Abused Drugs

Bowei-biotech
for better bioassays

Monitoring of Abused Drugs

Introduction

In recent decades, a variety of drug classes have contributed to patterns of recreational use, misuse, addiction, overdose, and death. While the traditional drugs of abuse remain popular, newer synthetic drugs have continued to increase. The epidemic of nonmedical use of prescription medications has added to the existing public health issue of illicit drug use. Besides the individual health problems, the abuse of drugs has posed a great challenge to the healthcare system. The monitoring of drugs of abuse in biological samples is important in different fields such as clinical toxicology, forensic toxicology, workplace drug testing, testing of driving under the influence of drugs, and doping analysis.

The tremendous increase in the abuse of drugs by our society creates the need for rapid, reliable, sensitive, specific and inexpensive methods to detect and identify drugs in biofluids, drinks, foods and health care products. Immunoassay well meets these requirements and has become the most commonly used screening method for routine drugs of abuse analysis.

Bowei-Bio has developed a panel of antibodies and conjugates for drug abuse monitoring, which can be applied for detecting the nonmedical and illicit drug abuse, evaluating the possible overdoses, and verifying the adherence to prescription medications.

Products

Abused Drugs	Conjugate	Antibody
Fentanyl	√	√
Xylazine	√	√
Dextromethorphan	√	√
Propofol	√	√
Sibutramine	√	√
Acetaminophen	√	√
Zolpidem	√	√
Pregabalin	√	√
Gabapentin	√	√
Modafinil	√	√
Etomidate	√	√
Carisoprodol	√	√
Diphenoxylate	√	√
Cotinine	√	√
Ethyl Glucuronide	√	√

Abused drugs

Fentanyl

Fentanyl is a synthetic opioid used as an analgesic for different kinds of chronic pains. Its high affinity for μ-opioid receptors (MORs) in the brain gives it strong analgesic effects. Its adverse reactions mainly include gastrointestinal complications, liver failure, drowsiness, confusion and hypotension; overdose of it can lead to respiratory depression and even death. The euphoria and pain-relieving effect induced by fentanyl can lead to strong dependence and addiction. In the past decade, the worldwide proliferation of fentanyl has brought about serious public health threat, and the alarming rise in fentanyl abuse is of growing concern globally. To address this issue, there is an expanding need for clinical laboratories to detect the presence of fentanyl in various samples. Although various chromatography-based techniques have been applied for fentanyl determination, immunoassay remains the most widely used screening method. Our mouse anti-fentanyl McAb-25 enables highly sensitive fentanyl detection by immunoassay with LOD as low as 10pg/mL. This antibody binds fentanyl and its primary metabolite norfentanyl with similar affinity, making it more suitable for monitoring fentanyl exposure, since norfentanyl in urine has a longer retention period and higher concentration than the parent drug after fentanyl administration.

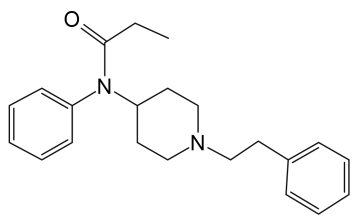

Fig. 1. The chemical structure of fentanyl

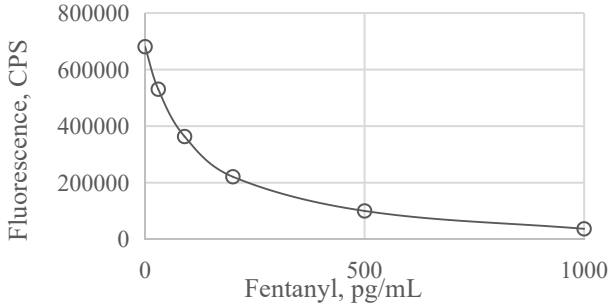

Fig. 2. The typical calibration curve for fentanyl-DELFIA using McAb-25

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-Fentanyl McAb-25	LOD <10pg/mL by fentanyl-DELFIA; shows about 105% cross-reactivity with norfentanyl; no cross-reactivities were observed with 10 μg/mL of dextromethorphan, acetylsalicylic acid, acetaminophen, caffeine, ethotoin, mephenytoin, nordoxepin and procaine.
Conjugate	• Fentanyl-PEG-Biotin • Fentanyl-PEG-OVA	Paired with anti-fentanyl antibodies for fentanyl testing.

