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## **Recent developments in counterfeits and imitations of Viagra, Cialis and Levitra**

A 2005-2006 update

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## **Abstract**

### **Recent developments in counterfeits and imitations of Viagra, Cialis and Levitra**

A 2005-2006 update

A strong trend is observed towards increasingly professional counterfeits and imitations of Viagra, Cialis and Levitra, with regard to the appearance of tablets, capsules and packaging. The professional presentation will deceive potential consumers into assuming these products are legal, efficacious and safe. However, a high health risk is posed by the increased use of potent active substances, mixtures thereof, and the rising number of active substances in adulterated herbal aphrodisiacs that have no known safety or toxicological profile (analogs). Consumers can not be certain of any of these products as to their pharmacological and toxicological safety.

These are the results of a trend analysis based on illegal erectogenics analysed by the RIVM, the Nederlands Forensisch Instituut and the Douane Laboratorium. Suspect samples were seized by the Dutch inspectorates outside the official medicines distribution chain over 2005–2006. The analysis data was combined in order to draw a more accurate picture of current trends in the Netherlands and the associated health risk. This material is supplemented with the results of a Pan-European investigation into the infiltration of counterfeit Cialis in the official distribution chain, the determination of the pharmacological potency of some sildenafil analogs, and a literature survey, which made it possible to predict which new analogs can be expected in the near future.

Key words:

Analog, Cialis, Levitra, PDE-5, Viagra

# Rapport in het kort

## **Recente ontwikkelingen onder vervalsingen en imitaties van Viagra, Cialis en Levitra.**

Een aanvulling over 2005-2006

Er wordt een sterke trend waargenomen naar steeds professionelere vervalsingen en imitaties van Viagra, Cialis en Levitra ten aanzien van het uiterlijk van de tabletten, capsules en verpakking. Deze toenemende professionele presentatie zal potentiële gebruikers misleiden aan te nemen dat deze middelen legaal, werkzaam en veilig zijn. Echter, een groot gezondheidsrisico vormt het toenemende gebruik van krachtig werkzame stoffen, mengsels daarvan en het groeiend aantal werkzame stoffen in vervalste kruiden waarvan de veiligheid nooit is onderzocht (analoga). De consument is echter bij geen van deze producten zeker van de farmacologische of toxicologische veiligheid.

Dit zijn de resultaten van een trendanalyse gebaseerd op illegale erectiemiddelen onderzocht door het RIVM, het Nederlands Forensisch Instituut en het Douane Laboratorium. De verdachte middelen werden in beslag genomen door de Nederlandse inspectiediensten buiten het officiële geneesmiddelen circuit gedurende 2005-2006. De onderzoeksresultaten werden samengebracht om een nauwkeuriger beeld te krijgen van de trends in Nederland en daarmee gepaard gaande gezondheidsrisico's. Het materiaal is aangevuld met gegevens van een Pan-Europees onderzoek naar de aanwezigheid van vervalste Cialis in het officiële circuit, een onderzoek naar de farmacologische werkzaamheid van sildenafil analoga en een literatuurstudie die aangeeft welke nieuwe analoga er in de nabije toekomst te verwachten zijn.

Trefwoorden:

Cialis, Vervalsingen, Levitra, PDE-5, Viagra

## Abbreviations

API	Active Pharmaceutical Ingredient
DAD	Diode Array Detector
EMA	European Agency for the Evaluation of Medicinal Products
EDQM	European Directorate for the Quality of Medicines
FIOD-ECD	Fiscale Inlichtingen- en Opsporingsdienst – Economische Controle Dienst
GABA	Gamma-butyric acid
GMP	Good Manufacturing Practice
HPLC	High-Performance Liquid Chromatography
ICH	International Committee on Harmonisation
IGZ	Inspectie voor de Gezondheidszorg (Dutch Healthcare Inspectorate)
MHRA	Medicines and Healthcare products Regulatory Agency
MS	Mass Spectrometry
NFI	Nederlands Forensisch Instituut (Dutch Forensic Institute)
NIR	Near Infra-Red
NMR	Nuclear Magnetic Resonance
OMCL	Official Medicines Control Laboratory
PDE-5	Phosphodiesterase 5 enzyme
RIVM	Rijksinstituut voor Volksgezondheid en Milieu
UK	United Kingdom
VWA	Voedsel- en Warenautoriteit (Dutch Authority on Food and Commodities)



# Contents

<b>Summary</b>	<b>9</b>
<b>1 Introduction</b>	<b>13</b>
<b>2 Materials and methods</b>	<b>15</b>
2.1 Samples	15
2.2 Pan-European Survey on Cialis	15
2.3 Literature study on Analogs	15
2.4 Efficacy studies on Analogs	16
<b>3 Results</b>	<b>17</b>
3.1 Samples	17
3.2 Pan-European Survey on Cialis	17
3.3 Analogs in literature	17
3.4 Pharmacological activity of analogs	18
<b>4 Discussion</b>	<b>19</b>
4.1 Results of the three laboratories	19
4.2 Counterfeits	19
4.3 Imitations	20
4.4 Analogs	21
4.5 General considerations	22
<b>5 Conclusions and recommendations</b>	<b>23</b>
<b>References</b>	<b>27</b>
<b>Tables and figures</b>	<b>29</b>
<b>Appendices</b>	<b>51</b>



## Summary

The analysis results of suspect erectogenic drug products over the period 2005–2006 by three governmental laboratories in the Netherlands are reported and summarised. Samples were seized by the Dutch inspectorates during separate investigations in the Netherlands and were analysed for their appearance, content and presentation. Sampling was not intended to draw a representative picture for the Dutch market in illegal erectogenics.

In addition, the results of a Pan-European Survey carried out in 2005 are reported, investigating possible infiltration of counterfeit Cialis<sup>®</sup> into the official distribution chain. These data are supplemented with the results of a literature study, also covering patents, to enable an intelligent guess if, and which, new sildenafil analogs can be expected to appear in illegal erectogenic drug products in future years. Lastly, the results of an in vitro assay of erectogenic potency of some new sildenafil analogs are presented. These data were examined in combination, making a broad trend analysis feasible.

### Counterfeits

We define counterfeits as falsifications that are look-a-likes of the genuine medicine, having the correct shape, color, and embossing. In the present survey, covering 2005-2006, 95 counterfeit erectogenics were identified, most of which were counterfeit Viagra<sup>®</sup> (69%). In the near future this may change, as trends in counterfeiting follow on the market introduction of new genuine products and on their popularity. Currently some 25% of the counterfeits are those of Cialis<sup>®</sup> whereas in 2004, this was only 2%. In our previous survey, no counterfeit Levitra<sup>®</sup> was detected, whereas in the present survey, counterfeit Levitra accounts for 6% of all detected counterfeits.

All counterfeits analysed have become increasingly accurate in their appearance. Boxes and blister packs of Viagra<sup>®</sup>, Cialis<sup>®</sup> and Levitra<sup>®</sup> have become so well copied that consumers can no longer judge from their appearance whether the medicine is genuine or counterfeit. Therefore, the risk for infiltration of counterfeits into the official distribution chain is increasing.

For health risk assessment we define six subclasses of counterfeits depending on the actual identity and content of active pharmaceutical ingredient(s) (APIs):

- **Professional counterfeit:** contains correct API within 90-110% of declared amount; no other APIs.
- **Non-professional counterfeit:** contains correct API outside 90-110% of declared amount; no other APIs.
- **Mixed counterfeit:** contains correct API and another, known API.
- **Fraudulent counterfeit:** contains other, known API.
- **Analog counterfeit:** contains other, unapproved API.
- **Placebo counterfeit:** does not contain APIs.

Although the visual presentation of counterfeits have become more professional, the share of professional counterfeits, according to their composition, decreased compared to the previous survey period. Overall, we classified 37% of the counterfeits as professional counterfeit, posing, from a pharmacological point of view, the relative lowest risk to public health.

The share of non-professional counterfeits, according to their composition, has decreased compared with the previous survey period. From a pharmacological point of view these also represent a relatively low health risk. In the present survey, this subclass accounted for 26% of the samples. All samples contained too little API and none too much. Placebo counterfeits were not found.

Higher risk categories are fraudulent counterfeits and mixed counterfeits, together accounting for 37% of the counterfeits in the present survey. In our previous survey, many non-PDE-5 inhibitors (e.g. amphetamine, GABA, et cetera.) were present in these categories. However, in the present survey, mostly regular pharmaceuticals for treating erectile dysfunction were identified. No counterfeit analogs were detected in the present survey.

### **Imitations**

We define imitations as illegal drug products that do not look like the genuine medicine, but by their name or claim strongly suggest an erectogenic effect ('do-a-like'). Depending on the actual identity and content of the API, we distinguish six subclasses:

- **Professional imitation:** contains declared API within 90 - 110% of declared value; no other APIs.
- **Non-professional: imitation:** contains declared API outside 90 - 110% of declared value; no other APIs.
- **Mixed imitation:** contains declared API and another API.
- **Fraudulent imitation:** contains an undeclared API.
- **Analog imitation:** contains other, unapproved API
- **Placebo imitation:** does not contain APIs.

Compared to our previous survey, imitations are more professional in appearance. Imitations nowadays are mostly tablets, packed in blister packs and boxes being presented as legal and hence safe medicines. Their appearance is professional and trustworthy. In our survey two years ago many imitations contained naturally occurring APIs, such as yohimbine, but in the present survey nearly all detected APIs are potent and synthetic active substances. Professional imitations and placebo imitations are two categories with a relatively low pharmacological risk, together now accounting for 42% of the imitations.

Higher risk subcategories are non-professional imitations, in which samples containing extremely high dosages of API were identified, and analog imitations accounting for 17% and 41% of the imitations, respectively. In the present survey analogs were identified only in alleged herbal aphrodisiacs and were never described as an ingredient on the label.

Comparing the identified analogs with patent literature showed that their molecular structures and synthesis routes are described in detail. To verify their pharmacological efficacy some sildenafil analogs, were tested in an in vitro assay on erectogenic potency. Because the tested analogs were as potent as the registered APIs, the products containing them will most probably meet consumer satisfaction. Hence, new and yet unknown analogs can be expected to appear in erectogenic drug products over the next years.

### **Overall**

We conclude that the risks to public health associated with illegal erectogenic drug products in the recent years have broadened. Two years ago, these risks were mainly associated with the inherent risks of the low-quality composition and manufacturing. However, these illegal medicines were easily detected as such. Currently, consumers are no longer able to distinguish between counterfeit and genuine medicines and the nowadays trustworthy appearance of imitations may cause potential consumers to underestimate the risk to their health by taking illegal medicines.

From a public health point of view, the increased health risks are associated with the increased use of potent PDE-5 inhibitors in illegal erectogenics, specifically of analogs. An additional health risk is posed by good-looking counterfeits (tablets, blister packs and boxes) infiltrating the official distribution chain in the future without being noticed.

Another trend observed is the shift from counterfeits to imitations. Producing or trading counterfeits is an explicitly criminal undertaking, violating trademarks and patents, whereas trading imitations (especially of analogs) may be perceived as less risky even though, very often, the same patents are violated.

The health risk inherent to all illegal medicines is that they are not produced under Good Manufacturing Practice (GMP) under survey of Inspectorates of countries participating in the International Committee on Harmonisation (ICH) or associated countries. Therefore, no two samples from one batch may be alike and yet each may contain poisonous contaminants.

