Ann Toxicol Anal. 2012; 24(2): 73-80
DOI: 10.1051/ata/2012012

Available online at:
www.ata-journal.org

ANNALES DE TOXICOLOGIE ANALYTIQUE

Original article / Article original

Counterfeit drugs and pharmaceutical preparations seized from the black market among bodybuilders

Médicaments de contrefaçon et préparations pharmaceutiques saisis sur le marché noir parmi les bodybuilders

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Abstract – Objectives: The aim of this study was to identify active ingredients present in counterfeit drugs and pharmaceutical preparations seized from the black market among bodybuilders. Preparations in closed or sealed packaging with different batch numbers (n = 74) and two preparations without labels were analyzed. **Methods:** The identification scheme was based on reversed-phase liquid chromatography with a photodiode array UV detector and gas chromatography-mass spectrometry. Methanolic sample extracts of tablets, capsules, oral jellies and water–based injectables were chromatographed on a ChromSpher 5 C18 column using a gradient program of triehylammonium phosphate and acetonitrile as mobile phases and were monitored at the wavelengths 220 nm and 254 nm. Oil-based injectables (n = 41) were extracted with hexane and methanol. The methanolic sample extracts and diluted supernatant layers were injected into an Agilent 6890 N gas chromatograph with a fused silica CPSIL 8CB low-bleed capillary column and Agilent 5973 inert mass selective detector operated in full-scan mode. The identified compound(s) were checked against the active ingredient(s) declared on the label. **Conclusion:** Packaging from counterfeits produced in underground labs cannot be visually distinguished from packaging originating from legitimate pharmaceutical companies. Out of 74 labeled products, the content of 25 (33.8%) did not match the label. Anabolic androgenic steroids are commonly found on the black market among bodybuilders, predominately esterified in oil-based injectables. Out of 40 steroidal oily solutions, the active ingredients of 21 (52.5%) did not match the label: one preparation did not contain an active compound, 20 contained other or more active ingredients. The additional compounds were often present in smaller quantities, which could be indicative of contamination. Active ingredients such as methandrostenolone, sildenafil, tamoxifen, quinine, clomiphene, dehydroepiandrosterone, anastrazole, clenbuterol, stanozolol, oxandrolone, liothyronine, finasteride and melatonin were identified in tablets, oral jellies and water-based injectables.

Key words: Black market, bodybuilding, liquid chromatography, gas chromatography-mass spectrometry, anabolic steroids, counterfeits

Résumé – Objectifs : Le but de cette étude était d'identifier les ingrédients actifs présents dans les médicaments de contrefaçon et de préparations pharmaceutiques saisis sur le marché noir parmi les bodybuilders. **Méthodes :** C'est sous emballage fermé et scellé, avec numéros de lots différents (n = 74) et deux préparations sans étiquette que ces analyses ont été réalisées. Le système d'identification a été basé sur chromatographie en phase inverse liquide avec un détecteur UV à barrette de photodiodes et de chromatographie en phase gazeuse-spectrométrie de masse. Des extraits d'échantillons méthanoliques de comprimés, de capsules, gelées orales et injectables à base d'eau ont été chromatographiés sur une colonne C18 ChromSpher 5 en utilisant un programme de gradient de tampon triehylammonium phosphate et l'acétonitrile comme phase mobile et ont été contrôlées à des longueurs d'onde 220 nm et 254 nm. Des injectables à base d'huile (n = 41) ont été extraits à l'hexane et au méthanol. Les extraits d'échantillons méthanoliques et dilués en couches surnageantes ont été injectés dans un Agilent 6890 N chromatographe en phase gazeuse avec de la silice fondue CPSIL 8CB purge basse colonne capillaire et Agilent 5973 détecteur de masse inerte sélective exploité à plein mode de balayage. Le composé identifié a été vérifié (ou les composés identifiés ont été vérifiés) par rapport à l'ingrédient actif déclaré (ou les ingrédients actifs déclarés) sur l'étiquette. **Conclusion :** Les emballages de contrefaçons produits dans des laboratoires clandestins ne peuvent pas être distingués visuellement de ceux provenant de sociétés