Abused drugs

Xylazine

Xylazine is a central nerve system depressant commonly used to sedate large animals such as horse, cattle, deer and sheep, especially prior to surgical procedures. Nevertheless, in the past decade it has emerged as a new drug of abuse in human population and is spreading rapidly owing to its multiple actions. Besides the analgesic and sedative potency, xylazine also causes severe adverse events associated with hypotension, central nervous system depression, and often potentiates the fatal effects of opioids. According to the recent publications, approximately 95% of fentanyl overdose cases involve xylazine. The rising abuse of xylazine has been regarded as a growing threat to public health worldwide, and this necessitates development of reliable, quick and simple test for determination of xylazine in different samples. Our anti-xylazine McAb is highly suitable for developing sensitive immunoassays for routine detection of xylazine exposure.

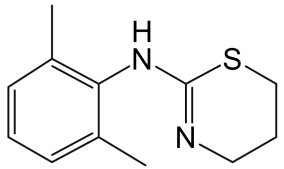

Fig. 1. The chemical structure of xylazine

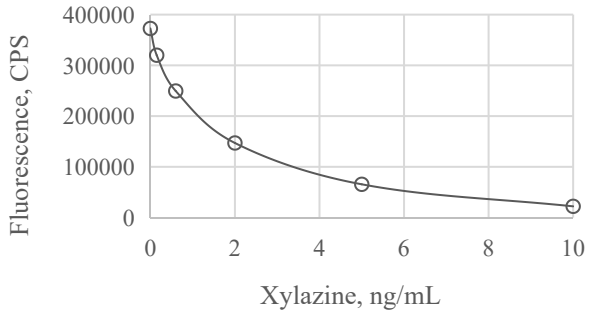

Fig. 2. Typical calibration curve for xylazine-DELFIA using McAb-32

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-xylazine McAb-32	LOD < 30pg/mL by xylazine-DELFIA. No cross-reactivities were observed with 10 μg/mL of clonidine.
Conjugate	• Xylazine-PEG-Biotin, • Xylazine-PEG-OVA	Paired with anti-xylazine antibodies for xylazine testing.

Abused drugs

Dextromethorphan (DMP)

Dextromethorphan (DMP) is an antitussive agent commonly used for non-prescription cough and cold medications. DMP is regarded as safe at the therapeutic dose, however, at high doses, it may produce a lot of disorders including dissociative hallucinations, tachycardia, hypertension, agitation, ataxia, euphoria, disorientation, hallucinations, visual disturbance, and psychosis. DMP abuse began as early as the 1960s, and increased rapidly since the late 1990s because of the false perception of safety and the easy accessibility of the drug. DMP was registered on the official list of controlled substances by the Korean government in October 2003, and by China in July, 2024, some other countries also have proposed legislation to control the sale of dextromethorphan-containing products. Our anti-DMP McAb and its paired conjugate can be used for developing ultrasensitive immunoassay for determination of DMP in different types of samples.

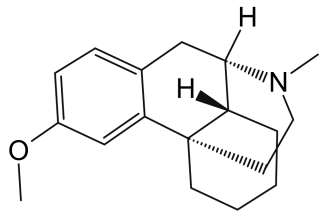

Fig. 1. The chemical structure of DMP

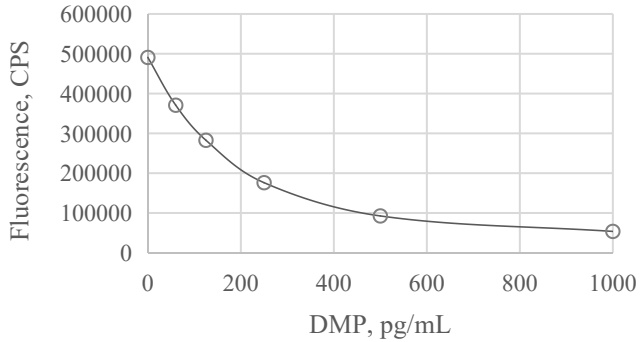

Fig. 2. Typical calibration curve of DMP-DELFIA using McAb-22

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-DMP McAb-22	LOD < 10pg/mL by DMP-DELFIA using McAb-22. The cross-reactivities are about ~89% with dextrorphan (the main metabolite of DMP), and <1.6% with 3-methoxymorphinan and 3-hydroxymorphinan.
Conjugate	• DMP-OVA • DMP-BSA	Paired with anti-DMP antibodies for DMP testing.