With the enormous amounts of counterfeits and imitations being sold, statistically, consumers should have required medical attention or have died using these products. It is therefore surprising that these cases have not surfaced. Clearly, the existing pharmacovigilance systems are not capable of detecting problems arising from illegal medicines. Contributing factors could be a great deal of shame connected with using erectogenics. Secondly, these products are typically being used outside the control of doctors and pharmacists. Therefore, serious side effects may go unnoticed, as may life-threatening interactions with regular medication. For instance, persons with a heart condition tend to experience erectile dysfunction. When such a vulnerable person, receiving regular heart medication, dies from cardiac arrest, it seems unlikely that drug-drug interactions are investigated.

**Recommendations:**

- a) Intensify warning of the public against the risks associated with the use of illegal medicines, even when looking professional.
- b) Encourage consumers of illegal erectogenics in reporting side-effects (anonymously) to an online database to be maintained by a new or existing organisation in registering side-effects or poisoning.
- c) Encourage hospital toxicologists to analyse for analogs in relevant cases and report to IGZ.
- d) Continue to survey the illegal medicines market.
- e) Set up a structured cooperation of governmental organizations in the Netherlands combating illegal medicines.
- f) Enforce the legal responsibility of distributors and wholesalers to monitor the authenticity of these medicines.
- g) Enforce distributors and wholesalers to use techniques able to detect professional counterfeit.
- h) Enforce Forensic Medicines Control Laboratories to use analytical techniques able to identify new analogs.
- i) Declare analogs in general as being unevaluated medicinal substances by using (patent) literature.



# 1 Introduction

In 2005, the RIVM report titled ‘Counterfeits and imitations of Viagra<sup>®</sup> and Cialis<sup>®</sup> tablets’ was published.<sup>1</sup> The report was based solely on the suspect samples investigated by the RIVM, brought in for analysis by the Inspectorates. The report concluded that “...the samples give an insight into the developments of the illegal market. However, they may not be representative for the market supply.” This restriction was made partially because RIVM is only one of the governmental laboratories in The Netherlands analyzing suspect illegal erectogenic drug products, and the recommendation was made to: “Combine and coordinate the activities of several governmental bodies to come to a more coherent overview on the trends and risks of falsifications of medicines.”

The present report concerns the analysis results for the years 2005-2006. Samples were brought in by the Inspectie voor de Gezondheidszorg (IGZ), enforcing the Dutch Medicines Act, and the Voedsel- en Warenautoriteit (VWA) acting on suspicion of adulterated foodstuffs. Complementing the RIVM data over this period are the chemical analysis results of two sister institutes in the Netherlands. The Nederlands Forensisch Instituut (NFI) and Douane Laboratorium have kindly shared their data enabling us to analyse trends on illegal erectogenics having a more representative overview of the illegal market.

To further broaden the scope of our report on falsifications of erectogenic medicines, the present report takes into account also other data. First, following the incidental detection of counterfeit Cialis in the official distribution chain, a specific survey on the occurrence of counterfeits in the official distribution chain of Cialis was carried out in 2005 by a cooperation of the European Inspectorates. The results of this survey will be reported shortly.

Second, we carried out a literature study on analogs and the predictability of the appearance of new analogs. Analogs are defined as molecules whose chemical structure strongly resembles the chemical structure of sildenafil, tadalafil or vardenafil but are not (yet) registered in any drug product and hence are of unknown efficacy and safety.

Third, the erectogenic potency of some sildenafil analogs was measured to demonstrate that structural analogy is reflected by a functional analogy. The objective was to show that analogs are unevaluated medicinal products, thereby burdening the manufacturers of adulterated food-supplements with responsibility of proving safety and efficacy.



## 2 Materials and methods

### 2.1 Samples

Samples analysed at the RIVM were obtained by the Inspectie voor de Gezondheidszorg (IGZ) and the Voedsel- en Warenautoriteit (VWA) and were analysed as reported previously.<sup>1, 2</sup> In addition, dosing form was investigated along with API, boxes, blister packs and safety features. Distinction between imitations of Viagra, Cialis or Levitra was only made when unambiguous.

Samples analysed by the NFI and the Douane Laboratorium had been confiscated by the Dutch customs, local criminal investigators or the Fiscale Inlichtingen- en Opsporingsdienst / Economische Controle Dienst (FIOD-ECD). The analysis data supplied by the NFI and the Douane Laboratorium were obtained using GC-MS, ESI-MS-MS, FTIR spectroscopy and HPLC-DAD-MS. The datasets contained information on the product name, appearance and the API identified. Based on these data, samples were classified as counterfeit or imitation. Because the content of the API generally was not quantified, further sub-classification was not possible.

RIVM samples were classified as described earlier.<sup>1</sup> Classification as counterfeit or imitation is based on visual parameters only, whereas the sub-classification is also based on their actual composition, i.e. identity and content of an API (Table 1).

### 2.2 Pan-European Survey on Cialis

The Pan-European survey was initiated by the Ad-hoc Inspectors Working Group and the Official Medicines Control Laboratories (OMCLs) of the UK and the Netherlands. In collaboration with the European Agency for the Evaluation of Medicinal Products (EMA), the European Directorate for the Quality of Medicines (EDQM) and our UK sister laboratory of the Medicines and Healthcare products Regulatory Agency (MHRA), it was decided to survey the legitimate regulated supply chain in Europe as part of a routine market surveillance study. Sampling was coordinated by EMA, and the Ad-hoc Inspectors Working Group.

Healthcare inspectors of 16 countries all over Europe took some 122 samples of Cialis 10 mg and Cialis 20 mg from the official supply chain during a four month period. Lilly-ICOS, the holder of the marketing authorization on Cialis, provided genuine Cialis tablets manufactured in the UK, Puerto Rico, Mexico and Brazil for reference.

Samples were independently analysed by both the RIVM and the laboratory of the MHRA using Near Infrared (NIR) spectroscopy as described previously.<sup>1</sup> Any sample under the threshold of 99.80% likeliness with the genuine product was considered counterfeit.

### 2.3 Literature study on Analogs

Relevant patent literature was gathered through publicly accessible internet sites (Espacenet, Wipo). Relevant conventional scientific literature was gathered through bibliographic search machines on the internet (Pubmed, Winspirls).

## 2.4 Efficacy studies on Analogs

Analogs are pharmacologically unknown varieties to the molecular structure of approved APIs. For in vitro efficacy studies three sildenafil analogs were tested at CEREP (Celle l'Evescault, France). Sildenafil citrate was included in the test to serve as a reference. Bulk homosildenafil was a generous gift of the Forensic Chemistry Centre of the Food and Drug Administration of the USA (FCC-FDA). The sample was used for the PDE-5 inhibition assay without any further purification (purity > 95%). Hydroxyhomosildenafil was extracted from products taken from the Dutch market by IGZ and VWA. The content of four capsules of different products, all containing hydroxyhomosildenafil, was suspended together in 30 ml of water. The suspension was acidified to a pH of about 1 using a solution of 2 M HCl and was washed twice with 10 ml of diethyl ether. The pH of the water layer was raised above 10 using a solution of 2 M NaOH, followed by extraction using 3 x 10 ml of CHCl<sub>3</sub>. The combined CHCl<sub>3</sub> layers were dried using Na<sub>2</sub>SO<sub>4</sub> and were evaporated to dryness under a stream of nitrogen (purity > 91%).

Bulk acetildenafil was a generous gift of the laboratory of the Dutch Customs and was purified using liquid-liquid extraction. About 15 g was suspended in 300 ml of water that was subsequently acidified to a pH of about 1 using a solution of 2 M HCl. The acidic solution was washed six times with 150 ml of diethyl ether. The pH of the water layer was then raised above 10 using a solution of 2 M NaOH, followed by extraction using 6 x 100 ml of CHCl<sub>3</sub>. The combined CHCl<sub>3</sub> layers were dried using Na<sub>2</sub>SO<sub>4</sub> and were evaporated to dryness under a stream of nitrogen (purity > 88%).

Confirmation of the structures was established using HPLC-MS<sup>2</sup> and <sup>1</sup>H- and <sup>13</sup>C-NMR spectroscopy. The purity of the samples was established using <sup>1</sup>H-NMR spectroscopy.

The in vitro human PDE-5 assay was carried out according to a method based on the publication of Weishaar and others.<sup>3</sup> Sildenafil and the three sildenafil analogs were tested in the concentration range 0.030 – 30 nM. In addition a PDE-6 assay carried out for acetildenafil. Inhibition of the PDE-6 enzyme is associated with experiencing side-effects (visual disturbances).<sup>4, 5</sup> The assay was carried out on bovine retina according to Ballard et al. in the concentration range 0.030 – 30 nM.<sup>6</sup>

For each inhibition curve eight concentrations were tested in duplicate. From these inhibition curves the concentration can be calculated at which 50% of the test-compound is associated with the PDE-5 or PDE-6 enzyme. This is expressed as the IC<sub>50</sub> value which is considered a generally accepted measure of erectogenic potency of a drug.<sup>5</sup>

## 3 Results

### 3.1 Samples

In Appendix 1, 2 and 3 the analysis results are listed for the samples analysed by the RIVM, NFI and Douane Laboratorium over 2005-2006. Listed are the year of analysis, product names, appearance, dosage form, packaging, API identified, observed content, and classification. In case no data were available the entry was left blank.

The RIVM has analysed 72 suspect samples taken outside the official supply chain and 122 Cialis taken from the official supply chain for the Pan-European Survey on Cialis. Only the 72 suspect samples were taken into account for the figures. The tablets and capsules concerned were frequently brought in packed inside a blister pack and a box, accompanied by a patient information leaflet. Examples of counterfeit packaging material are given in Figure 1'. The NFI analysed 93 samples and the Douane Laboratorium analysed 114 samples.

Figure 2 shows the share of counterfeits and imitations of all samples.

Figure 3 shows the trend in counterfeit and imitation categories.

Figure 4 shows the trend in counterfeit Viagra, Cialis and Levitra as percentages of all counterfeits.

Figure 5 shows the APIs identified in all samples analysed, together.

Figure 6 shows the trend in APIs identified at the RIVM.

Figure 7 shows the sub-classification made according to Table 1. 7a) the subclasses of counterfeits and 7b) the subclasses of imitations. The subclasses represent the RIVM data only because the content of an API was generally not determined by the NFI and Douane Laboratorium.

### 3.2 Pan-European Survey on Cialis

Samples taken from the official supply chain could be differentiated using NIR spectroscopy. The differences were attributed to their location of manufacturing (UK and USA only), their coating and dosage. No samples did pass the lower threshold limit (correlation > 99.80%) and hence all samples taken in the Pan-European Survey on Cialis were considered genuine medicine.

### 3.3 Analogs in literature

Up to 2004 only three analogs of sildenafil had been reported in literature, which all had been identified in different herbal aphrodisiacs.<sup>7-9</sup> By the end of 2006 this number had grown to over 10 different analogs of sildenafil, tadalafil and vardenafil.<sup>10-13</sup> Most of these analogs have now been identified and still more are being found (Figure 8).<sup>14-18</sup>

Most of these analogs were already described in patents, along with detailed synthesis procedures and limited pharmacological data.<sup>18-25</sup> An overview of some of these reportedly pharmacologically active analogs is depicted in Figure 9. To date, only amino-tadalafil, carrying a highly reactive hydrazone, is the only tadalafil analog identified so far, and is the only analog not described in a patent.