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pharmaceutiques légitimes. Sur les 74 produits étiquettés, le contenu de 25 (33,8 %) ne correspondait pas à l'étiquette. Les stéroïdes anabolisants androgènes sont généralement trouvés dans le marché noir parmi les culturistes, principalement estérifié dans l'huile à base de produits injectables. Sur les 40 stéroïdiens solutions huileuses, les ingrédients actifs de 21 (52,5 %) ne correspondent pas à l'étiquette : une préparation ne contient pas de composé actif, 20 contenaient des ingrédients autres ou plus actifs. Les autres composés sont souvent présents en petites quantités, lesquelles pourraient être indicatives de contamination. Les ingrédients actifs tels que methandrostenolone, le sildénafil, le tamoxifène, la quinine, le clomiphène, déhydroépiandrostérone, anastrazole, le clenbutérol, le stanozolol, oxandrolone, liothyronine, le finastéride et de la mélatonine ont été identifiés sous forme de comprimés oraux, gelées ou à base d'eau injectables.

Mots clés : Marché noir, musculation, chromatographie en phase liquide, chromatographie en phase gazeuse-spectrométrie de masse, stéroïdes anabolisants, contrefaçons

Received 29 April 2012, accepted after revision 28 May 2012
Published online 22 June 2012

1 Introduction

Bodybuilders purchase preparations to enhance muscle size and strength and to alleviate adverse effects associated with steroid use or to mask steroid abuse. Counterfeit products produced in so-called "underground labs" are available on the black market and are offered on the internet as legitimate pharmaceutical preparations. Besides the health issues associated with the use of androgenic anabolic steroids and drugs obtained without the mandatory subscription, unexpected side effects can occur when preparations do not or do not only contain the claimed active compounds.

The identification of active ingredients in confiscated illegally distributed anabolic steroid products and/or black market drugs was previously reported by Walters *et al.* (1990), Musshoff *et al.* (1997), Ritsch *et al.* (2000), Thevis *et al.* (2008) [1–4] and Kohler *et al.* (2009) [5].

This paper reports the analysis of 76 products confiscated from the black market among bodybuilders. Identification of active compounds in sample extracts was based on reversed-phase liquid chromatography with a photodiode array UV detector (HPLC/PDA) and quadrupole gas chromatography-mass spectrometry (GC/MS).

2 Materials and methods

2.1 Samples

Preparations confiscated from different individuals suspected to use or to be involved in the black market of counterfeits and pharmaceuticals among bodybuilders were submitted to the laboratory for identification of active compounds. Tablets (n = 26), capsules (n = 3), oral jellies (n = 4), aqueous solutions for intramuscular injection (n = 2) and oily solutions for intramuscular injection (n = 41) were analyzed. Preparations in closed or sealed packaging with different batch numbers (n = 74) and two preparations without labels were included in the study.

2.2 Sample extraction

2.2.1 Capsules, tablets, oral jellies and water-based injectables

To a finely-ground tablet, gel or water-based injectable from one dosage form, methanol was added. The concentration of the active ingredients on the labels was used as a guideline to obtain theoretical concentrations of 1 mg/mL. The suspensions and solutions were vortex-mixed and sonicated for 10 min. After centrifugation, 50 µL of the supernant layer was transferred to an auto-sampler vial containing the external standard solution, 20 µg/mL diphenylamine in the initial mobile phase. After homogenization, the sample was injected into the HPLC/PDA. For the GC/MS analysis, the methanolic supernant layer was diluted (1:1) in methanol (containing 100 µg/mL diphenylamine) before injection.

2.2.2 Oil-based injectables

Oil-based injectables were extracted with methanol and hexane [6].