Abused drugs

Propofol

Propofol is one of the most popular intravenous anesthetic agent due to its rapid onset and short duration of action, rapid metabolism, and rapid clearance. When being used appropriately, propofol is safe with fewer side effects; however, when it's misused or abused, severe adverse consequences may be triggered. Serious poisoning cases have been reported frequently worldwide, partly due to the fact that propofol has an extremely narrow therapeutic index. In the past 15 years, the abuse of propofol has increased rapidly in Europe, America and some other regions. Since February 2011, propofol has been classified as a controlled substance in South Korea. Rapid and sensitive monitoring of propofol can help to strengthen the regulation of its usage and alleviate its abuse. A large number of published papers have described the measurement of propofol in human blood, urine, hair or tissues by LC-MS, GC-MS and HPLC, but the report on immunoassay of propofol is very few due to the lack of high-quality antibodies. Our anti-propofol McAb and its paired conjugates, can be used for developing sensitive immunoassay for detection of propofol with a LOD < 10ng/mL by DELFIA.

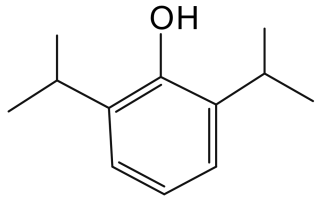

Fig. 1. The chemical structure of propofol

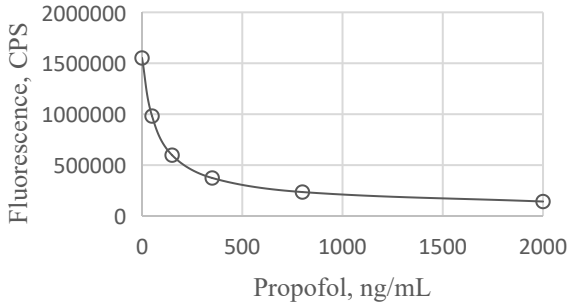

Fig. 2. Typical calibration curve for propofol-DELFIA using McAb-23

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-Propofol McAb-23	LOD <5ng/mL by propofol-DELFIA. The cross-reactivities with propofol glucuronide and 1-quinol glucuronide, two main metabolites of propofol, were less than 1.2%.
Rabbit polyclonal antibody	• Anti-Propofol-BSA PcAb-1	LOD <5ng/mL by propofol-DELFIA. The cross-reactivities with propofol glucuronide and 1-quinol glucuronide, two main metabolites of propofol, were less than 2%.
Conjugate	• Propofol-PEG-BSA • Propofol-PEG-Biotin	Paired with the antibodies for propofol testing.

Abused drugs

Sibutramine (SBT)

Sibutramine (SBT) is a racemic mixture of enantiomers (+) and (-) of 1-[1-(4-chlorophenyl)cyclobutyl]-N,N,3-trimethylbutan-1-amine, and has been widely used as an appetite suppressant for weight-loss. To be used for reduction of body weight, SBT is often added in different natural herbal medicines, functional foods and soft drinks. Although SBT is effective for treating obesity, ingestion of SBT will increase the risk of cardiovascular and nonfatal stroke, and often lead to symptoms such as headaches, restlessness, malaise, tachycardia and confusion. Up to now, FDA, European Commission, and the Ministry of Health of the People's Republic of China have banned the addition of SBT in weight loss supplement, and recommended that its production and sale be stopped. Determination of SBT in various matrices is crucial to for effective supervision and control of the abuse of SBT. Our monoclonal anti-SBT antibody and its paired conjugates are designed for developing sensitive SBT immunoassays.

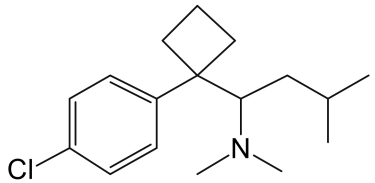

Fig. 1. The chemical structure of SBT

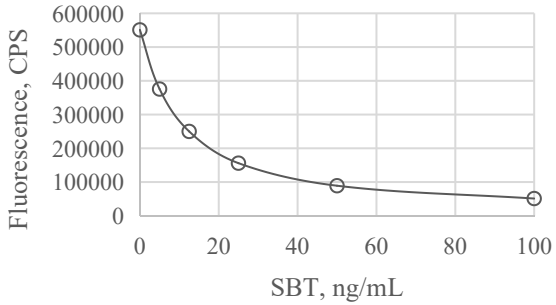

Fig. 2. Typical calibration curve for SBT-DELFIA using McAb-45

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-SBT McAb-45	LOD < 1ng/mL by SBT-DELFIA. The cross-reactivities of the McAb-45 with the metabolites of SBT, N-desmethylsibutramine (M1) and N,N-bidesmethylsibutramine (M2) are ~82% and ~3.9%, respectively. No cross-reactivities were observed with 50 μg/mL of sildenafil and fenfluramine. Any conjugation reaction performed via the primary amine groups of McAb-45 will result in loss of its activity. It is recommended to use anti-mouse IgG secondary antibody for labeling or solid-phase coating.
Conjugate	• SBT-PEG-BSA	Paired with anti-SBT antibodies for SBT testing.

