short-acting beta agonists), which are used as needed at the onset of respiratory symptoms.
- Long-acting bronchodilators LABA (beta agonists) and LAMA (anticholinergics), which the patient should NEVER receive in monotherapy, but always in combination with inhaled glucocorticoids. LAMA only as an addition to the previously introduced ICS/LABA.

Fast-acting beta-2 sympathomimetics in spray are the drugs of choice for acute symptoms of bronchospasm (relievers). This group of drugs includes the short-acting sympathomimetics salbutamol and fenoterol and the long-acting sympathomimetic formoterol, which some also classify as a reliever. They begin to work in a few minutes, reach maximum bronchodilation in 10 to 15 minutes and work for 2 to 6 hours (formoterol over 12 hours). Their immediate side effects are tremors and tachycardia with palpitations. Caution is required in the elderly, in patients with heart muscle damage, in those with simultaneously prescribed medications (theophylline, diuretics) and in those with medical conditions that cause hypokalemia. Medicines of this type are generally not prescribed in the form of tablets or syrups. Excessive use of sympathomimetics causes tachyphylaxis to their effects. This is crossover between short- and long-acting beta-2 sympathomimetics and may be clinically relevant. Salmeterol and formoterol belong to the group of long-acting beta-2 sympathomimetics (LABAs). They work for more than 12 hours. In asthma, they are never prescribed as monotherapy, but only with the simultaneous use of an inhaled glucocorticoid. The goal of EIB treatment is to prevent the occurrence and treat if symptoms of EIB occur. However, there is caution when using inhaled agonists of beta-2 adrenergic receptors. With regular use, their effect decreases due to a decrease in the number of beta-2 receptors. Short-acting inhaled beta-2 agonists should therefore be used infrequently, i.e., less than three times a week. The main treatment is preventive measures and inhaled corticosteroids when indicated. If control is not achieved with low-dose ICS, a long-acting beta-2 agonist or leukotriene-receptor antagonist can be added to therapy, which can also help reduce exercise-induced bronchoconstriction.

Peptidni hormoni in rastni dejavniki: uporaba kot doping v športu in nove metode odkrivanja

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Ključne besede: peptidi, rastni dejavniki, peptidomimetiki, doping, identifikacija

Peptidi in peptidomimetiki sodelujejo v številnih bioloških in fizioloških procesih, zato so tudi pogosto zlorabljeni v dopingu. V seznamu prepovedanih substanc, ki ga je pripravila WADA za leto 2023, je vsebovanih več kot 30 različnih peptidov, peptidnih hormonov, rastnih dejavnikov in njihovih analogov. V seznamu so razdeljeni v tri sekcije: Sekcija S2: Peptidni hormoni, rastni dejavniki in podobne substance ter peptidomimetiki. V sekciji S4 so hormoni in metabolni regulatorji, v sekciji S5 pa diuretiki in maskirne substance. Na osnovi pozitivnih vzorcev, ki jih je objavila WADA v letu 2020, kar 24% pozitivnih vzorcev predstavlja peptidne hormone, peptide ali peptidomimetike. Med njimi najdemo rastne dejavnike, eritropoetinsko skupino, inzulinu-podoben rastni dejavnik I, grelin, rastni hormon-sprostitutveni hormon in peptide, gonadotropin-sprostitutvene hormone (GnRH), insulinsko skupino in maskirni peptid desmopresin. Analiza peptidnih hormonov, peptidov in peptidomimetikov je trenutno še vedno velik izziv za protidopinške laboratorije. Trenutno je analizna standardna metoda LC-MS oziroma RP-HPLC-MS. Pred tem je potrebno peptide, peptidne hormone ali peptidomimetike izolirati, največkrat z metodo HILIC, gelsko filtracijo, kationsko-izmenjevalno kromatografijo in s superkitično tekočinsko kromatografijo. Kot analizni sistemi se dodatno uporabljajo tudi ESI-MS, (tandemska) trojna kvadropolna MS, tandemska MS/MS, TOF in Orbitrap MS. Z namenom razviti metodo detekcije peptidov oziroma proteinov, smo v laboratoriju Fakultete za farmacijo, Univerze v Ljubljani, razvili preliminarni sistem detekcije na osnovi imuno-MS detekcije, kar bo predstavljeno v predavanju.