2.3 Liquid chromatography

The HPLC/PDA analysis was performed using a Varian Prostar solvent delivery module in combination with a Varian Prostar 410 auto-sampler and Varian Prostar photodiode array detector. Data acquisition and analysis were performed with the Varian Star and Polyview software. A Lichrospher® 100 RP-18 (5 µm) was used as a saturation column. The separation of compounds was performed in gradient mode with the use of a ChromSpher C18 column (150-mm length × 4.6 mm *i.d.*, 5 µm particle size, Chrompack) connected to a C18 guard column (4-mm length × 3.0 mm *i.d.*, 3.5 µm particle size). The oven temperature was set at 35 °C. The mobile phases consisted of 25 mM TEA-phosphate buffer (A) and acetonitrile (B). The following gradient elution was programed: 95% A at time 0 min, changed to 30% A at 30 min and held for 5 min. The injection volume was 50 µL. The scan range was 220–340 nm and the chromatogram was monitored at 220 nm and 254 nm for 35 min. Before injection of the next sample the column was allowed to re-equilibrate for 10 min. The UV spectrum of an unknown was compared with the UV spectra of approximately 500 compounds present in the library stored in the Polyview software. Identification of active ingredients was based on the retention time (±2%) and similarity index (>0.995).

2.4 Mass spectrometry

GC/MS analysis was performed using an Agilent 6890 N gas chromatograph in combination with an Agilent 7683 injector and an Agilent 5973 inert mass selective detector. A Varian CP-SIL 8 CB low-bleed capillary column (30 m × 0.25 mm *i.d.*, 0.25 μm film thickness) was used connected to a fused silica retention gap (2.5 m × 0.25 mm). The carrier gas was helium at a constant flow of 1.1 mL/min. The temperature program was started at 70 °C, held for 2 min, increased to 310 °C at 8 °C/min and held for 23 min, with a runtime of 55 min. The temperatures of the injection port and the detector were set at 300 and 230 °C, respectively. The transfer line temperature was set at 280 °C. The injection volume was 1 μL using the spotless injection mode. Mass spectra were recorded in the range m/z 40–650. Before and after each injection of a sample, a blank injection of methanol was performed. Identification of an active compound was performed by comparing the retention time (±2%) and full-scan mass spectra to reference standards or by NIST computer library search.

3 Results

In total, 74 preparations in closed or sealed packaging with different batch numbers and 2 unlabeled preparations were analyzed. For the items whose identified compound(s) did not correspond with the labeled active ingredient(s), a reanalysis was performed on a second aliquot. All results confirmed the initial results, which are summarized in Table I.

In tablets, capsules, oral gels and water-based injectables one of the following compounds was identified: methandrostenolone, sildenafil, tamoxifen, quinine, clomiphene, dehydroepiandrosterone (DHEA), anastrazole, clenbuterol, stanozolol, oxandrolone, liothyronine, finasteride and melatonin. Item 9 was claimed to contain methandrostenolone, but quinine was identified. Clenbuterol was found in tablets labeled to contain ephedrine (item 38) and in aqueous solution for i.m. injection (item 39) supposed to contain clenbuterol and yohimbine. Anastrazole was present in tablets (item 44) claimed to contain mesterolone. 4-chlorodehydromethyl-testosterone in tablets (item 47) was found to be substituted by metandrostenolone. Item 73 consisted of non-labeled fragments of film-coated tablets (blue coating with white core) in which finasteride was identified.

With the exception of item 45, all oil-based injectables contained androgenic anabolic steroids (AAS). The following anabolic steroids (esters) were identified: testosterone enanthate (17), testosterone propionate (16), nandrolone decanoate (8), boldenone undecylenate (5), testosterone phenylpropionate (3), testosterone decanoate (3), testosterone (3), testosterone isocaproate (2), nandrolone (2), trenbolone acetate (2), methandrostenolone (1), masteron or drostanolone propionate (3), testosterone cypionate (1), masteron enanthate (1), methenolone enanthate (1), trenbolone enanthate (1) and testosterone isocaproate (1). The number of oily solutions in which the compound was identified is stated between brackets. In items 11, 16, 21, 42, 43, 52, 53, 54 and 55 the labeled active ingredient(s) were substituted with one other or more anabolic steroids. Items 20, 31, 32, 46, 49, 50, 51 and 64 contained one or more additional active ingredients besides the claimed compound(s).