Abused drugs

Acetaminophen (APAP)

Acetaminophen (also known as paracetamol, N-acetyl-p-aminophenol, APAP) is the most commonly used medication for treatment of pain and fever. The toxicity of APAP is mainly attributed to the excess production of a metabolite intermediate, n-acetyl-p-benzoquinone-imine. The damage caused by its overdose is primarily seen in liver, and may lead to liver failure and death. In cases of overdosing, liver damage can be prevented in most cases by early treatment with antidotes, such as nacetylcysteine, if administered within a few hours from ingestion. For emergency treatment of the overdose induced hepatotoxicity, accurate and rapid quantitation of plasma APAP concentration is necessary for timely deciding appropriate treatment strategy. According to clinical toxicology literature [*J Pharm Biomed Anal 2007, 44(4):831–844*], APAP levels below 150 and above 200 µg/mL require different treatment regimes that differ greatly in complexity, length of time, implications to the patient and probable cost-benefit outcomes. The analysis of APAP is now an accepted part of the repertoire of tests performed in most hospital biochemistry laboratories. Our monoclonal anti-APAP McAbs can be used to establish highly sensitive and specific immunoassay for rapid determination of APAP.

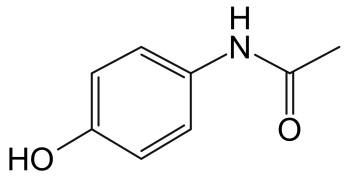

Fig. 1.The chemical structure of APAP

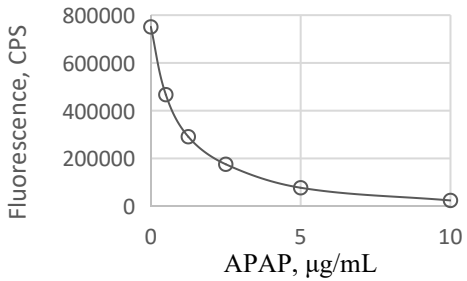

Fig. 2. Typical calibration curve of APAP-DELFIA using McAb-69

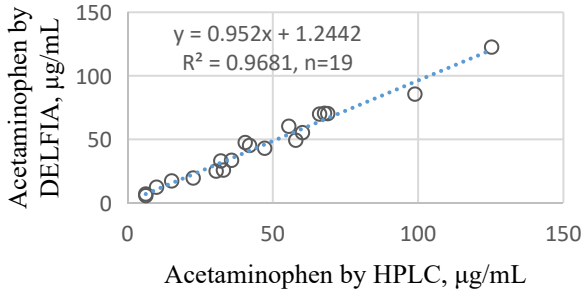

Fig. 3. Agreement between the APAP concentration determined by HPLC and the DELFIA using McAb-69

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-APAP McAb-69	Used for testing APAP with LOD < 0.06µg/mL by DELFIA. No cross-reaction was detected with the glucuronide, sulphate, N-acetyl-cysteinyl and L-cysteinyl metabolites of paracetamol at 150µg/mL.
Conjugate	• APAP-BSA	Paired with anti-APAP McAb for APAP immunoassay

Abused drugs

Zolpidem

Zolpidem is a non-benzodiazepine sedative-hypnotic, and is considered safer for treatment of insomnia compared to benzodiazepines. However, in recent years, there have been growing reports of zolpidem dependence, addiction, and withdrawal symptoms. Zolpidem is rapidly adsorbed and has a very short half-life, this feature makes it being used as the most prescribed insomnia treatment and, in the meanwhile one of the main choice of drugs for criminal purposes. Zolpidem is frequently involved in serious crimes such as arson, murder, and drug-facilitated sexual abuse. Also, a significantly increased risk of suicide or suicide attempt was found in zolpidem users compared to non-users.Taken together with the wide usage of zolpidem all over the world and the accompanied risks, developing a valid analytical method for detecting zolpidem in body fluids or other specimens is important for forensic and clinical centers. Our anti-zolpidem polyclonal antibodies with the paired conjugates allow detection of zolpidem with LOD as low as 50pg/mL by DELFIA.