Peptide hormones and growth factors: use as doping in sports and novel detection methods

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Keywords: peptides, growth factors, peptidomimetics, doping, identification

Peptides and peptidomimetics can participate in a wide variety of biological processes, therefore they represent a very attractive potential doping substances. In WADA international standard prohibited list from 2023, more than 30 different peptides and their analogs are listed as doping substances. They are classified into 3 sections: Section S2: peptide hormones, growth factors, related substances and mimetics; S4: hormone and metabolic regulators; and S5: diuretics and masking agents. Based on data from WADA positive sample findings, 24% of all tested samples contains one or more peptide hormones, peptides or peptidomimetics, Among them are growth hormones, erythropoietin group, insulin-like growth factor I, ghrelin, growth-hormone-releasing hormone, GH-releasing peptides and gonadotropin-releasing hormones (GnRH) as well as insulin group and masking agent desmopressin. The analysis of peptide hormones, peptides and peptidomimetics in biological samples is an area of relevance in the study of doping. The detection and quantification of peptide hormones, peptides and peptidomimetics has been shown to be a great challenge for antidoping laboratories. At present, the development of robust methods based on LC-MS or RP-HPLC-MS become standard analytical techniques, prior to separation chromatography by using HILIC, cation-exchange, size exclusion and supercritical fluid chromatography. For the MS analysis of peptides and proteins, an ESI-MS, triple quadrupole mass spectrometry or MS/MS have become the premier analytical platform. Beside, TOF or Orbitrap mass spectrometry has increased in antidoping laboratories. In order to develop novel method, based on the structurally-unrelated peptide or peptidomimetic substances, our laboratory developed the immuno-affinity MS method which is in its proof-of-principle stage and will be presented in this topic.



POVZETKI VABLJENIH PREDAVANJ

Laboratorijsko določanje in prikaz primerov / Laboratory determination and case studies

Forensic and doping laboratory analyses: similarities, dissimilarities, disseminations

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Keywords: forensic vs doping analysis, postmortem

Background:

Forensic as well as doping analysis are two highly specialized fields of analytical chemistry. Both are dealing with the unequivocal detection of active compounds, their markers and/or metabolites using highly sophisticated analytical instruments, mainly dominated by mass spectrometry after chromatographic separation in its various forms. Doping analysis can be regarded as a special field of forensic analysis, too.

While doping analysis is a strictly regulated area of chemical analysis, where the analytical result serves in most of the cases as stand-alone proof for an antidoping rule violation, forensic investigations include many different sources of evidence, where analytical evidence may contribute an important role.

Importantly, the simple presence of a prohibited drug in sports drug testing is a satisfying proof for an antidoping rule violation, whereas the forensic approach focusses on the possible effect of the drug in the analysed bodily specimen, according to the Paracelsus principle.

Objectives:

To highlight the different approaches and solutions for complex tasks in each of the two fields of chemical analysis.

Methods:

Regulations, analytical tools, selected cases as well as different approaches are presented, including the legal implications in court.

Results and Discussion:

The presentation shows the similarities as well as the dissimilarities, pointing out the potential for dissemination of the experiences on both sides.

Blood doping and athlete's biological passport

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Keywords: Blood doping, Athlete's biological passport (ABP), hematological module, Bayesian model

Blood doping, defined as the use of substances and/or methods to enhance the oxygen availability in the working muscles and improve sport performance, has a long history in sport. Its effectiveness is pronounced in disciplines where endurance is important. Various substances (for example erythropoiesis stimulation agents included erythropoietin) and methods (for example blood transfusions) may be used. To ensure fair competitions and protect the athlete's health, there is a constant race to develop new methods for the direct and indirect doping detection. For blood doping detection direct detection methods may be insufficient. The idea behind the indirect methods is to detect doping by its impact on athlete's blood values. A system analyzing different hematological variables and factors influencing them, was developed to mark potential doping. In 2009, World Anti-Doping Agency (WADA) introduced hematological module of Athlete's biological passport (ABP) consisting of measured hematological parameters (hemoglobin, reticulocytes, ...) and calculated scores based on the measured values (OFF-score, ...). ABP is managed by Athletes passport management unit (APMU). With longitudinal follow up of each athlete, blood profile is established with personalized reference values. Statistical model used for calculations in the hematological module is based on Bayes' network. This adaptive model predicts the probability of a certain event (in this case blood doping) based on the available scientific and individual data. Highlighted aberrations (values/patterns) are analyzed by expert panel. In case of atypical passport finding there is regulated process (by WADA guidelines) involving APMU, Experts, Passport custodian and Athlete that may result in assertion of Antidoping rule violation (ADRV) and sanctions. In conclusion, hematologic module of Athletes biological passport has significantly improved effectiveness of fight against blood doping.