4 Discussion

Packaging for legitimate pharmaceutical companies and underground labs cannot be differentiated based on their physical appearance: the manufacturer, trade name, active ingredient(s), amount(s), batch number and expiry date were present. Often, a recommended dosage was stated or a package insert was enclosed. Imprints appeared on tablets, ampoules and glass bottles. These findings were consistent with the conclusions of other studies [1–3]. Only the absence of a registration number compulsory for drugs marketed in Belgium may be an indication for a trained person (pharmacist) that the product is a counterfeit or was purchased abroad, possibly via the internet.

With the exception of the two unlabeled preparations, only preparations in closed and sealed packaging were included in the study so substitution or cross-contamination by the vendor or user could be excluded. The applied HPLC/PDA method is not specific for anabolic steroids, therefore methanolic sample extracts of tablets, capsules, oral gels and water-based injectables were also analyzed on GC/MS.

Although consistent with information found on internet forums and in the literature [7–11], it is remarkable to note that drugs used in traditional medicine to treat diseases such as cancer are circulating in the black market among amateur athletes: anastrozole (Arimidex®) is an aromatase inhibitor with estrogen-blocking properties used to treat breast cancer in women. Bodybuilders use anastrazole in combination with an anabolic (aromatizing) steroid cycle since it reduces side effects such as gynecomastia, acne and water retention and has the additional advantage of increasing testosterone levels. Finasteride (Propecia®, Proscar®) is an inhibitor of the 5-alpha-reductase enzyme used for the treatment of androgenetic alopecia (1 mg tablets), prostatic hyperplasia and prostate cancer (5 mg tablets). Tamoxifen citrate (Nolvadex®) and clomiphene (Clomid®) belong to a class of drugs known as Selective Estrogen Receptor Modulators. Nolvadex® and Clomid® are marketed for the treatment of breast cancer and male hypogonadism, respectively. They are taken by bodybuilders to prevent gynecomastia and as a "recovery drug". They are supposed to influence post-anabolic steroid cycle recovery since they would help raise testosterone, LH and FSH back to normal. Sildenafil is a selective 5-phosphodiesterase inhibitor with vasodilator properties marketed to be effective for erectile dysfunction. It is taken by bodybuilders to overcome the impotence sometimes caused by testosterone injections. On internet forums, sildenafil is promoted as a performance-enhancing drug taken as a pre-workout vasodilator along with AAS. Yohimbine is a centrally-acting selective alpha-2-antagonist medically used for erectile dysfunction and is promoted among bodybuilders as a lipid-mobilizing agent useful during weight loss. Clenbuterol hydrochloride is a selective β2 adrenergic agonist with decongestant and brochodilator properties used in medicine to treat chronic breathing problems. It is taken by bodybuilders for its fat-burning

Table I. List of seized preparations and identified active compound(s).

Item	Product labeling	Identified active compound(s)
1	Methandienone 5 mg 5 mg/tablet	Methandrostenolone
2	Kamagra *100 mg Oral Jelly each contains sildenafil citrate equivalent to sildenafil 100 mg, pineapple flavor	Sildenafil
3	Kamagra *100 mg Oral Jelly each contains sildenafil citrate equivalent to sildenafil 100 mg, vanilla flavor	Sildenafil
4	Kamagra *100 mg Oral Jelly each contains sildenafil citrate equivalent to sildenafil 100 mg, orange flavor	Sildenafil
5	Kamagra *100 mg Oral Jelly each contains sildenafil citrate equivalent to sildenafil 100 mg, lemon flavor	Sildenafil
6	Golden Gear active compound(s) not labeled	Boldenone undecylenate
7	Tamoxifen citrate 20 mg/tablet	Tamoxifen
8	Testoviron® Depot 250 testosterone enanthate injection USP	Testosterone enanthate
9	Naposim® 5 mg/tablet, methandienonum	Quinine
10	Naposim® 5 mg/tablet methandienonum	Methandrostenolone
11	Decanabol 250 nandrolone decanoate 10 mL; 250 mg/mL testosterone propionate	Testosterone enanthate
12	Testosterone 450, 10 mL 200 mg/mL testosterone-enanthate 150 mg/mL testosterone-cypionate 100 mg/mL testosterone-propionate	Testosterone propionate
13	Testolic® testosterone propionate 100 mg/2 mL	Testosterone propionate
14	Sustanon 250; 1 mL 30 mg testosteron propionat 60 mg testosteron fenilpropionat 60 mg testosteron izokaproat 100 mg testosteron dekanoat	 Testosterone propionate Testosterone phenylpropionate Testosterone isocaproate Testosterone decanoate
15	Sustanon 250; 1 mL 30 mg testosteron propionat 60 mg testosteron fenilpropionat 60 mg testosteron izokaproat 100 mg testosteron dekanoat	 Testosterone propionate Testosterone phenylpropionate Testosterone isocaproate Testosterone decanoate
16	Golden Gear, nandrolone decanoate 200 mg/mL; 10 mL	Testosterone enanthate
17	Golden Gear, testosterone enanthate 250 mg/mL; 10 mL	Testosterone enanthate
18	Tamoxifen 10 mg/tablet	Tamoxifen