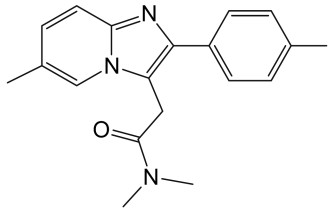

Fig. 1. The chemical structure of zolpidem

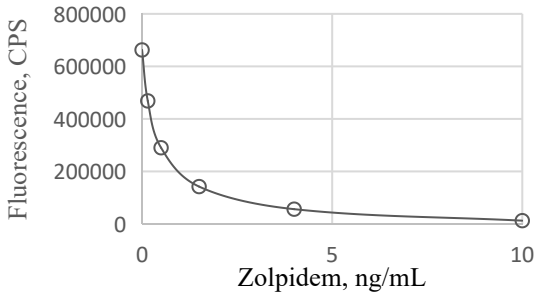

Fig. 2. Typical calibration curve for zolpidem-DELFIA using PcAb-1211-4

Product Type	Catalog #	Description
Rabbit polyclonal antibody	• Anti-zolpidem-BSA PcAb-1211-4	LOD <50pg/mL by zolpidem-DELFIA. The cross-reactivity with zolpidem 4-phenyl carboxylic acid (ZCA), the main metabolite of zolpidem, was about 79%. The targets detected by immunoassay using PcAb-1211-4 include both zolpidem and ZCA.
Conjugate	• Zolpidem-PEG-Biotin • Zolpidem-PEG-OVA	Paired with Anti-zolpidem antibody for zolpidem testing.

Abused drugs

Pregabalin (Preg)

Pregabalin (Preg) is a well-recognized central nervous system depressant. It binds to the α-2-δ subunit of voltage-gated calcium channels, decreasing the release of several excitatory neurotransmitters and blocking the development of hyperalgesia and central sensitization. It was used for the treatment of seizures, neuropathic pain, anxiety disorder (GAD) or social anxiety disorder (SAD), spinal cord injury, and fibromyalgia. The side effects of Preg are less severe compared to other anti-epileptic drugs, being the most frequently reported somnolence, angioedema, dizziness, blurred vision, dry mouth, and weight gain. The TDM of pregabalin is a useful to achieve the therapeutic effect while minimizing the risk of side effects in critically ill patients, especially in those with severe renal impairment. Moreover, the abuse of Preg has increased substantially over the last decade, monitoring of this drug will facilitate government authorities in regulating its abuse. Our anti-Preg McAb can be used to develop sensitive immunoassays for convenient and reliable Preg monitoring.

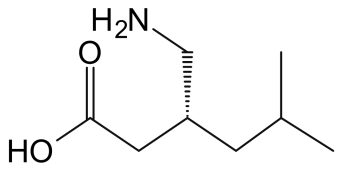

Fig. 1. The chemical structure of Preg

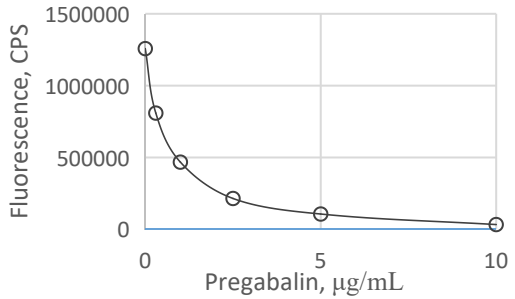

Fig. 2. The typical calibration curve of Preg-DELFIA using McAb-16

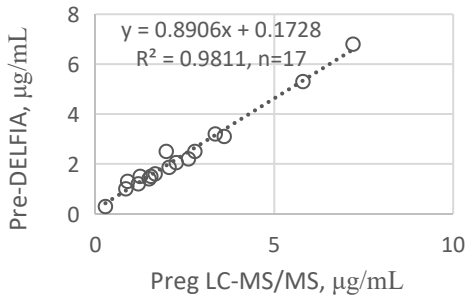

Fig. 3. The correlation of Preg concentration obtained by LC-MS/MS and DELFIA using McAb-16

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-Preg McAb-16	Used for developing Preg immunoassay with LOD <20 ng/mL and good correlation with HPLC. No cross-reactivity was detected with gabapentin, γ-Hydroxybutyric Acid and γ-aminobutyric acid at 50μg/mL.
Conjugate	• Preg-BSA	Paired with anti-Preg antibody for Preg testing.