Mikrovzorčenje in uporaba posušenih krvnih madežev

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Ključne besede: mikrovzorčenje, posušeni krvni madeži, doping, validirane analizne metode

Mikrovzorčenje je tehnika vzorčenja bioloških tekočin, ki se je razširila na različna področja. Med najbolj razširjenimi in najstarejšimi je tehnika posušenih krvnih madežev (DBS), ki sodi med nevolometrične tehnike, saj volumen vzorca običajno ne poznamo. Sledil je razvoj v smeri volumetričnih tehnik, ki omogočajo odvzem vzorca z znanim volumnom. Med volumetrične tehnike sodita volumetrično absorptivno mikrovzorčenje in različne kapilarne tehnike. V primerjavi s tradicionalnimi vzorci, kot sta plazma in urin, so glavne prednosti mikrovzorcev minimalna invazivnost pri odvzemu, velika stabilnost vzorcev in zmanjšanje stroškov povezanih s shranjevanjem vzorcev. Z mikrovzorčenjem običajno vzorčimo kapilarno kri iz prstne blazinice ali nadlakti. Kapilarna kri se po nanosu na nosilec posuši. Posušene vzorce hranimo v plastičnih vrečkah s sušilnim sredstvom pri sobnih pogojih, kar omogoča dobro stabilnost analitov, ki je lahko od nekaj tednov pa tudi do več mesecev. Zaradi majhnega volumna vzorca se za določanje koncentracije analita uporabljajo zelo občutljive analizne metode, kot je masna spektrometrija. Tehnike mikrovzorčenja se v zadnjih dveh desetletjih uporabljajo tudi na področju določanja prepovedanih snovi v športu. Mednarodna kolesarska zveza UCI je od leta 2019 uvedla obsežen program DBS za določanje tramadola, ki je prepovedan samo v kolesarstvu. Svetovna protidopinška agencija je v zimskih olimpijskih in paraolimpijskih igrah 2022 v Pekingu uporabila tehniko DBS za nekatere rutinske preglede športnikov. V literaturi lahko zasledimo številne prepovedane snovi v športu za katere so že bile razvite in validirane metode na osnovi DBS in sicer iz skupin neodobrenih snovi, anaboličnih učinkovin, peptidnih hormonov, rastnih faktorjev in podobnih snovi, β_2 agonistov, hormonov in metabolnih modulatorjev, diuretikov, stimulansov, narkotikov, kanabinoidov in glukokortikoidov. Neglede na široko uporabo tehnik mikrovzorčenja na področju določanja prepovedanih snovi v športu so potrebne nove raziskave, ki bodo izboljšale občutljivost in standardizacijo metod in tako omogočile širitev uporabe mikrovzorčenja v boju proti dopingu v športu.

Microsampling and use of dried blood spots

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Keywords: microsampling, dried blood spots, doping, validated analytical methods

Microsampling is a sampling technique for biological fluids used in various fields. One of the oldest and most commonly used techniques is dried blood spots (DBS), which is the non-volumetric technique because the volume of the samples is generally unknown. Further advances in microsampling techniques have been made with the development of volumetric techniques such as volumetric absorptive microsampling and various capillary techniques that allow sampling with precise and accurate amounts of a liquid sample. Compared to conventional samples such as plasma or urine, the main advantages of microsamples are minimally invasive sampling, high analyte stability, and lower sample storage costs. The sample of choice is capillary blood obtained from the fingertip or upper arm. The capillary blood is deposited on the sampler, dried and stored in plastic bags with desiccant at room conditions. The analytes are stable between weeks and months. The small volume of the sample makes determination of analyte concentration challenging, and sensitive analytical methods such as mass spectrometry must be used. A number of DBS detection methods for doping agents have been developed over the past two decades. The Union Cycliste Internationale has implemented an extensive program using DBS samples to detect tramadol, which has been banned in cycling since 2019. Recently, the World Anti-Doping Agency used DBS for routine doping controls at the Beijing Olympic and Paralympic Winter Games. Validated analytical methods using DBS have been described in the literature for numerous banned substances in sports. These methods include non-approved substances, anabolic agents, peptide hormones, growth factors and related substances, β_2 -agonists, hormone and metabolic modulators, diuretics, stimulants, narcotics, cannabinoids, and glucocorticoids. Despite the widespread use of microsampling in anti-doping, new studies are needed to improve the sensitivity and standardization of methods and to enable further progress of microsampling methods in anti-doping.