Table I. Continued.

Item	Product labeling	Identified active compound(s)
19	Deca-Durabolin® 200 mg 2 mL ampoule; nandrolone decanoate	Nandrolone decanoate
20	Boldenone® 200 mg 2 mL ampoule, boldenone undecylenate	Boldenone undecylenate Testosterone propionate
21	Parabolan Neo 100 mg 2 mL ampoule; trenbolone hexahydrobenzyl carbonate	Nandrolone decanoate Testosterone propionate
22	Serpafar 50 mg/tab; clomiphene citrate	Clomiphene
23	Testoviron 250 mg/mL 1 mL ampoule; testosterone enathate	Testosterone enanthate
24	METAHΔPOCTEHOΛOH	Methandrostenolone
25	Naposim 5 mg/tablet; methandrostenolone	Methandrostenolone
26	Testosterone 450 200 mg/mL testosterone-enanthate 150 mg/mL testosterone-cypionate 100 mg/mL testosterone-propionate	 Testosterone enanthate Testosterone cypionate Testosterone propionate
27	Tamoxifen citrate 20 mg/tablet	Tamoxifen
28	Methyl-1-T (17 alpha methyl-17 beta hydroxy-androst-1-ane-3-one) dehydroepiandrosterone, 10 mg/capsule	DHEA
29	Boldenone 250, 10 mL 250 mg/mL USP 68; boldenone undecylenate	Boldenone undecylenate
30	Arimidex, anastrazole 1 mg/tablet	Anastrazole
31	Deca 200, 10 mL 200 mg/mL nandrolone decanoate	Nandrolone decanoate Nandrolone Testosterone propionate Testosterone enanthate
32	Deca 200, 10 mL 200 mg/mL nandrolone decanoate	Nandrolone decanoate Nandrolone Testosterone propionate Testosterone enanthate
33	Dianabol 10, 10 mg/tablet methandrostenolone	Methandrostenolone
34	Clomid 25, clomiphene citrate 25 mg/tablet	Clomiphene
35	Mast 100, 10 mL 100 mg/mL masterone Propionate	Masteron or drostanolone Propionate
36	Kamagra, 100 mg/tablet sildenafil citrate	Sildenafil
37	Lovegra, 100 mg/tablet sildenafil	Sildenafil
38	Ephedrine 25, 25 mg/tablet, ephedrine hydrochloride	Clenbuterol
39	Helios, 10 mL clenbuterol HCL 100 mcg/mL yohimbine HCL 13.5 mg/mL	Clenbuterol
40	Masteron 200, 10 mL 200 mg/mL masteron enanthate	Masteron enanthate
41	Nolvadex 10, 10 mg/tablet tamoxifen citrate	Tamoxifen

Table I. Continued.