Abused drugs

Gabapentin (Gaba)

Gabapentin (Gaba) is an anticonvulsant drug, initially used for adjunctive treatment of partial seizures, and later for treatment of cancer- and childbirth-related pain. It also has utility in diabetic neuropathy, migraine disorders, restless leg syndrome, and in the treatment of mood disorders, panic attacks, and social phobias. For seizure control, most patients exhibit predose plasma concentrations between 2 to 20 µg/mL. The major side effects of it include somnolence, dizziness, ataxia, fatigue, nystagmus, and an increased risk of respiratory depression. TDM of gabapentin is helpful for establishing compliance and detecting individual patient thresholds for saturation of gabapentin absorption. Due to renal elimination, gabapentin monitoring may be useful for optimizing the dose in the renal-compromised patient. Moreover, although Gaba was once believed to be safe and have a low potential for abuse, there has been an increasing number of case reports that gabapentin is being misused for its subjective pleasurable effects. Monitoring of Gaba will facilitate government authorities in regulating its abuse. Our anti-Gaba McAb can be used to develop sensitive immunoassays for convenient and reliable Gaba monitoring.

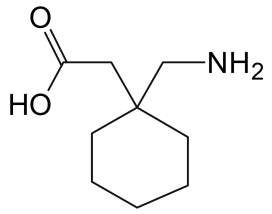

Fig. 1. The chemical structure of Gaba

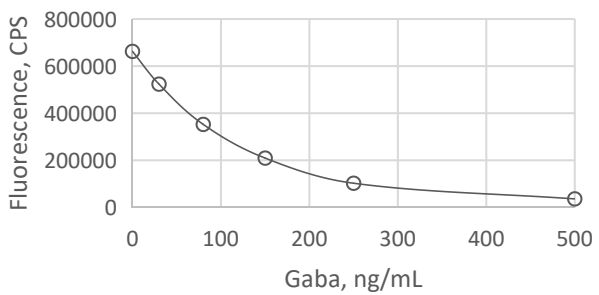

Fig. 2. Typical calibration curve of Gaba-DELFIA using McAb-3

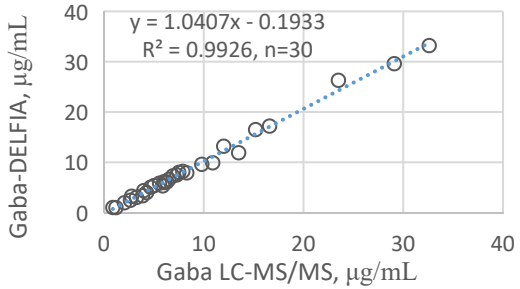

Fig. 3. The correlation of Gaba concentration obtained by LC-MS/MS and DELFIA using McAb-3

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-Gaba McAb-3	Used for developing Gaba immunoassay with LOD <2.5ng/mL by DELFIA. No cross-reactivity was detected with pregabalin, γ-Hydroxybutyric Acid and γ-aminobutyric acid at 50µg/mL. No metabolite cross-reactivity issues are involved in Gaba immunoassay since this drug is not metabolized in humans.
Conjugate	• Gaba-PEG-BSA	Paired with anti-Gaba antibody for Gaba testing.

Abused drugs

Modafinil

Modafinil is increasingly used as a cognitive enhancer to improve alertness, attention, memory and performance. Despite its legitimate therapeutic applications, modafinil is frequently misused as a so-called "smart drug". Although modafinil was initially considered to have a low risk of abuse and dependence, emerging evidence has demonstrated that it can induce a variety of adverse effects including headache, nausea, insomnia, anxiety and memory impairment. The misuse of modafinil has attracted considerable concerns, particularly in professional sports, academic examinations, driving safety and forensic toxicology fields. Immunoassay serves as a sensitive analytical method for the identification of modafinil use in both legitimate and illicit settings, including instances of overdose and misuse. Our rabbit anti-modafinil-BSA polyclonal antibodies, combined with the paired antigen, enable sensitive detection of modafinil with a limit of detection (LOD) as low as 1.5 ng/mL via DELFIA.