Primeri uporabe zeliščnih preparatov kot dopinga

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Ključne besede: efedrin, ergogeni, kofein, prehranska dopolnila, ženšen

Različne ergogene snovi, to je snovi, ki povečajo fizično zmogljivost, se uporabljajo že od davnih časov. V zadnjih desetletjih je narasla uporaba zeliščnih pripravkov in prehranskih dopolnil (ZP-PD). Ocenjuje se, da ZP-PD uporablja 70-94% športnikov. Prehranska dopolnila so katerikoli pripravek (razen tobaka), ki se dodaja prehrani in vsebuje eno od naslednjih sestavin: vitamin, mineral, zelišče ali rastlino, aminokislino, metabolit, izvleček ali kombinacijo navedenih. Zeliščni pripravki so deli rastlin ali njihovih izvlečkov. Vsebujejo številne biološko aktivne snovi, kot npr. alkaloidne, karotenoide, flavonoide, glikozide, lignane, polifenole, saponine, steroide.

V zvezi s fizično zmogljivostjo je najbolj preučevano zelišče ženšen: kitajski (*Panax ginseng*), sibirski (*Eleutherococcus senticosus*), malezijski (*Eurycoma longifolia* Jack). Poroča se, da poveča aerobno in srčno-dihhalno zmogljivost, mišično moč in zmanjša nastajanje laktata. Pripravki iz kakava (*Theobroma cacao*), kave, (*Coffea arabica*), zelenega čaja (*Camilla sinensis*), gvarane (*Paulinina cupana*) kola oreščka (*Cola acuminata*), mateja (*Ilex paraguayensis*) vsebujejo med drugim kofein, teofilin, teobromin in se uporabljajo kot poživila. Rastline iz rodu *Efedra* so vir številnih efedrinskih alkaloidov, ki učinkujejo kot adrenergični agonisti. Poleg poživilnih učinkov delujejo tudi antioksidativno in imunostimulativno ter zmanjšujejo telesno maščobo in maso. Uporabo pripravkov s kofeinom in efedrinom povezujejo z motnjami spanja, tesnobo, glavobolom, hipertenzijo, izgubo apetita, psihozami, srčnim infarktom, možgansko kapjo in smrtjo. Številni navedeni neželeni dogodki so se zgodili med energično vadbo, kar je vodilo v umik prehranskih dopolnil, ki vsebujejo efedro, s tržišča. Med dvigalci uteži, sprinterji in metalci so popularni pripravki z izvlečki navadne zobačice (*Tribulis terrestris*), ki povečajo nastajanje testosterona in zmanjšujejo vnetne in oksidativne poškodbe.

Področje ZP-PD zakonsko ni urejeno tako strogo kot zdravila in so zato ZP-PD pripravki lahko neustrezno ali napačno označeni. Včasih vsebujejo nedeklarirane sestavine, kot so prohormoni in anabolni androgeni steroidi, zaradi česar lahko pride do pozitivnih dopinških testov.

Case studies of herbal substances used as doping

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Keywords: caffeine, ephedrine, ergogenics, ginseng, food supplements

Since ancient times, various substances were used as ergogenics, i.e., enhancing physical performance. Over the last decades, the use of herbal products and food supplements (HP-FS) has increased. It is estimated that 70-94% of sportsmen use HP-FS. Food supplements are defined as any product (other than tobacco) added to the diet that contains one of the following ingredients: a vitamin, mineral, herb or botanical, amino acid, metabolite, extract, or combination of any of the above. Herbal products are plant parts or their extracts, and contain numerous biologically active compounds, such as alkaloids, carotenoids, flavonoids, glycosides, lignans, polyphenols, saponins, steroids.