Item	Product labeling	Identified active compound(s)
42	Sustanon 250, 10 mL 250 mg/mL testosterone propionate 30 mg testosterone phenylpropionate 60 mg testosterone icocaproate 60 mg testosterone decanoate 100 mg	Testosterone enanthate Testosterone
43	Primabolan 100, 10 mL 100 mg/mL methenolone enanthate	Masteron or drostanolone Propionate, nandrolone decanoate
44	Proviron, 25 mg/tablet mesterolone	Anastrazole
45	Nandrolone 200, 10 mL 200 mg/mL	–
46	Ultra Drive 320, 10 mL 320 mg/mL boldenone undecylenate 200 mg methandriol 120 mg	Boldenone undecylenate Testosterone enanthate
47	Turinabol 10, 10 mg/tablet 4-chlorodehydromethyl-testosterone	Methandrostenolone
48	Testomix 300, 10 mL testosterone propionate 50 mg testosterone phenylpropionate 70 mg testosterone isocaproate 80 mg testosterone decanoate 100 mg	Testosterone propionate
49	Test Prop 100, 10 mL 100 mg/mL testosterone propionate	Testosterone propionate Testosterone enanthate
50	Testosterone 250, 10 mL 250 mg/mL testosterone	Testosterone enanthate Testosterone
51	Testosterone 250, 10 mL 250 mg/mL testosterone enanthate	Testosterone enanthate Testosterone
52	Winstrol 50, 10 mL 50 mg/mL stanozolol	Testosterone propionate Testosterone enanthate
53	Winstrol 50, 10 mL 50 mg/mL stanozolol	Testosterone propionate Testosterone enanthate
54	Trenbolone 200, 10 mL 200 mg/mL trenbolone enanthate	Trenbolone acetate
55	Trenbolone 200, 10 mL 200 mg/mL trenbolone enanthate	Trenbolone acetate
56	Winstrol 10, 10 mg/tablet stanozolol	Stanozolol
57	Winstrol 10, 10 mg/tablet stanozolol	Stanozolol
58	Testosterone propionate injection 250 mg/mL	Testosterone propionate
59	Methandienone, 5 mg/tablet	Methandienone
60	Oxandrolone, 10 mg/tablet	Oxandrolone
61	Tabulettae Methandrostenolone 0.005/tablet	Methandrostenolone
62	Methenolone-enanthate, 10 mL 100 mg/mL	Methenolone enanthate
63	Trenbolac Drostanpro, 10 mL 200 mg/mL 100 mg/mL trenbolone acetate 100 mg/mL drostanolone proprionate	Trenbolone acetate Masteron or drostanolone Propionate
64	Trenbolen Testen, 10 mL 200 mg/mL 100 mg/mL trenbolone enanthate 100 mg/mL testosterone enanthate	Boldenone undecylenate Testosterone enanthate
65	Nandrolone decanoate, 10 mL 200 mg/mL	Nandrolone decanoate
66	Boldenone undecylentate, 10 mL 200 mg/mL	Boldenone undecylenate

Table I. Continued.

Item	Product labeling	Identified active compound(s)
67	Tiromel, 25 mcg/tablet L-triiodotironin	Liothyronine
68	Cidoteston, 250 mg/mL testosterone oenanthate	Testosterone enanthate
69	Deca 200, 10 mL, 200 mg/mL nandrolone decanoate	Nandrolone decanoate
70	Deca 200, 10 mL, 200 mg/mL nandrolone decanoate	Nandrolone decanoate
71	Cytomel T3, 25 mcg/tablet liothyronine sodium	Liothyronine
72	Sustanon 250 mg/mL; 1 mL ampoule	
	testosterone propionate 30 mg	Testosterone propionate
	testosterone phenylpropionate 60 mg	Testosterone phenylpropionate
	testosterone isocaproate 60 mg	Testosterone isocaproate
	testosterone decanoate 100 mg	Testosterone decanoate
73	Tablet fragments, unlabeled	Finasteride
74	Strombaject Aqua, 50 mg/mL stanozolol	Stanozolol
75	Dhea, 50 mg/capsule dihydroepiandrosterone	Dihydroepiandrosterone
76	Melatonine, 3 mg/capsule	Melatonin