Most of the analogs identified are those of sildenafil. These can be prepared synthetically by using a sildenafil half-product called Sildenafil Intermediate B. In two synthesis steps this half-product can be

converted to sildenafil or any sildenafil analog.<sup>21</sup> Sildenafil Intermediate B is being offered in large quantities on Asian websites but can also be bought in small quantities at Sigma-Aldrich, a regular supplier of laboratory chemicals.

The chemistry for producing vardenafil analogs is identical to that for sildenafil analogs.<sup>20</sup> Tadalafil analogs, like amino-tadalafil can be synthesised in four steps from an amino acid.<sup>19</sup>

### 3.4 Pharmacological activity of analogs

Acetildenafil, homosildenafil and hydroxyhomosildenafil were found pharmacologically active on the same enzyme (PDE-5) as sildenafil (Table 2). For comparison the pharmacological activity of tadalafil<sup>5</sup>, vardenafil<sup>26</sup> and morpholino-acetildenafil<sup>21</sup> is also shown along with their potency relative to sildenafil. In addition, we found acetildenafil to be pharmacologically active on the PDE-6 enzyme which is associated with experiencing visual disturbances.

## 4 Discussion

### 4.1 Results of the three laboratories

Compared to the classification used in our previous report<sup>1</sup>, the classification of samples in this survey was adjusted slightly. Analogs are no longer treated as a separate category, but as part of Counterfeits and Imitations, yielding the new subclasses: analog counterfeit or analog imitation. No distinction is made between imitations of Viagra, Cialis or Levitra, as the product information of imitations does not allow such a differentiation: imitations suggest a general erectile effect.

Over 90% of all samples were tablets (Appendix 1-3). Only at the RIVM a substantial number of capsules were analysed (20%). Dosing forms as gels, powders or beverages were observed incidentally. Tablets usually contain a registered API while capsules usually contain analogs.

Figure 2 shows that 65% of the received samples were imitations whereas in the previous survey period, about 50% of the samples were imitations (Figure 3). The majority of these imitations consist of Kamagra, a sildenafil-containing medicine produced by a legitimate pharmaceutical company in India. Kamagra products are not licensed and are therefore illegal in West-European countries and the USA. In our previous survey nearly all counterfeits were counterfeit Viagra (Figure 4). The share of counterfeit Cialis accounted for less than 6% of all counterfeits and no counterfeit Levitra was found in that period. Now, counterfeit Cialis and counterfeit Levitra together make up 31% of the counterfeits. This demonstrates there is a trend to follow the introduction of new, legal medicines.

With respect to the APIs used, sildenafil is identified most often (Figure 5). Sildenafil seems to be the cheapest and most easily available API with erectile properties for producers of illegal medicines. Figure 6 shows the trends observed in the use of APIs. Tadalafil is increasingly being identified in counterfeits but still sporadically in imitations. Contrarily, analogs were only being identified in imitation products.

Another striking difference with the previous survey is the sharp decrease in the use of weak or non-erectogenic APIs classified under “Other” (e.g. yohimbine<sup>\*</sup>).<sup>27</sup> Already in our previous survey, a drop in the use of APIs without any erectile effect was detected, and obviously this trend has continued.

### 4.2 Counterfeits

For this section only the RIVM data could be used because of the lack of information on samples analysed at the NFI and Douane Laboratorium. Counterfeits and imitations were classified in health risk categories according to Table 1. The results are depicted in Figure 7.

Thirty-seven percent of the counterfeits classify as a professional counterfeit; content and appearance are close to the genuine product. Non-professional counterfeits account for 24% of the counterfeits, and had too low a content, reducing the health risk. The high risk categories of fraudulent counterfeits (22%) and mixed counterfeits (15%) are mostly made up of Cialis tablets with the wrong API or with multiple APIs. Placebo counterfeits were not observed nor were any containing yohimbine, arginine et

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<sup>\*</sup> As of 01Aug07, yohimbine is declared a controlled substance in the Netherlands

cetera. Most of the counterfeited products analysed were copies of the highest dose of the genuine product on the market.

Counterfeit Viagra has become copied with increasing accuracy with regard to appearance, presentation and declared API. Although many counterfeits still contain too little API, their content has increased compared to our previous survey. First, this shows the increased technical ability to produce tablets. Second, this points at sildenafil being easily available and cheap. Third, it shows that counterfeiters are not after manufacturing extremely high doses of sildenafil. Actually, it seems counterfeiters are interested in increasing the duration of action.

This is illustrated by the growth in counterfeit Cialis and in the use of tadalafil (Figure 6). Because tadalafil (the API in genuine Cialis) has a longer duration of action than sildenafil (36h vs. 6h)<sup>4</sup>, Cialis is becoming more popular. However, as counterfeit Cialis usually contains sildenafil or mixtures of moderate dosages of sildenafil and tadalafil it is assumed tadalafil is less easily obtained. By using mixtures, counterfeiters may aim at taking advantage of the long-acting characteristics of tadalafil, but at low production costs.

Counterfeit Levitra 20 mg was observed for the first time since the market introduction of the product in 2003. Levitra counterfeits contained either sildenafil (40 mg), tadalafil (11 mg) or vardenafil (not quantified) which is the supposed API.

The health risk of counterfeits in general seems relatively modest because dosages of API are not extremely high. Still, consumers have no certainty about the API that is used and whether the product is free of toxic pollutants. In addition, by mixing APIs like sildenafil and tadalafil new and unknown health risks are taken.

It is expected that dosages of the registered APIs will not increase. Instead, a balance will be sought between cost of an API, the intensity and the duration of the experience. Fine-tuning will be done by marketing combinations of sildenafil, tadalafil, vardenafil and analogs, thereby increasing the health risk of counterfeits. Compared to the previous survey it seems that counterfeiters are much more aiming at customers' trust and consumer satisfaction.

Gaining consumer's trust is targeted through perfecting of counterfeit packaging which may eventually even deceive pharmacists. Any future infiltration of counterfeits in the official distribution chain is likely to undermine the trust of the public in the official distribution chain. Because checking every single tablet is not realistic, measures to combat and detect counterfeits have to be enforced upstream.

The government should take measures to guarantee the authenticity of medicines in the official distribution chain. This could be done by enforcement of the legal responsibility that distributors and wholesalers have to check the authenticity of the medicines they are trading, and stricter monitoring of the adequacy of their actions taken, also in terms of the techniques they use to check this authenticity. At the same time the forensic OMCLs should be asked to routinely check top-selling medicines on authenticity.

### 4.3 Imitations

Though imitations were defined as not being exact copies of the genuine product, some do resemble certain characteristic features of the genuine product. Often the characteristic shape of Viagra and Cialis tablets has been copied but the products have different names, colour, and embossing. Other imitations did not look like the genuine products at all but their name and/or labelling suggest an erectogenic effect.

Imitation tablets were generally packed in blister packs and boxes on which was clearly stated the product contained sildenafil or tadalafil. Contrarily the packaging of the capsulated herbal aphrodisiacs

never mentioned the presence of sildenafil, tadalafil or analogs. Therefore, consumers of these alleged foodstuffs are deceived into unwittingly taking dangerous APIs and while not counting on contraindications or side-effects.

The majority of imitations are of relatively high health risk. Analogs and non-professional imitations together account for nearly 60% of the imitations. The analogs, representing 41% of the imitations, concern some 4 unapproved APIs out of the 13 currently known (Figure 8). Non-professional imitations (17%) are characterised by the use of regular erectogenic APIs. Some were detected in extremely high content thereby increasing the health risk of this sub-category. An example of this is a product called Darling, which capsules each contain 155 mg of sildenafil. Normal dosages of sildenafil range from 25-100 mg.

Contrary to the previous survey no fraudulent imitations and mixed imitations were identified. In the previous survey most of the samples in these categories contained yohimbine, arginine et cetera Sildenafil is the API predominantly identified followed by tadalafil. In general, the actual content found is lower than the declared dosages. However, the content and API are not always clearly stated and sometimes just implied. Few placebo imitations were identified in all laboratories suggesting there is a small market.

Relatively low risk imitations are placebo imitations (14%) and professional imitations (28%). Most of the professional imitations were those manufactured by regular pharmaceutical companies in Asia (e.g. Ajanta, Cipla).

Compared to the 2000-2004 period the presentation of imitations has professionalised but the dosage and API are still unreliable. The volume of imitation products offered on the internet is so enormous that one may question whether consumers regard these products as illegal or untrustworthy.

The health risk posed by imitations is obvious; consumers do not know what API or dosage to expect nor what drug-drug interaction may come about. It is expected that the use of tadalafil and vardenafil will increase in imitation products. As successful erectogenics are prone to counterfeiting, it is likely that some counterfeit imitations (e.g. Kamagra) will be identified in the future.

## 4.4 Analogs

Analogs are PDE-5 inhibitors, designed and synthesised using scientific literature that have only one known purpose; the treatment of erectile dysfunction. Therefore, analogs are solely intended to be used as designer drug in counterfeits and imitations. Chemicals needed for the synthesis of analogs are cheap and available in bulk quantities around the world. Yet, as analog production seems to follow closely on official drug development it is assumed that the availability of legally produced half-products contributes to the specific analog being developed. However, because there are so many active molecules to design and to synthesize, it is hard to predict what analog will turn up next.

All analogs of sildenafil, tadalafil and vardenafil can reasonably be assumed to be potent PDE-5 inhibitors that also act on other enzymes.<sup>5, 14, 25</sup> However important, potency only partially contributes to the resulting health risk. Small differences in molecular structure may have drastic effects on their absorption in the body, their distribution, metabolism and excretion. Onset of action, blood levels, half-lives, brain penetration and metabolism may all be very different. All of these factors could give rise to (un)expected side-effects and do permanent health damage after single or repeated exposure.<sup>28</sup>

Two analogs were identified for which these risks are evident. First, there is the only tadalafil analog identified thus far: amino-tadalafil.<sup>12, 13, 29</sup> Instead of using methylamine to synthesize tadalafil, the more reactive and toxic hydrazine is used in the last synthesis procedure. The resulting amino-tadalafil

carries a still very reactive mono-hydrazone that may cause permanent inhibition of enzymes. It is therefore not surprising that amino-tadalafil is not protected by the Lilly-ICOS patent on treatment of erectile dysfunction.<sup>30</sup>

Second, there is piperidino-wardenafil. Lacking the primary target for metabolism present in vardenafil and sildenafil this analog will be metabolised less quickly. Being much more lipophilic, absorption and brain penetration for this analog will be much higher.<sup>5</sup> As a result it is expected that piperidino-wardenafil will give higher blood levels and remain active in the body longer compared to an equal dose of vardenafil. Especially worrying is that an increased brain penetration may contribute to neurological damage.<sup>28</sup>

Third, there is acetildenafil that shows no selectivity in inhibiting the PDE-5 or PDE-6 enzyme. Because PDE-6 inhibition is associated with visual disturbances and blindness, pharmaceutical industry has done much in drug development to attain an optimal selectivity for PDE-5.<sup>5</sup> Still, sildenafil, which has a 3-fold selectivity for PDE-5, causes visual disturbances at high doses (>200 mg).<sup>4</sup> An unselective analog like acetildenafil may therefore be expected to cause similar complaints at the dosages observed in capsules ( $\pm$  60 mg). So far, acetildenafil is the only analog tested for PDE-6 inhibition but this unfavourable balance may well hold for other analogs as well.