The most studied herb with regard to physical performance is ginseng: Chinese (*Panax, ginseng*), Siberian (*Eleutherococcus senticosus*), Malaysian (*Eurycoma longifolia* Jack). Increased aerobic capacity, cardio respiratory function and muscle strength, and decreased lactate production were reported. Products containing caffeine, theophylline, theobromine, from cocoa (*Theobroma cacao*), coffee (*Coffea arabica*), green tea (*Camilla sinensis*), guarana (*Paulinina cupana*) kola nut (*Cola acuminata*), mate (*Ilex paraguayensis*) are used as stimulants. Plants from the Ephedra genus are a source of several ephedrine alkaloids which act as adrenergic agonists. Beside the stimulant effects, their extracts also possess anti-oxidant, immuno-stimulating, body fat and mass decreasing properties. The use of caffeine and ephedrine containing products was linked to sleeping disorders, anxiety, headache, hypertension, tachycardia, loss of appetite, psychoses, cardiac infarction, stroke and death. Many of the adverse events occurred in the context of vigorous exercise leading to Ephedra-containing food supplements withdrawal from the market. Extracts of goat's-head (*Tribulis terrestris*), popular among weight lifters, sprinters and throwers, increase testosterone production and muscle growth, reduce inflammation and oxidative damage.

HP-FS are not covered by the stringent medicine legislation and may be labelled inadequately or erroneously. They sometimes contain undeclared constituents like prohormones and anabolic androgen steroids which may result in positive doping tests.



**Povzetki posterjev /
Poster Abstracts**

Doping in sport in Bosnia and Herzegovina

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Keywords: prevalence of doping, athletes, BiH

It is well-known fact that playing sports and physical activity improves physical and mental health. Therefore, sports should have their share in everyday events for all of us. Unfortunately, athletes, both throughout history and today, used and still use a variety of substances and methods, so-called doping agents, in order to improve their sports performances.

On the other hand, the use of doping agents carries a great health risk and is one of the key issues related to sports ethics. The Anti-Doping Control Agency of Bosnia and Herzegovina (ADA-BiH) has been established at the end of 2009 with the main mission to secure the application of the conventions and codes of the World Anti-Doping Agency (WADA), and the rules of the International Olympic Committee, the International Paralympic Committee, and international sports federations.

The main aim of this paper was to provide insight into the presence and prevalence of doping in sports in Bosnia and Herzegovina (BiH). The method of theoretical analysis as well as the method of content analysis was used in analyzing the reports of the ADA-BiH in the period from 2010 to 2021. The main findings of this research were as follows: the most common anti-doping rule that athletes in BiH violated is Article 2.1 of the World Anti-Doping Code, which implies the presence of a prohibited substance or its metabolites or markers in an athlete's sample, the most often abused substances were from the S6, S1, and S8 of WADA's Prohibited list, the main sports disciplines in which the doping occurred were kickboxing, basketball, handball, boxing, and weightlifting and the largest number of violations of anti-doping rules occurred in 2016. According to the analysis of ADA-BiH's reports, it can be assumed that despite the presence of doping in sports, BiH through serious and regular educational programs, is successfully combating this problem.

About science through sport – STEMsport

The science and sport popularization project of the Croatian Judo Federation

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Keywords: STEM popularization, sport popularization, judo, chemicals toxicity

The main project objectives are i) to strengthen the capacities of civil society organizations for the active involvement of children and young adults, but also of the broader public into STEM (biology, chemistry, physics and mathematics), and ii) to popularize knowledge from a wide range of STEM disciplines through the sports environment. A range of popular science presentations and workshops will be designed and performed at sports events and public festivals during two project years (2022–2024). One specific project goal is to train the sports trainers to perform workshops for raising awareness and overall knowledge of young athletes on the hot topics in the field of applied chemistry and biology such as: toxicology of nutritional supplements, "invisible" plastics, cannabis-based products and tattoo-dyes, carbohydrate metabolism and the noise-exposure challenge. More than 35 STEMsport trainers from Croatia will be educated to conduct the STEMsport workshops. Until the end of the project, nearly twenty STEMsport events related to both science popularization and sports activities will be organized for the target audience. All of the planned activities aim to demonstrate sport operations through the lens of STEM and to show STEM as an integral part of modern sport. A sustainability of the project will be provided by the original curriculum on STEMsport educational activities and by the design and implementation of both the permanent and mobile science exhibits placed in a partner elementary school. The project was granted by both the EU European Social Fund and the State Budget within the framework of the call Strengthening the Capacity of Civil Society for the Popularization of STEM (UP.04.2.1.10.0160).



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