properties and its supposed anabolic effects. Clenbuterol was found in tablets labeled to contain ephedrine. Liothyronine sodium is a synthetic thyroidal hormone used medically as a substitute for the natural thyroid hormone triiodothyronine for the treatment of fatigue, metabolic disorders, obesity and thyroid insufficiency. Liothyronine sodium is used by bodybuilders to burn off excess body fat without the restriction of protein intake. On bodybuilders' forums it is advised to use it in combination with clenbuterol or AAS to heighten its fat-burning ability. In tablets claimed to contain methandrostenolone, quinine was identified as the active ingredient. Thin-layer chromatography was applied to distinguish the diastereoisomers quinine and quinidine. In traditional medicine quinine is prescribed as a muscle relaxant and to treat malaria. On bodybuilders' forums little information was found regarding its use, although it was mentioned that quinine prevents muscle-cramping. Melatonin is a natural hormone secreted by the pineal gland. It is suggested as a supplement to ease jet lag, hasten sleep and to strengthen the immune system.

Anabolic androgenic steroids (AAS) are synthetic derivatives of the male hormone testosterone and can be taken orally, by intramuscular injection or in creams or gels. In medicine AAS are used to treat diseases such as delayed puberty, osteoporosis, endometriosis, weight loss due to illness and some types of impotence, anemia or breast cancer. AAS are taken by bodybuilders for their ability to increase muscle mass and decrease body fat. Methyltestosterone, methandrostenolone, oxandrolone, stanozolol and dehydroepiandrosterone were identified in tablets or capsules. Oil-based injectables containing esterified AAS are popular among bodybuilders since they slow the release of the parent steroid from the site of injection, avoiding the need for daily injection. Out of 40 steroidal oily solutions, the active ingredients of 21 (52.5%) did not match the label: one preparation did not contain an active compound, 20 contained other or more active ingredients. The additional compound(s) were often present in smaller quantities than the claimed compound(s). This may be indicative of contamination of raw materials or contamination occurring during production and/or packaging. Testosterone enanthate, testosterone propionate, nandrolone decanoate and boldenone undecylenate were most commonly found in, respectively, 17, 16, 8 and 5 of a total of 41 analyzed oil-based injectables. One of the oil-based injectables did not contain an AAS. In this item only tocopherol was identified and benzyl alcohol and benzyl benzoate were absent. The co-solvents benzyl alcohol and benzyl benzoate were identified in all oily solutions in which AAS were identified. The applied methods do not allow the detection of trace amounts, therefore liquid chromatography and mass spectrometry methods with the use of deuterated internal standards are more suitable. Despite the reported illegal use of protein- and peptide-based substances and selective androgen receptor modulators in elite and amateur sport, no products labeled as such were present in the preparations seized [5].

5 Conclusions

The aim of this study was to identify active ingredient(s) present in pharmaceutical products seized from the black market among bodybuilders. Despite the finding that packaging from counterfeits produced in underground labs cannot be visually distinguished from packaging originating from legitimate pharmaceutical companies, this proved not to be a guarantee that the active ingredient(s) present in the preparations match the information claimed on the labels. Out of 74 analyzed products, 25 (33.8%) contained other or did not only contain the labeled active ingredients. Besides the health issues associated with their use, unexpected side effects can occur when preparations do not contain the claimed active compound(s) or amount(s).

Anabolic androgenic steroids are commonly found on the black market among bodybuilders, predominately esterified in oil-based injectables, but also in tablet or capsule form. Out of 40 steroidal oily solutions, the active ingredients of 21 (52.5%) did not match the label. The additional compounds were often present in smaller quantities, which could be indicative of contamination.

Prescribed drugs used in traditional medicine are often purchased by amateur athletes as counterfeits on the black market. They are mainly taken to alleviate adverse effects associated with the abuse of anabolic steroids.

Acknowledgements. The authors wish to thank Philippe Lacroix and Annick Uytterhaegen for their assistance with the French translation.

Conflicts of interest: The authors declare that there are no conflicts of interest.

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