It is expected that many new analogs will appear in the future. Clinical development of new erectogenics as thiosildenafil<sup>31</sup>, benzamidenafil<sup>32</sup> and aildenafil<sup>33</sup> will prompt their misuse and that of their analogs. In addition to the known health risks for PDE-5 inhibitors in general, every new analogs will induce unforeseen adverse events and drug-drug interactions.

Currently analogs were only detected in alleged herbal aphrodisiacs. Manufacturers of these products are probably motivated by trying to avoid detection, to avoid prosecution under a Medicines Act and also to avoid patent infringement charges. Treating analogs as unevaluated medicines like in the Libidfit court case (acetildenafil) could suppress their development.<sup>34</sup>

Vigilance is warranted as manufacturers will probably regularly switch between analogs; prompted by economy, efficacy or detectability. Therefore, regular sampling is warranted. With the increasing availability of tadalafil and vardenafil the availability of their half-products and thus of their analogs will grow.

## 4.5 General considerations

There is more to the technical quality of illegal erectogenics than appearance, and identity and content of the API. Depending on the dosage form other quality criteria may be uniformity of content, dissolution, residues of organic solvents, of heavy metals, reagents and synthesis side products, microbial purity and identity and content of the excipients, but these were not tested for in our survey.

It should be made clear that even if an occasional sample meets the criteria we tested for, this illegal medicine still bears a risk to public health. Counterfeits and imitations are not produced under Good Manufacturing Practice (GMP) under survey of Inspectorates of countries participating in the International Committee on Harmonisation (ICH) or associated countries. The risk of non-GMP production often is underestimated but real. A dramatic example of the consequences of non-GMP manufacturing is the use of glycerine adulterated with ethylene-glycol (anti-freeze) in syrups, repetitively leading to mass poisoning.<sup>35, 36</sup> In 2006, it caused the death of many Panamanian children despite the fact the syrup fully complied with the criteria for identity and content of the API.

Even if a sample should meet all quality criteria, if it is not produced under inspected GMP conditions, there is no guarantee the next sample will be in compliance also.

## 5 Conclusions and recommendations

### Counterfeits

The appearance of counterfeit tablets as well as their packaging are being copied increasingly well. However, with regard to the identity of the API and content thereof in counterfeit tablets a trend was observed towards less professionalism, in particular for Cialis-counterfeits.

From a pharmacological point of view professional counterfeits pose a relatively low risk to public health. In the present survey the same was found for non-professional counterfeits as all contained too little API. However, relatively high risk categories are fraudulent counterfeits and mixed counterfeits. In these categories also, the appearance of the tablets and packaging are being perfected.

In our previous survey, many non-PDE-5 inhibitors were identified in counterfeits (e.g. amphetamine, GABA et cetera). However, in the present survey, mostly regular pharmaceuticals for treating erectile dysfunction were identified. Analogs were not detected in counterfeits.

### Imitations

Imitations also have professionalised in appearance, API and content. Imitations nowadays are mostly tablets, packed in blister packs and boxes being presented as legal and hence safe medicines. Their appearance is professional and trustworthy. In our survey two years ago many imitations contained naturally occurring APIs, such as yohimbine, but in this survey nearly all detected APIs are synthesised drug substances.

From a pharmacological point of view professional and placebo imitations pose a relatively low health risk. A relatively high health risk is posed by non-professional and analog imitations. In the present survey non-professional imitations were found containing extremely high amounts of an API. The health risk of analog imitations is evident because no safety profiles are known whatsoever.

Literature study showed that analogs are designed synthetic molecules derived from the molecular structures of known erectogenics published in (patent) literature. Some sildenafil analogs were tested in an in vitro assay on erectogenic potency and were found effective. Therefore, the products containing these unapproved APIs will most probably meet consumer satisfaction. Hence, new and yet unknown analogs can be expected to appear in erectogenic drug products over the next years.

### Overall

We conclude that the risks to public health associated with illegal erectogenic drug products in the recent years have broadened. Two years ago, these risks were mainly associated with the inherent risks of the low-quality composition and manufacturing. However, these illegal medicines were easily detected as such. Currently, consumers are no longer able to distinguish between counterfeit and genuine medicines and the nowadays trustworthy appearance of imitations may cause potential consumers to underestimate the risk to their health by taking illegal medicines.

From a public health point of view, the health risks are associated with the increased use of potent PDE-5 inhibitors in illegal erectogenics, specifically of analogs. An additional health risk is caused by good looking counterfeits (tablets, blister packs and boxes) infiltrating the official distribution chain in the future without being noticed.

Another trend observed is the shift from counterfeits to imitations. Producing or trading counterfeits is an explicitly criminal undertaking, violating trademarks and patents, whereas trading imitations (especially of analogs) may be perceived as less risky even though, very often, the same patents are violated.

The health risk inherent to all illegal medicines is that they are not produced under Good Manufacturing Practice (GMP) under survey of Inspectorates of countries participating in the International Committee on Harmonisation (ICH) or associated countries. Therefore, no two samples from one batch may be alike and yet each may contain poisonous contaminants.

With the enormous amounts of counterfeits and imitations being sold, statistically, consumers should have required medical attention or have died using these products. It is therefore surprising that these cases haven't surfaced. Clearly, the existing pharmacovigilance systems are not capable of detecting problems arising from illegal medicines. Contributing factors could be a great deal of shame connected with using erectogenics. Secondly, these products are typically being used outside the control of doctors and pharmacists. Therefore, serious side effects may go unnoticed, as may life-threatening interactions with regular medication. For instance, persons with a heart condition tend to experience erectile dysfunction.<sup>37</sup> When such a vulnerable person, receiving regular heart medication, dies from cardiac arrest, it seems unlikely that drug-drug interactions are investigated.

**Recommendations:**

- a. Intensify warning of the public against the risks associated with the use of illegal medicines, even when looking professional.
- b. Encourage consumers of illegal erectogenics in reporting side-effects (anonymously) to an online database to be maintained by a new or existing organisation in registering side-effects or poisoning.
- c. Encourage hospital toxicologists to analyse for analogs in relevant cases and report to IGZ.
- d. Continue to survey the illegal medicines market.
- e. Set up a structured cooperation of governmental organizations in the Netherlands combating illegal medicines.
- f. Enforce the legal responsibility of distributors and wholesalers to monitor the authenticity of there medicines.
- g. Enforce distributors and wholesalers to use techniques able to detect professional counterfeit.
- h. Enforce Forensic Medicines Control Laboratories to use analytical techniques able to identify new analogs.
- i. Declare analogs in general as being unevaluated medicinal substances by using (patent) literature.

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## Tables and figures

Table 1. Classification of illegal erectogenic drug products and their relative health risk.

Main category	Subcategory	Inclusion and exclusion criteria	Relative health risk <sup>a</sup>
<b>Counterfeit</b>	<i>Professional</i>	Appearance in conformity with genuine medicine; Content of correct API within 90 - 110 % of declared value; No other APIs; not genuine medicine.	+
	<i>Non-professional</i>	Appearance in conformity with genuine medicine; Content of correct API outside 90 - 110 % of declared value; No other APIs.	++
	<i>Mixed</i>	Appearance in conformity with genuine medicine; Contains correct API and another, known API	+++
	<i>Fraudulent</i>	Appearance in conformity with genuine medicine; Contains a different, known API.	+++
	<i>Analog</i>	Appearance in conformity with genuine medicine, Contains other, unapproved API	+++
	<i>Placebo</i>	Appearance in conformity with genuine medicine; Does not contain APIs.	+ <sup>b</sup>
<b>Imitation</b>	<i>Professional</i>	Appearance not in conformity with genuine medicine; Content of correct API within 90 - 110 % of declared value; No other APIs.	+
	<i>Non-professional</i>	Appearance not in conformity with genuine medicine; Content of declared API outside 90 - 110 % of declared value; No other APIs.	++
	<i>Mixed</i>	Appearance not in conformity with genuine medicine; Contains declared API and another API.	+++
	<i>Fraudulent</i>	Appearance not in conformity with genuine medicine; Contains an undeclared API.	+++
	<i>Analog</i>	Appearance not in conformity with genuine medicine; Contains other, unapproved API	+++
	<i>Placebo</i>	Appearance not in conformity with genuine medicine; Does not contain APIs.	+ <sup>b</sup>

<sup>a</sup>) + moderate relative health risk

++ medium relative health risk

+++ high relative health risk

<sup>b</sup>) Assessing placebo's as posing a moderate relative health risks holds for illegal erectogenic drug products but not necessarily for placebo's of illegal drug products with other therapeutic indications, in particular not for illegal drug products with life-threatening indications, such as antibiotics, antiviral drugs, antimalarials et cetera.





Figure 1: Examples of counterfeit boxes, patient information leaflets, and safety features like seals and holographic stickers.



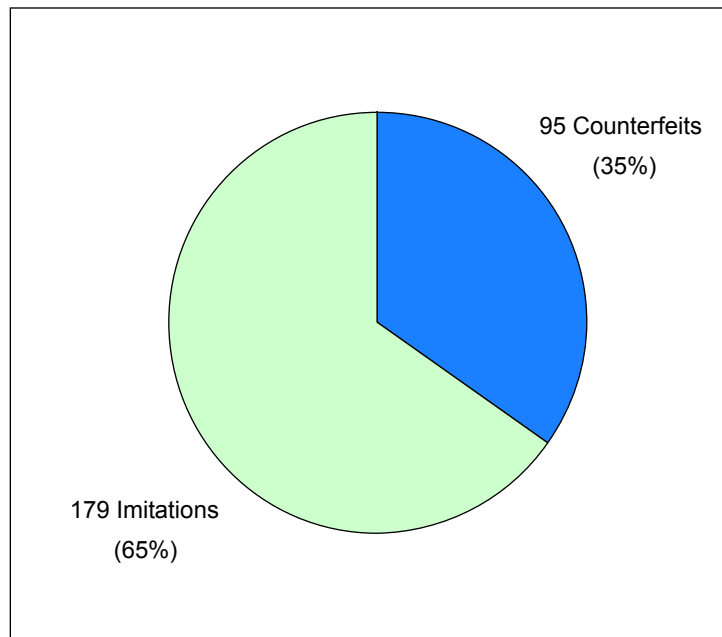


Figure 2. Number of illegal erectile counterfeits and imitations analysed by the RIVM, NFI and the Douane Laboratorium together. Also shown is the share of counterfeits and imitations, expressed as percentage of all samples.