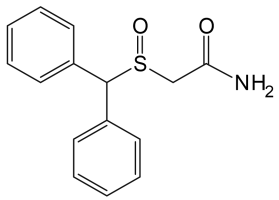

Fig. 1. The chemical structure of modafinil

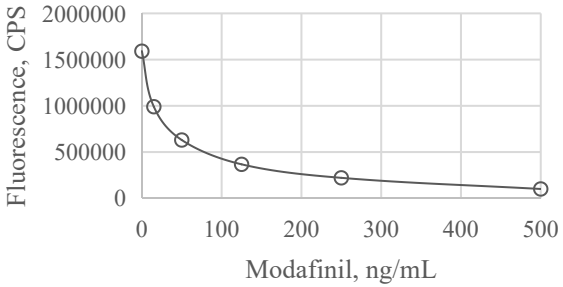

Fig. 2. Typical calibration curve for modafinil-DELFIA using PcAb-0327-3

Product Type	Catalog #	Description
Rabbit polyclonal antibody	• Anti-modafinil-BSA PcAb-0327-3	LOD <1.5ng/mL by modafinil-DELFIA. The cross-reactivity with modafinil acid was ~72%, and no cross-reactivity was detected with modafinil sulfone at 5000ng/mL.
Conjugate	• Modafinil-PEG-OVA	Paired with anti-modafinil- antibody for modafinil testing.

Abused drugs

Etomidate (ETO)

Etomidate (ETO) is an imidazole-derived, ultra-short-acting sedative traditionally used for induction of general anesthesia. Since it has positive effects on cardiovascular stability, it is useful in patients with increased tendency of heart disease morbidity. However, In the past decade there is a troubling increase in the abuse of ETO, particularly as an additive in electronic cigarettes for recreational purposes. In China, etomidate has become the most frequently misused substance among narcotic and psychotropic drugs. The widespread abuse of etomidate has posed a grave risk not only because of their addictive nature but also due to the severe health consequences including adrenocortical suppression, myoclonus, respiratory failure and even death. Detection of etomidate in various biological samples is essential for identifying its illegal use and assisting better control of this emerging issue. Our anti-ETO polyclonal antibody and its paired conjugate can be used to developing sensitive immunoassay for ETO monitoring, allow detection of ETO as low 0.2ng/mL by DELFIA.

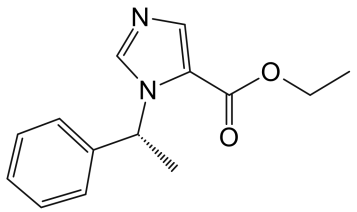

Fig. 1. The chemical structures of ETO

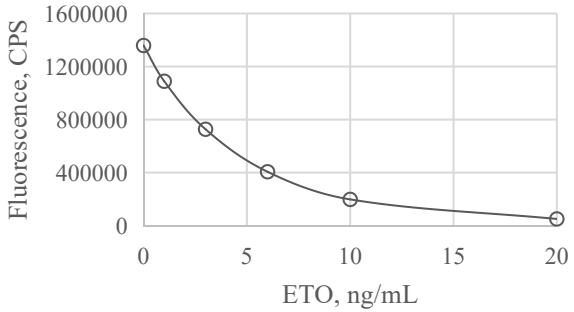

Fig. 2. Typical calibration curve for ETO-DELFIA using PcAb-1006

Product Type	Catalog #	Description
Rabbit polyclonal antibody	• Anti-ETO-BCP PcAb-1006	LOD was < 0.2ng/mL by ETO-DELFIA. The cross-reactivities is about 32% with etomidate acid.
Conjugate	• ETO-PEG-Biotin	Paired with the anti-ETO antibodies for ETO testing. It can be used by direct NC membrane coating, or paired with streptavidin coated solid phase for development of ELISA and CLIA.
BCP: Blue carrier protein		

Abused drugs

Carisoprodol/Meprobamate

Carisoprodol and meprobamate have been commercially available for over 50 years for treatment of musculoskeletal pain. Meprobamate is the major metabolite of carisoprodol. The effects of both carisoprodol and meprobamate are similar to those of alcohol, including confusion, sedation, and loss of balance, and are frequently associated with accidental or suicidal events. Overdose of these medicines may cause coma, hypotension, respiratory depression, shock, pulmonary edema, and heart failure. So, both of these drugs are on the list of the most regulated drugs in many countries, and the identification/quantitation of carisoprodol and meprobamate is a necessary for clinical and forensic toxicology applications. Carisoprodol has a half-life estimated at approximately 1-3h, while meprobamate has a longer elimination half-life of 6-17 h. So, it's highly desirable to detect both carisoprodol and meprobamate when an immunoassay is designed for carisoprodol monitoring. Our anti-carisoprodol polyclonal antibody can be used to developing sensitive immunoassay for monitoring of carisoprodol and meprobamate, allow detection of carisoprodol and meprobamate as low as 1ng/mL by DELFIA.