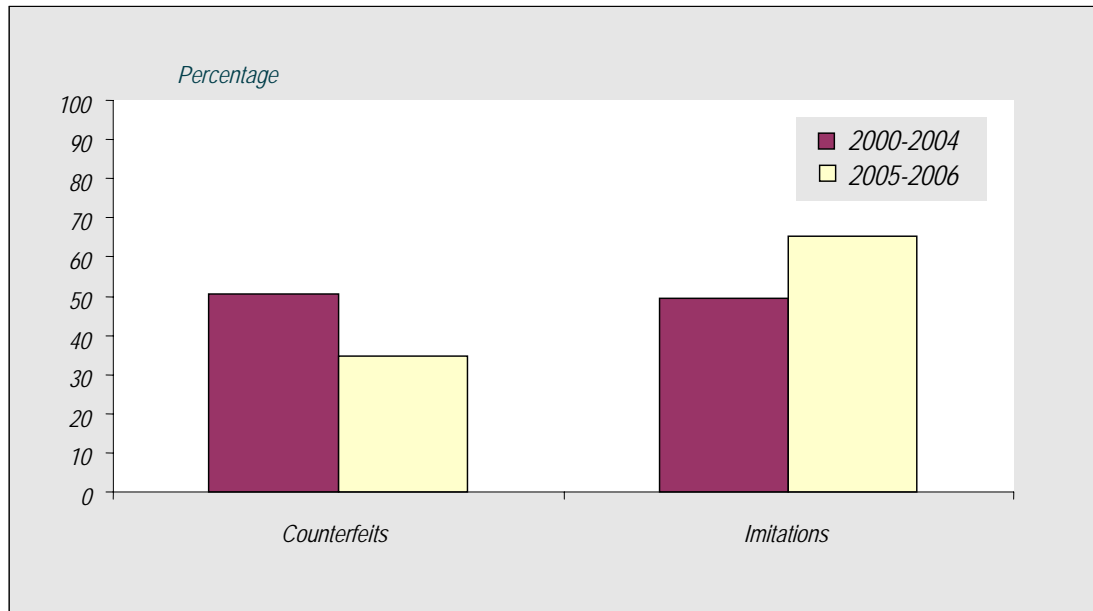


Figure 3. Trend in illegal erectile counterfeits and imitations expressed as percentages over the previous and present survey period. The results of the previous survey are solely based on RIVM data (red bars). The results of the present survey include data collected by the RIVM, NFI and the Douane Laboratorium together (yellow bars). Analogs are classified under imitations for both survey periods.



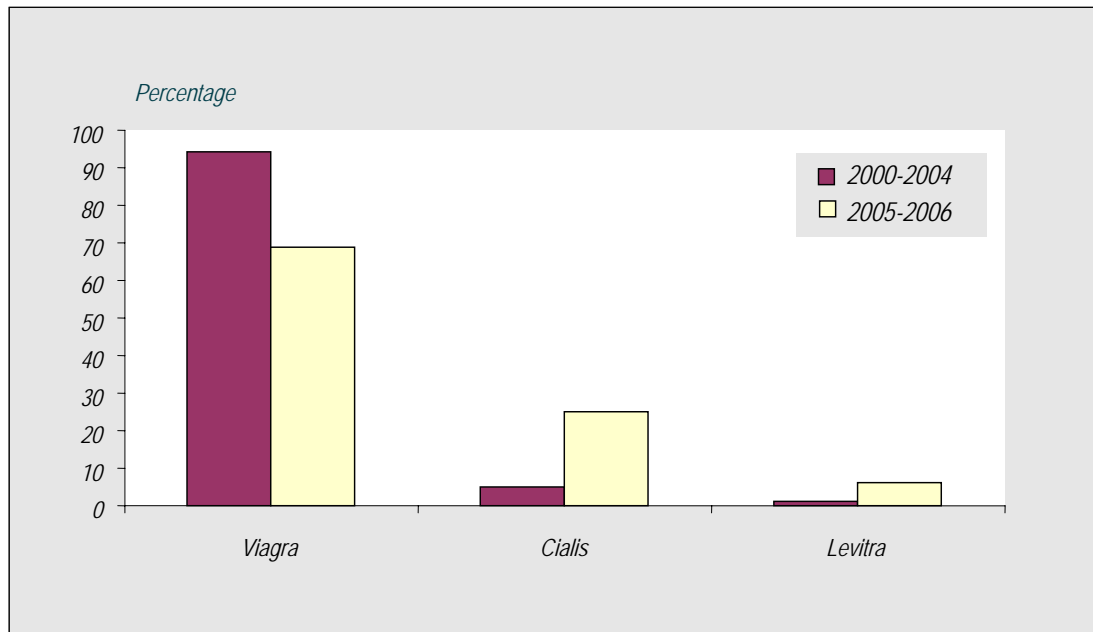


Figure 4. Trend in counterfeits of Viagra, Levitra and Cialis analysed, expressed as percentage of all counterfeits. The results of the previous survey are solely based on RIVM data (red bars). The results of the present survey include data collected by the RIVM, NFI and the Douane Laboratorium together (yellow bars).



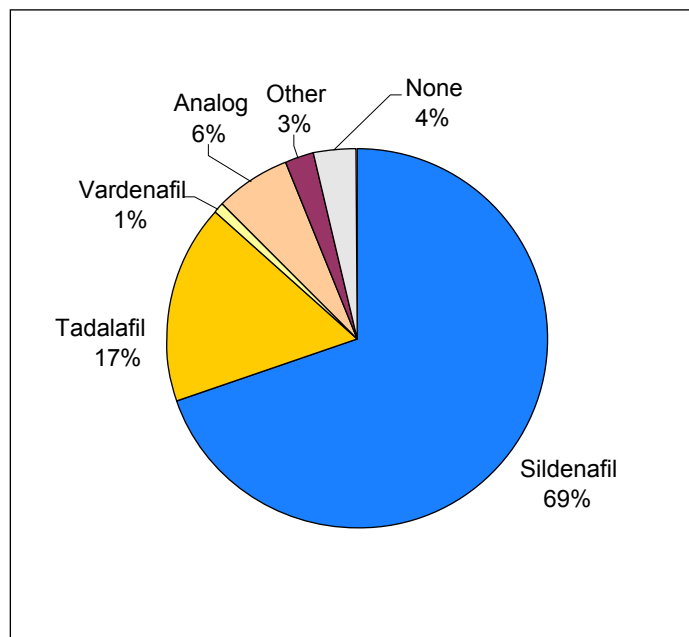


Figure 5. APIs identified in illegal erectile dysfunction drugs by the RIVM, NFI and the Douane Laboratorium over 2005-2006, expressed as percentage of counterfeits and imitations together.



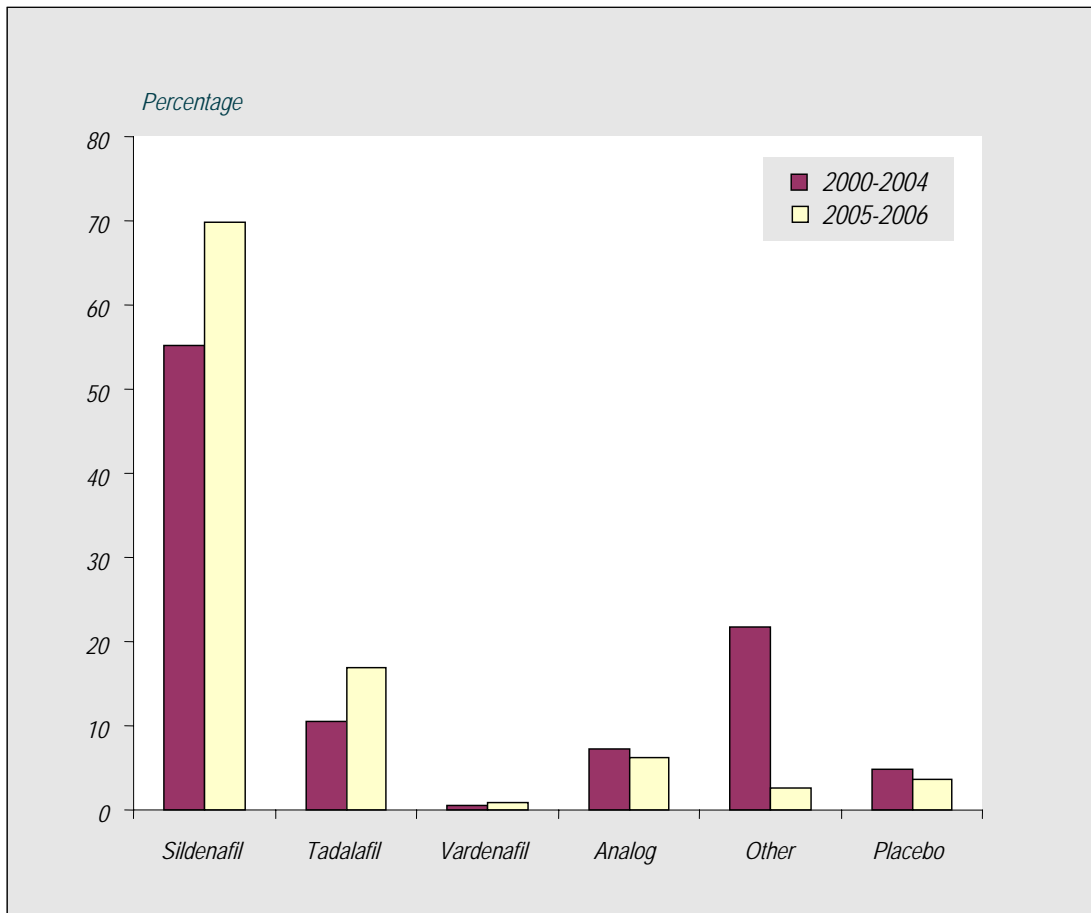
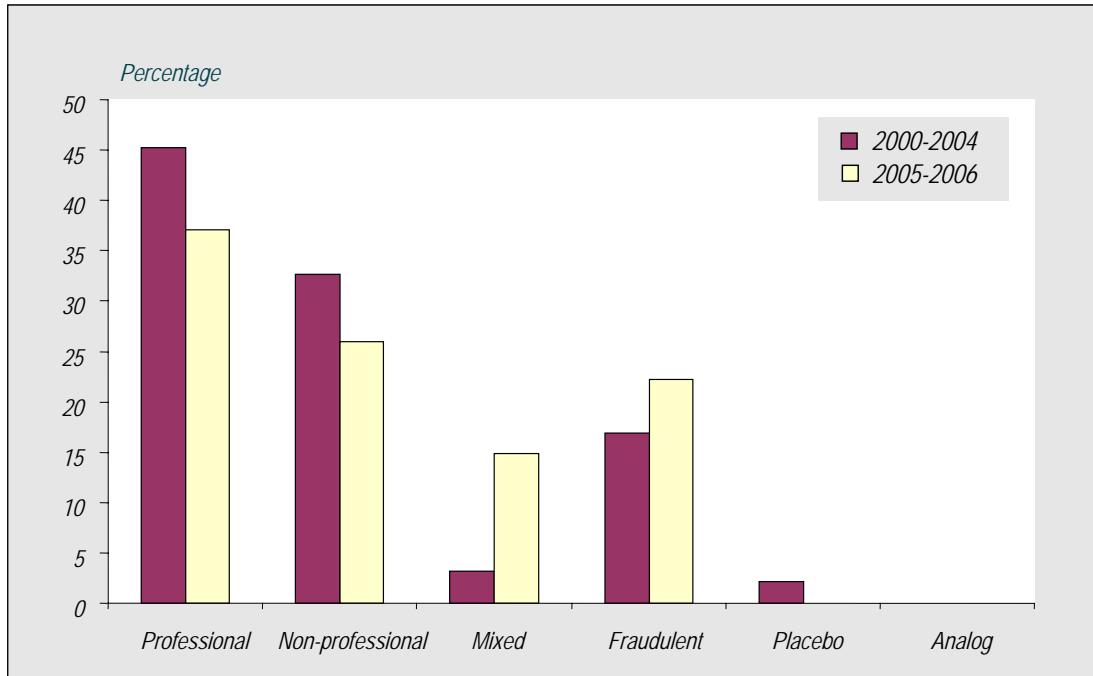


Figure 6. Trends in APIs identified in counterfeit and imitations together. On the x-axis; Sildenafil, Tadalafil, Vardenafil, Analog, Other, and Placebo. Natural substances (e.g. yohimbine) and non-PDE5 inhibitors (e.g. fluoxetine, amphetamines) were categorised under 'Other'. On the y-axis; the percentage of the total counterfeits and imitations analysed over the period concerned.



a) Counterfeit subclasses



b) Imitation subclasses

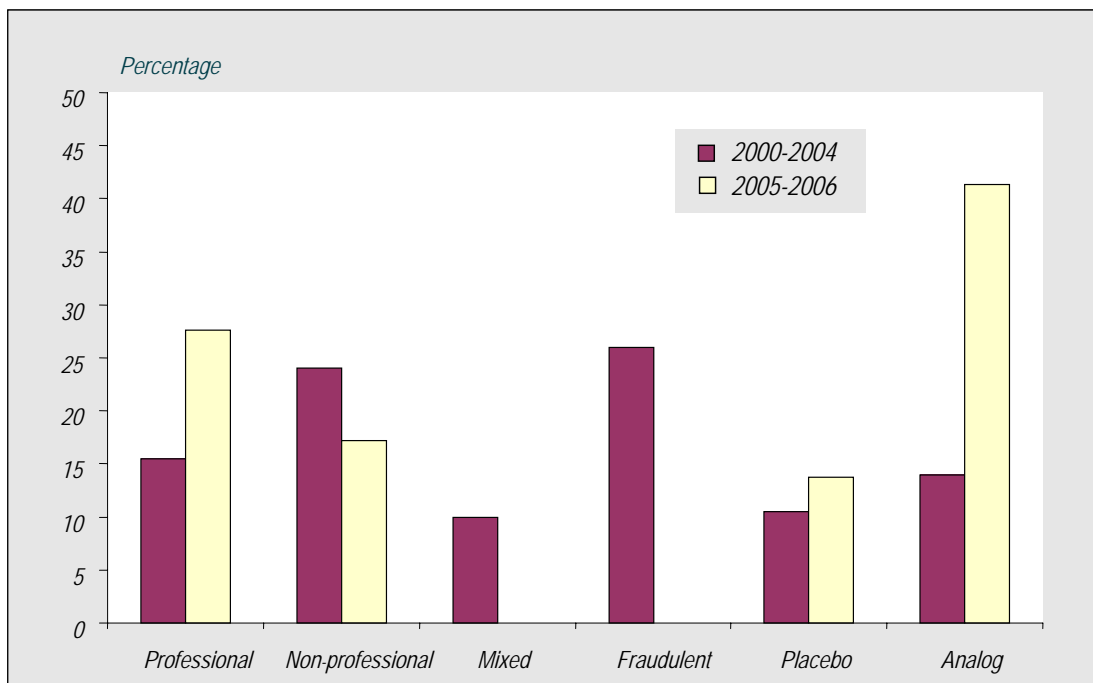


Figure 7. Trend in sub-classes of the counterfeits (a) and imitations (b) analysed at the RIVM, expressed as percentage of counterfeits or imitations analysed by the RIVM in the present survey.



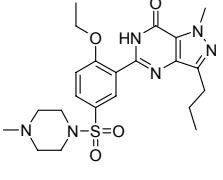
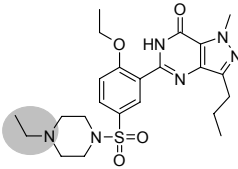
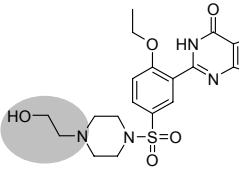
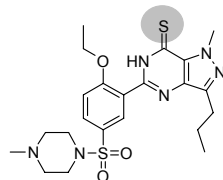
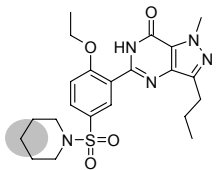
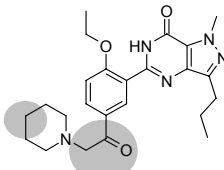
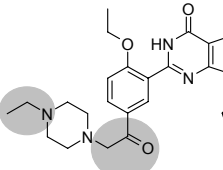
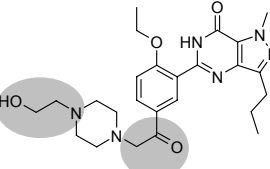
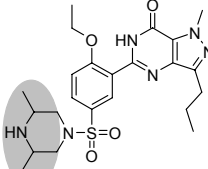
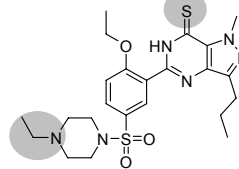
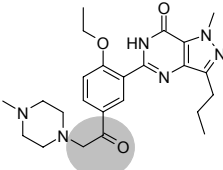
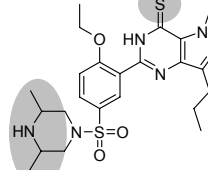
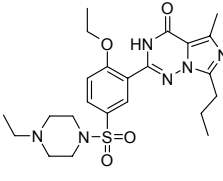
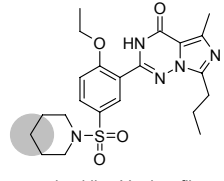
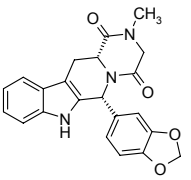
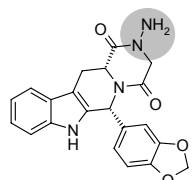
Registered APIs	Analogues identified		
 <p data-bbox="347 600 481 622">sildenafil (Viagra®)</p>	 <p data-bbox="639 600 742 622">homosildenafil</p>	 <p data-bbox="946 600 1106 622">hydroxyhomosildenafil</p>	 <p data-bbox="1233 600 1335 622">thiosildenafil</p>
 <p data-bbox="639 824 780 846">piperidino-sildenafil</p>	 <p data-bbox="927 824 1086 846">piperidino-acetildenafil</p>	 <p data-bbox="1217 824 1319 846">acetildenafil</p>	
 <p data-bbox="652 1048 802 1070">hydroxy-acetildenafil</p>	 <p data-bbox="994 1048 1064 1070">aildenafil</p>	 <p data-bbox="1240 1048 1380 1070">homo-thiosildenafil</p>	
 <p data-bbox="652 1272 770 1294">nor-acetildenafil</p>	 <p data-bbox="1000 1272 1099 1294">thio-aildenafil</p>		
 <p data-bbox="331 1541 472 1563">vardenafil (Levitra®)</p>	 <p data-bbox="911 1541 1067 1563">piperidino-Vardenafil</p>		
 <p data-bbox="323 1792 448 1814">tadalafil (Cialis®)</p>	 <p data-bbox="920 1792 1045 1814">amino-Tadalafil</p>		

Figure 8. Current APIs identified in analog imitations. The structural differences with the registered APIs are indicated in grey.



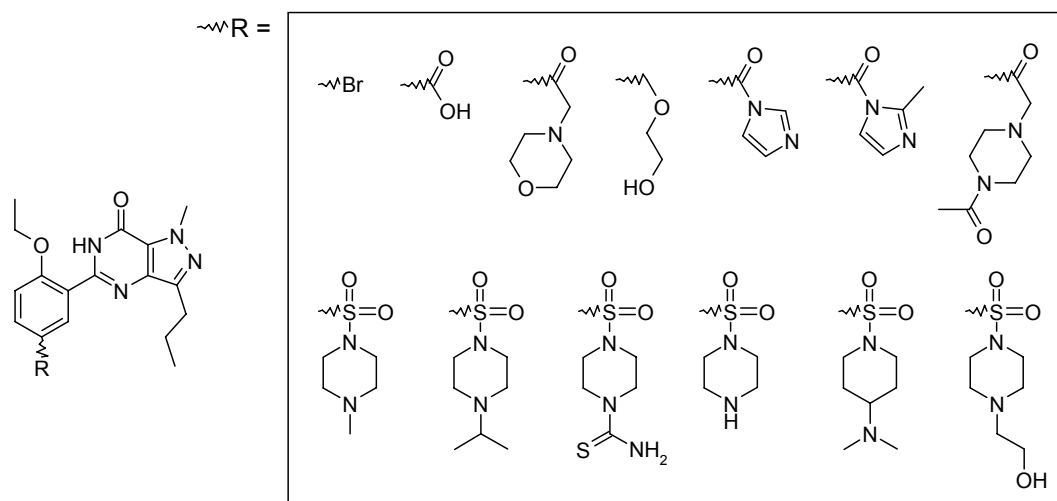


Figure 9. Analogs of sildenafil of which the pharmacological activity is described in (patent) literature.<sup>18-20</sup>



<b>Analog or API</b>	<b>IC<sub>50</sub> (nM)</b>	<b>Potency relative to sildenafil</b>
Acetildenafil	7.6	0.9
<b>Sildenafil</b>	<b>7.1</b>	<b>1.0</b>
Tadalafil	5.0 <sup>23</sup>	1.4
Homosildenafil	3.8	1.9
Hydroxyhomosildenafil	3.4	2.1
Morpholino-acetildenafil	1.8 <sup>18</sup>	3.9
Vardenafil	0.7 <sup>24</sup>	10.1

Table 2. Pharmacological potencies expressed as IC<sub>50</sub> values for sildenafil, acetildenafil, homosildenafil and hydroxy-homosildenafil in an in vitro human PDE-5 assay (<sup>3</sup>H-cGMP). For comparison, values taken from literature are shown for tadalafil<sup>23</sup>, vardenafil<sup>24</sup>, and morpholino-acetildenafil<sup>18</sup>.



## Appendices

Appendix 1. Analytical results of erectogenics analysed by the RIVM over 2005-2006.

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Viagra 50 mg	diamond-shaped, blue; Pfizer/VGR 50	Tablet(s)	Plastic bag	sildenafil	43	Non-professional counterfeit
2005	Viagra 50 mg	diamond-shaped, blue; Pfizer/VGR 50	Tablet(s)	Plastic bag	sildenafil	45	Professional counterfeit
2005	Blue tablets	round, grey-blue; no embossing, brittle	Tablet(s)	Plastic bag	sildenafil	38	Non-professional imitation
2005	Libidfit		Capsule(s)	Box + Blister pack	acetildenafil		Imitation analog
2005	Libidfit		Capsule(s)	Box + Blister pack	acetildenafil		Imitation analog
2005	V conqueror		Capsule(s)	Box + Blister pack	hydroxyhomosildenafil		Imitation analog
2005	Homosildenafil		Powder		homosildenafil		Imitation analog
2005	Acetildenafil		Powder		acetildenafil		Imitation analog
2005	Sensafem	oblong, purple-pink; no embossing	Tablet(s)	Box + Blister pack	sildenafil	<10 µg	Imitation analog
2005	Libido forte (capsules)	turquoise capsule; powder grey with white grains	Capsule(s)	Box + Blister pack	acetildenafil	65	Imitation analog
2005	Darling (capsules)	light-green/dark-green capsule; powder white	Capsule(s)	Box + Blister pack	sildenafil	155	Non-professional imitation
2005	Aurogra-100	diamond-shaped, blue; 100	Tablet(s)	Blister pack	sildenafil	101	Professional imitation
2005	Levitra 20 mg	round, light-orange; BAYER/20; coating, white core	Tablet(s)	Box + Blister pack	tadalafil	12	Fraudulent counterfeit
2005	Cialis 20 mg	almond-shaped, light-yellow; C20; coating, white core	Tablet(s)	Box + Blister pack	sildenafil	99	Fraudulent counterfeit
2005	Pesigra 50	diamond-shaped, blue; P/PGR 50; coating, white core	Tablet(s)	Blister pack	sildenafil	45	Professional imitation
2005	Lovegra	diamond-shaped, hard-pink; drawing/100; coating, white core	Tablet(s)	Blister pack	sildenafil	90	Professional imitation
2005	Cialis 20 mg	almond-shaped, yellow; C20	Tablet(s)	Box + Blister pack	tadalafil		Other
2005	Viagra 25 mg		Tablet(s)	Box + Blister pack	sildenafil		Other
2005	Levitra 20 mg	round, orange; BAYER/20	Tablet(s)	Box + Blister pack	vardeafil		Other
2005	Viagra 50 mg	diamond-shaped, blue; Pfizer/VGR50; coating	Tablet(s)	Box + Blister pack	sildenafil		Other
2005	Levitra 20 mg	round, orange; BAYER/20; coating	Tablet(s)	Box + Blister pack	vardeafil		Other
2005	Cialis	almond-shaped, yellow; C20; coating	Tablet(s)	Box + Blister pack	tadalafil		Other
2005	Vardenafil HCl		Powder	Jar	sildenafil		Other
2005	Lavigra men	oblong, bright yellow	Tablet(s)	Plastic bag	lcarin		Placebo imitation