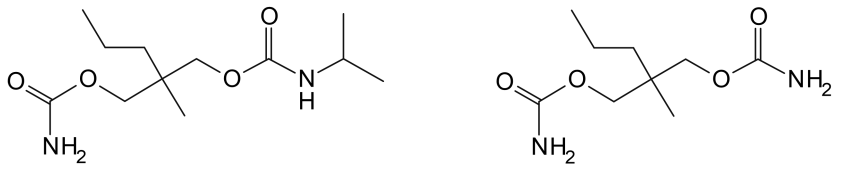

Fig. 1. The chemical structures of carisoprodol (left) and its metabolite meprobamate (right)

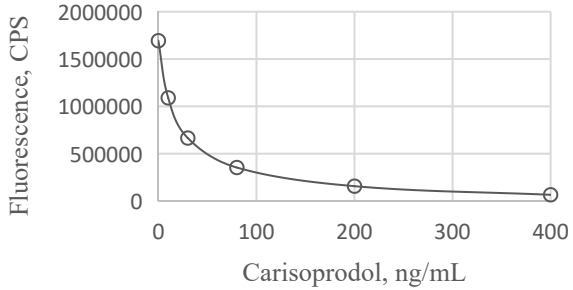

Fig. 2. Typical calibration curve for carisoprodol-DELFIA using PcAb 0320-1

Product Type	Catalog #	Description
Rabbit polyclonal antibody	• Anti-Carisoprodol-BSA PcAb, 0320-1	LOD was detected as 1ng/mL by carisoprodol-DELFIA. PcAb 0320-1 shows similar affinity for carisoprodol and meprobamate, and can be used for determination of the total concentration of carisoprodol and meprobamate.
Conjugate	• Carisoprodol-PEG-OVA • Carisoprodol-PEG-BCP	Paired with anti-carisoprodol antibodies for carisoprodol testing.

Abused drugs

Diphenoxylate

Diphenoxylate, ethyl 1-(3-cyano-3,3-diphenylpropyl)-4-phenylpiperidine 4-carboxylate, is a derivative of pethidine that shows typical opioid activity at high doses. It is useful in the treatment of protracted diarrhea in children. With the similar chemical structure to meperidine, diphenoxylate carries many of the characteristic of the opiates. The side effects of diphenoxylate include drowsiness, rash, dizziness, depression, nausea; when combined with atropine, it has more serious toxicity such as respiratory depression, cerebral edema, and even death. Overdose of it is capable of producing a morphine-like euphoria, which usually leads to dependence and addiction. Our anti-diphenoxylate McAb allows detection of diphenoxylate with LOD < 0.5ng/mL by microwell-DELFIA.

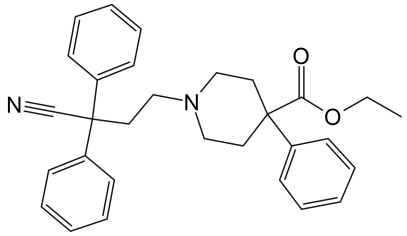

Fig. 1. The chemical structure of diphenoxylate

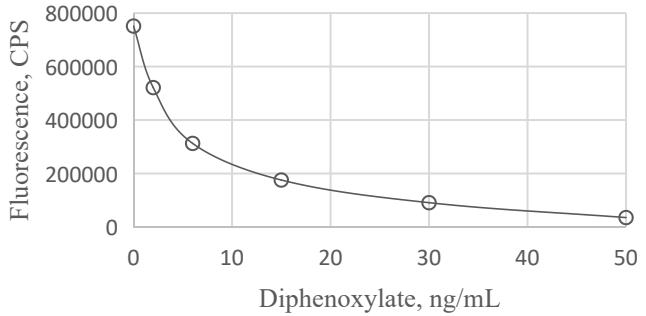

Fig. 2. Typical calibration curve for diphenoxylate –DELFIA using McAb-10

Product Type	Catalog #	Description
Mouse monoclonal antibody	• Anti-Diphenoxylate McAb-10	Used for detection of diphenoxylate with a LOD < 0.5ng/mL by microwell-DELFIA or ELISA. However, the analytical sensitivity is dramatically decreased when the antibody is applied in ordinary immuno-chromatographic platform, with LOD at ~150ng/mL by fluorescent lateral flow immunoassay.
Conjugate	• Diphenoxylate-OVA • Diphenoxylate-PEG-Biotin	Paired with anti-diphenoxylate antibodies for diphenoxylate testing.