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Lavagra women	oblong/oval, bright yellow	Tablet(s)	Plastic bag	None		Placebo imitation
2005	Capsule	Red and white capsule with light-brown powder	Capsule(s)		acetildenafil	32	Imitation analog
2005	-	Extract from a capsule	Capsule(s)	Vial	acetildenafil		Imitation analog
2005	-	Extract from a capsule	Capsule(s)	Vial	None		Placebo imitation
2005	Brown capsules	oval, dark-brown; soft capsule;	Capsule(s)		tadalafil	12	Non-professional imitation
2005	Vitarex Plus	hard light-blue; capsule; content: brown	Capsule(s)	Box + Blister pack	yohimbine	2	Other
2005	Golden Dragon	light-grey en rode capsule with light-brown powder	Capsule(s)	Box + Blister pack	acetildenafil	42	Imitation analog
2005	P-Pill	blue capsule	Capsule(s)	None	hydroxyhomosildenafil	92	Imitation analog
2005	Sizepro	oblong, blue; no embossing; coating, brown core	Tablet(s)	Box + Blister pack	None		Placebo imitation
2005	blue tablets 100	diamond-shaped, light-blue; 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	86	Non-professional counterfeit
2005	Yellow tablets C20	almond-shaped, light-yellow; C20; coating, white core	Tablet(s)	Plastic bag	tadalafil	18	Professional counterfeit
2005	Happy-caps	light-blue capsules with brown powder	Capsule(s)	Box	yohimbine	2	Other
2005	Viagra 100 mg	white tablets, no embossing	Tablet(s)	None	sildenafil	53	Other
2005	Sigra Plus	blue capsules	Capsule(s)	Box + Blister pack	tadalafil	0	Other
2005	6 blue capsules	blue capsules	Capsule(s)	Blister pack	tadalafil	0	Other
2005	White tablets	white tablet; no embossing	Tablet(s)	Plastic bag	sildenafil	45	Non-professional imitation
2005	Sigraplus	blue capsule	Capsule(s)	Blister pack	tadalafil	0.2	Other
2005	Sigraplus	blue capsule	Capsule(s)	Blister pack	tadalafil	0.2	Other
2005	Sigraplus	blue capsule	Capsule(s)	Blister pack	tadalafil	0.2	Other
2005	Viagra Imitation	Viagra imitation	Tablet(s)		sildenafil		Other
2005	Viagra Imitation	Viagra imitation	Tablet(s)		sildenafil		Other
2005	Cialis Imitation	Cialis imitation	Tablet(s)		tadalafil		Other
2005	Pan-European Survey on Cialis	-	Tablet(s)	Blister pack	tadalafil	-	-
2005	Capsule	blue/white capsules, content brown with spots	Capsule(s)	Box + Blister pack	acetildenafil	52	Imitation analog
2006	Viagra 100 mg	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)		sildenafil	65	Mixed counterfeit
2006	Kamagra*-100 GOLD	diamond-shaped, blue; logo/KGR 100; coating, white core	Tablet(s)	Box + Blister pack	sildenafil	90	Professional imitation
2006	Tadalafil 20	almond-shaped, yellow; A 20; coating, white core	Tablet(s)	Blister pack	tadalafil	17	Professional imitation
2006	Cygalis 20	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Blister pack	tadalafil	19	Professional imitation
2006	Blue tablets 100	diamond-shaped, blue; 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	96	Professional imitation
2006	Viagra	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	107	Professional counterfeit

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2006	Cialis	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Plastic bag	sildenafil	74	Fraudulent counterfeit
2006	Viagra	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	88	Non-professional counterfeit
2006	Cialis 10	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Envelop	tadalafil	10	Professional counterfeit
2006	Viagra 50 mg	diamond-shaped, blue; Pfizer/VGR 50; coating, white core	Tablet(s)	Envelop	sildenafil	41	Non-professional counterfeit
2006	Viagra 100 mg	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Envelop	sildenafil	109	Professional counterfeit
2006	Viagra 100 mg	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Envelop	sildenafil	101	Professional counterfeit
2006	Levitra 20	round, orange; BAYER/20; coating; white core	Tablet(s)	Envelop	sildenafil	110	Fraudulent counterfeit
2006	C-20	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Envelop	sildenafil	8	Mixed counterfeit
2006	Viagra 100 mg	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Box + Blister pack	sildenafil	55	Non-professional counterfeit
2006	Kamagra 100 Gold	diamond-shaped, green; logo/KGR 100; coating, white core	Tablet(s)	Box + Blister pack	sildenafil	98	Professional imitation
2006	C20	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Plastic bag	sildenafil	1	Mixed counterfeit
2006	Bayer 20	round, orange; BAYER/20; coating; white core	Tablet(s)	Plastic bag	sildenafil	42	Fraudulent counterfeit
2006	VGR 100	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	86	Non-professional counterfeit
2006	VGR 50	diamond-shaped, blue; Pfizer/VGR 50; coating, white core	Tablet(s)	Plastic bag	sildenafil	51	Professional counterfeit
2006	Viagra 100 mg	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Blister pack	sildenafil	37	Non-professional counterfeit
2006	Viagra 50 mg	diamond-shaped, blue; Pfizer/VGR 50; coating, white core	Tablet(s)	Plastic bag	sildenafil	53	Professional counterfeit
2006	Cupido 50	diamond-shaped, light- blue; Cupido 50; no coating, blue core	Tablet(s)	Plastic bag	sildenafil	37	Non-professional imitation
2006	Yellow Tabl. Bayer 20	round, orange; BAYER/20; coating; white core	Tablet(s)	Plastic bag	sildenafil	43	Fraudulent counterfeit
2006	Bl.tabl. Pfizer VGR 100	diamond-shaped, blue; Pfizer/VGR 100; coating, white core	Tablet(s)	Plastic bag	sildenafil	95	Professional counterfeit
2006	Bl.tabl. Pfizer VGR 50	diamond-shaped, blue; Pfizer/VGR 50; coating, white core	Tablet(s)	Plastic bag	sildenafil	53	Professional counterfeit
2006	Yellow elips tabl. C20	almond-shaped, yellow; C 20; coating, white core	Tablet(s)	Plastic bag	sildenafil	0.3	Mixed counterfeit
					tadalafil	14	

Appendix 2. Analytical results of erectogenics analysed by the NFI over 2005-2006. If the name of an imitation product was unknown, it was listed 'imitation' under the description.

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Viagra	diamond-shaped, blue; Pfizer/VGR100	Tablets(s)		sildenafil		
2005	Imitation	white, heart-shaped	Tablets(s)		sildenafil		
2005	Viagra	diamond-shaped, blue	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR100; coating	Tablets(s)		sildenafil		
2005	Imitation	diamond-shaped, blue; '100'; fragments of tablets	Tablets(s)		sildenafil		
2005	Imitation	blue	Tablets(s)		sildenafil		
2005	Imitation	white, heart-shaped	Tablets(s)		sildenafil		
2005	Viagra	diamond-shaped, blue; Pfizer/VGR 50; coating, white core	Tablets(s)		sildenafil		
2005	Imitation	blue	Tablets(s)		sildenafil		
2005	Viagra	diamond-shaped, blue; Pfizer; coating, white core	Tablets(s)		sildenafil		
2005	Cialis	egg-shaped, dark-yellow	Tablets(s)		tadalafil		
2005	Kamagra	diamond-shaped, blue; Pfizer/KGR; coating, white core	Tablets(s)		sildenafil		
2005	Kamagra	blue	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR; coating, white core	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP; coating, white core	Tablets(s)		sildenafil		
2005	Viagra	diamond-shaped, blue; Pfizer/VGR100; coating, white core	Tablets(s)		sildenafil		
2005	Imitation	pink	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR100; coating, white core	Tablets(s)		sildenafil		
2005	Viagra	fragment of a tablet, blue, Pfizer/VGR 50	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR100; coating, white core	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR100; coating, white core	Tablets(s)		sildenafil		
2005	Imitation	white	Tablets(s)		sildenafil		
2005	Imitation	blue, white core	Tablets(s)		sildenafil		
2005	Imitation	white, tablet-parts	Tablets(s)		sildenafil		
2005	Imitation	blue, coated	Tablets(s)		sildenafil		
2005	Kamagra	diamond-shaped, blue; AP/KGR100; coating, white core	Tablets(s)		sildenafil		
2005	Cialis	Oblong, yellow, coated	Tablets(s)		tadalafil		
2005	Cupido	blue	Tablets(s)		sildenafil		
2005	Imitation	white; Cupido50	Tablets(s)		sildenafil		

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Imitation	white	Tablets(s)		sildenafil		
2005	Imitation	white	Powder		sildenafil		
2005	Imitation	pink	Tablets(s)		sildenafil		
2005	Imitation	blue	Tablets(s)		sildenafil		
2005	Kamagra	blue; KGR	Tablets(s)		sildenafil		
2006	Saligra	diamond-shaped, blue; AP/KGR100; coating	Tablets(s)	Film tube	sildenafil		
2006	Imitation	diamond-shaped, light-blue; Pfizer/KGR; coating, white core	Tablets(s)	Blister pack	sildenafil		
2006	Cialis	egg-shaped, yellow	Tablets(s)	Plastic bag	tadalafil		
2006	Vega 100	diamond-shaped, blue; 100; coating	Tablets(s)	Blister pack	sildenafil		
2006	Uprima 100	diamond-shaped, blue; 100; coating	Tablets(s)	Blister pack	sildenafil		
2006	Cilaa-20	diamond-shaped, blue	Tablets(s)	Blister pack	tadalafil		
2006	Imitation	diamond-shaped, blue	Tablets(s)	Plastic bag	sildenafil		
2006	Cialis	oblong, off-white	Tablets(s)	Plastic bag	tadalafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Imitation	heart-shaped, white	Tablets(s)	Plastic bag	sildenafil		
2006	Cialis 10	oblong, dark-yellow	Tablets(s)	Blister pack	tadalafil		
2006	Imitation	heart-shaped, off-white	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	grey	Tablets(s)	Plastic bag	tadalafil		
2006	Imitation	off-white	Tablets(s)	Plastic bag	tadalafil		
2006	Viagra	diamond-shaped, light-blue; Pfizer/VGR 50; coating, white core	Tablets(s)	Plastic bag	sildenafil		
2006	pure E II	white	Tablets(s)	Jar	sildenafil		
2006	Imitation	fragment of a tablet; white; coated	Tablets(s)	Paper	sildenafil		
2006	Imitation	fragment of a tablet; white; coated	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	blue	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	blue; Pfizer; coated	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	blue	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	blue	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	blue; coated	Tablets(s)	Plastic bag	sildenafil		

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2006	Imitation	white; coated	Tablets(s)	Plastic bag	sildenafil		
2006	Cupido	diamond-shaped, light-blue; Cupido50; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	light-blue	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, blue; Pfizer/VGR 50; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, blue; Pfizer/VGR 50; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Kamagra 100	diamond-shaped, blue; AP/KGR; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Imitation	diamond-shaped, blue; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Cialis	oblong; yellow; coated	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra 50	diamond-shaped, blue; Pfizer/VGR 50; coating	Tablets(s)	Blister pack	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, light-blue; 100; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, blue; coating	Tablets(s)	Blister pack	sildenafil		
2006	Viagra	diamond-shaped, blue; ASIA; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Kamagra 100	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Viagra	diamond-shaped, blue; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	heart-shaped; white	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	white	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	diamond-shaped, blue; coating	Tablets(s)	Plastic bag	tadalafil		
2006	Kamagra GOLD 100	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		
2006	Forzest 20	elongated, blue; Pfizer/KGR; coating	Tablets(s)	Blister pack	tadalafil		
2006	Imitation	oblong, orange; Pfizer/KGR; coating	Tablets(s)	Plastic bag	sildenafil		
2006	kamagra	diamond-shaped, blue; Pfizer/KGR; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, blue; Pfizer/VGR 50; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Imitation	diamond-shaped, blue; coating	Tablets(s)	Plastic bag	tadalafil		
2006	Imitation	Coated tablets, white	Tablets(s)	Plastic bag	sildenafil		
2006	Viagra	diamond-shaped, blue; coating	Tablets(s)	Plastic bag	sildenafil		
2006	Cialis	oblong; yellow; coated	Tablets(s)	Plastic bag	tadalafil		
2006	Imitation	beige-pink with deposit	Tablets(s)	Ampoules	tadalafil		
2006	Imitation	white with deposit	Tablets(s)	Ampoules	tadalafil		
2006	Viagra	fragments, blue; Pfizer/KGR; coating	Tablets(s)	Plastic bag	sildenafil		

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Plastic bag	sildenafil		
2006	Kamagra	diamond-shaped, blue; AP/KGR100; coating,	Tablets(s)	Blister pack	sildenafil		

Appendix 3. Analytical results of erectogenics analysed by the Douane Laboratorium over 2005-2006.

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Kamagra	blue	Tablets(s)		Yohimbine		
2005	Kamagra	light-brown	Tablets(s)		Yohimbine		
2005	Yellow tablets	almond-shaped, yellow	Tablets(s)		Tadalafil		
2005	Fiagra 100 mg	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	104	
2005	Vigora 50		Tablets(s)	Blister pack	Sildenafil	63	
2005	Vigora 100		Tablets(s)	Blister pack	Sildenafil	117	
2005	Kamagra		Tablets(s)	Plastic bag	Sildenafil	84	
2005	Tadalafil tablets 20mg	almond-shaped, yellow	Tablets(s)		Tadalafil		
2005	Sildenafil tablets 100 mg	diamond-shaped, blue	Tablets(s)		Sildenafil	116	
2005	Blue tablets	diamond-shaped, blue	Tablets(s)		Sildenafil	97	
2005	Suhagra-100	oval shaped, blue	Tablets(s)	Blister pack	Sildenafil	97	
2005	Tadalafil 20mg	orange	Tablets(s)	Blister pack	Tadalafil		
2005	Blue tablets	diamond-shaped, blue	Tablets(s)		Sildenafil	100	
2005	Viagra 50 mg	diamond-shaped, blue	Tablets(s)		Sildenafil	41	
2005	Viagra 100 mg	diamond-shaped, blue	Tablets(s)	Box + Blister pack	Sildenafil	77	
2005	Viagra 100 mg	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	89	
2005	Kamagra	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	93	
2005	Caverta 50	trigonal	Tablets(s)	Blister pack	Sildenafil	101	
2005	Erexer	diamond-shaped, red	Tablets(s)	Box + Blister pack	Sildenafil	55	
2005	Viagra 50 mg	diamond-shaped, blue	Tablets(s)		Sildenafil	97	
2005	Kamagra 100mg Oral Jelly	Sachet with gel	Gel		Sildenafil	106	
2005	Kamagra 100	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	100	
2005	Kamagra	diamond-shaped	Tablets(s)	Blister pack	Sildenafil	87	
2005	Aurogra-100	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	125	
2005	Kamagra 100	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	96	
2005	Cialis	pear-shaped, yellow	Tablets(s)	Blister pack	Sildenafil	86	
2005	Levitra 20 mg	round, beige	Tablets(s)	Blister pack	Tadalafil		
2005	Golden Dragon	red-white capsules	Capsule(s)	Blister pack	Acetildenafil		
2005	Edegra 50		Tablets(s)	Blister pack	Sildenafil	115	
2005	KGR 100 Kamagra	diamond-shaped, blue	Tablets(s)		Sildenafil	86	

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Kamagra 100		Tablets(s)	Blister pack	Sildenafil	100	
2005	Green capsules	green	Capsule(s)		Sildenafil	137	
2005	Blue capsules	blue	Capsule(s)	Plastic bag	Sildenafil	155	
2005	Yellow tablets	Yellow, almond-shaped	Tablets(s)	Plastic bag	Tadalafil		
2005	Viagra	blue	Tablets(s)	Jar	Sildenafil	51	
2005	Erecto-100	blue	Tablets(s)	Box	Sildenafil	54	
2005	Androz-50	blue	Tablets(s)	Blister pack	Sildenafil	66	
2005	Erectalis	yellow	Tablets(s)		Tadalafil		
2005	Orgafil	yellow	Tablets(s)		Tadalafil		
2005	Peak	blue	Tablets(s)		Sildenafil	82	
2005	Kamagra	blue	Tablets(s)	Blister pack	Sildenafil	104	
2005	Green capsule	green	Capsule(s)		Sildenafil	117	
2005	Blue tablet	diamond-shaped, blue	Tablets(s)		Sildenafil	175	
2005	Yellow tablets "Bayer"	round, yellow	Tablets(s)		Tadalafil		
2005	Viagra 50 mg in Blister	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	51	
2005	Yellow tablet	almond-shaped, yellow	Tablets(s)		Tadalafil		
2005	Blue tablet	diamond-shaped, blue	Tablets(s)		Sildenafil	101	
2005	2 blue capsules	blue	Capsule(s)	Blister pack	none		
2005	Blue tablets	diamond-shaped, blue	Tablets(s)		Sildenafil	93	
2005	Lovegra	diamond-shaped, pink	Tablets(s)	Blister pack	Sildenafil	102	
2005	Kamagra	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	108	
2005	Viagra 100 mg	diamond-shaped, blue	Tablets(s)	Box + Blister pack	Sildenafil	84	
2005	Snafi tadalafil 20 mg	almond-shaped, yellow	Tablets(s)	Blister pack	Tadalafil		
2005	Vegro sildenafil 120 mg	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	104	
2005	Viagra 50 mg	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	50	
2005	Vega 100	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	114	
2005	Mamagra-100	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	131	
2005	Fiagra 100 mg	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	111	
2005	Pramil Comp 50 mg		Tablets(s)	Blister pack	Tadalafil en theophylline		

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2005	Cleopatra	diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	100	
2005	Satibo capsules		Capsule(s)	Can + Blister pack	Hydroxyhomosildenafil		
2005	Santi capsules	white powder	Capsule(s)	Sachet	Sildenafil		
2006	Cialis tadalafil	Almond-shaped, yellow	Tablets(s)	Blister pack	Sildenafil	86	
2006	Viagra	Diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	64	
2006	Tianxin jiaonang	Light-brown powder	Capsule(s)	Blister pack	Acetildenafil		
2006	Kamagra-100 gold	Diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	104	
2006	Kamagra 100 mg.	Diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	101	
2006	Kamagra oral jelly vanilla	Sachets with gel	Gel	Blister pack	Sildenafil	86	
2006	Kamagra plus	Almond-shaped, light-brown	Tablets(s)	Blister pack	Tadalafil		
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	106	
2006	Viagra 50 mg.	Blue	Tablets(s)	Plastic bag	Sildenafil	46	
2006	1 round blue tablet		Tablets(s)	Plastic bag	Sildenafil		
2006	Cupido 50	Blue	Tablets(s)	Plastic bag	Sildenafil	37	
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil		
2006	Viagra 50 mg.	Pink	Tablets(s)	Plastic bag	Amphetamine		
2006	Edegra	Blue	Tablets(s)	Plastic bag	Sildenafil	51	
2006	Viagra 50 mg.	Blue	Tablets(s)	Plastic bag	Sildenafil		
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil		
2006	Cilaa-20	Yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil		
2006	Oral jelly		Tablets(s)	Plastic bag	Sildenafil	115	
2006	Viagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	38	
2006	Viagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	56	
2006	Viagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil		
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	80	
2006	Kamagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	50	
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	101	
2006	Cilaa-20	Yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Viagra 100 mg.	Blue	Tablets(s)	Plastic bag	None		
2006	Viagra 100 mg.	Blue	Tablets(s)	Blister pack	None		
2006	Kamagra oral jelly vanilla		Gel		Sildenafil	106	

Year of analysis	Product name	Appearance	Dosage form	Packaging	API identified	Observed dose(mg)	Classification
2006	Cilaa-20	Yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Viagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	32	
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	104	
2006	Cilaa-20	Yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Viagra 50 mg.	Light-blue	Tablets(s)	Blister pack	Sildenafil	32	
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil		
2006	Viagra 50 mg.	Light-blue	Tablets(s)	Blister pack	Sildenafil		
2006	Cilaa-20	Yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Kamagra oral jelly	Pineapple taste	Tablets(s)	Sachets	Sildenafil	106	
2006	Kamagra 100 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	103	
2006	Viagra 50 mg.	Blue	Tablets(s)	Plastic bag	Sildenafil		
2006	Viagra 50 mg.	Blue	Tablets(s)		Sildenafil	53	
2006	Viagra 50 mg.	Blue	Tablets(s)	Blister pack	Sildenafil	34	
2006	Viagra 100 mg	Diamond-shaped, blue	Tablets(s)	Box + Blister pack	Sildenafil	53	
2006	Yellow pills	Almond-shaped, yellow	Tablets(s)	Blister pack	Tadalafil		
2006	Viagra pills	Diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	84	
2006	Pfizer Viagra	Diamond-shaped, blue	Tablets(s)	Blister pack	Sildenafil	77	
2006	Cialis 20 mg	Almond-shaped	Tablets(s)	Blister pack	Sildenafil	70	
2006	OED 1+2	Sachets, red/beige	Tablets(s)	Box + sachets	Tadalafil	68	
2006	Kamagra 100 Gold	diamond-shaped, green	Tablets(s)	Blister pack	Sildenafil	91	