Are Male Enhancement Ultraceuticals Sold Online Safe, Natural and Compliant with their Label Claim?

Nadine Amine, Cindy Zheng, Harshvir Kaur, Jessica Sweeney, Mark Mikail, and Mohamed Ismail Nounou*
Department of Pharmaceutical Sciences, University of Saint Joseph, USA

Abstract
Attention to ultraceuticals has become extremely prevalent. A large surge of male enhancement ultraceuticals has hit the U.S. market through online retail stores such as eBay, Amazon, GNC, and Alibaba that consist of unverified therapeutic label claims. The issue at hand is the increase in the production, marketing and sale of adulterated products from these online retail stores that falsify the safety, efficacy, and therapeutic claims on their websites. These products are further provoked to continue their false claims due to the absence of strict regulatory laws to govern label claims, manufacturing, and marketing in U.S. and global markets. The online retail stores that sponsor and advertise the sales of these ultraceuticals neglect the literature that show many of the products were discovered to be counterfeit, mislabeled, or adulterated with active pharmaceutical ingredients (API). Ultimately, regulatory authorities should instill regulations in order to monitor, examine, and test the ultraceutical market and the research community should draw public attention to the possible effects of these products on consumers.

Keywords: Ultraceuticals; Adulteration; Counterfeit; Nutraceuticals; Male enhancement; Online retail stores

Introduction & Background Problem
Natural, organic, chemical free, and homeopathic, are all buzzwords consumers tend to associate with safety and efficacy. In many cases, such marketing terminology is misleading and deceitful [1]. Many people seek out this terminology when purchasing dietary supplements and vitamins. Health organizations and researchers have attempted to introduce policies to regulate these industries and have largely failed due to a lack of interest [2-5]. Ultraceutical formulations are expanding widely to include products that include male-enhancement, weight loss, and cognitive enhancement products. The U.S. Food and Drug Administration (FDA) have very limited control over dietary supplements. The FDA only regulates the labeling of these products in the United States, requiring a disclaimer label stating “This statement has not been evaluated by the FDA. This product is not intended to prevent, cure or treat any disease” [6]. Despite this, the advertised claims, trade names, and even the shape of the pills suggest therapeutic effects as seen on their online retail stores.

Online sale of Ultraceuticals: a market place unchecked
The absence of regulatory laws, enforcement, and oversight of the ultraceutical industry promotes the production and adulteration of the products being sold; thus, encouraging their trade throughout online retail stores including Alibaba, GNC, eBay, and Amazon [7-10]. This is a major area of sales for unregulated ultraceutical sales in the United States. In March 2019, over 10,000 and 10,938 male enhancement nutraceuticals were advertised on Amazon and eBay, respectively [8,9].

Abstract
Attention to ultraceuticals has become extremely prevalent. A large surge of male enhancement ultraceuticals has hit the U.S. market through online retail stores such as eBay, Amazon, GNC, and Alibaba that consist of unverified therapeutic label claims. The issue at hand is the increase in the production, marketing and sale of adulterated products from these online retail stores that falsify the safety, efficacy, and therapeutic claims on their websites. These products are further provoked to continue their false claims due to the absence of strict regulatory laws to govern label claims, manufacturing, and marketing in U.S. and global markets. The online retail stores that sponsor and advertise the sales of these ultraceuticals neglect the literature that show many of the products were discovered to be counterfeit, mislabeled, or adulterated with active pharmaceutical ingredients (API). Ultimately, regulatory authorities should instill regulations in order to monitor, examine, and test the ultraceutical market and the research community should draw public attention to the possible effects of these products on consumers.

Keywords: Ultraceuticals; Adulteration; Counterfeit; Nutraceuticals; Male enhancement; Online retail stores

Introduction & Background Problem
Natural, organic, chemical free, and homeopathic, are all buzzwords consumers tend to associate with safety and efficacy. In many cases, such marketing terminology is misleading and deceitful [1]. Many people seek out this terminology when purchasing dietary supplements and vitamins. Health organizations and researchers have attempted to introduce policies to regulate these industries and have largely failed due to a lack of interest [2-5]. Ultraceutical formulations are expanding widely to include products that include male-enhancement, weight loss, and cognitive enhancement products. The U.S. Food and Drug Administration (FDA) have very limited control over dietary supplements. The FDA only regulations the labeling of these products in the United States, requiring a disclaimer label stating “This statement has not been evaluated by the FDA. This product is not intended to prevent, cure or treat any disease” [6]. Despite this, the advertised claims, trade names, and even the shape of the pills suggest therapeutic effects as seen on their online retail stores.

Online sale of Ultraceuticals: a market place unchecked
The absence of regulatory laws, enforcement, and oversight of the ultraceutical industry promotes the production and adulteration of the products being sold; thus, encouraging their trade throughout online retail stores including Alibaba, GNC, eBay, and Amazon [7-10]. This is a major area of sales for unregulated ultraceutical sales in the United States. In March 2019, over 10,000 and 10,938 male enhancement nutraceuticals were advertised on Amazon and eBay, respectively [8,9].

Abstract
Attention to ultraceuticals has become extremely prevalent. A large surge of male enhancement ultraceuticals has hit the U.S. market through online retail stores such as eBay, Amazon, GNC, and Alibaba that consist of unverified therapeutic label claims. The issue at hand is the increase in the production, marketing and sale of adulterated products from these online retail stores that falsify the safety, efficacy, and therapeutic claims on their websites. These products are further provoked to continue their false claims due to the absence of strict regulatory laws to govern label claims, manufacturing, and marketing in U.S. and global markets. The online retail stores that sponsor and advertise the sales of these ultraceuticals neglect the literature that show many of the products were discovered to be counterfeit, mislabeled, or adulterated with active pharmaceutical ingredients (API). Ultimately, regulatory authorities should instill regulations in order to monitor, examine, and test the ultraceutical market and the research community should draw public attention to the possible effects of these products on consumers.

Keywords: Ultraceuticals; Adulteration; Counterfeit; Nutraceuticals; Male enhancement; Online retail stores

Introduction & Background Problem
Natural, organic, chemical free, and homeopathic, are all buzzwords consumers tend to associate with safety and efficacy. In many cases, such marketing terminology is misleading and deceitful [1]. Many people seek out this terminology when purchasing dietary supplements and vitamins. Health organizations and researchers have attempted to introduce policies to regulate these industries and have largely failed due to a lack of interest [2-5]. Ultraceutical formulations are expanding widely to include products that include male-enhancement, weight loss, and cognitive enhancement products. The U.S. Food and Drug Administration (FDA) have very limited control over dietary supplements. The FDA only regulations the labeling of these products in the United States, requiring a disclaimer label stating “This statement has not been evaluated by the FDA. This product is not intended to prevent, cure or treat any disease” [6]. Despite this, the advertised claims, trade names, and even the shape of the pills suggest therapeutic effects as seen on their online retail stores.

Online sale of Ultraceuticals: a market place unchecked
The absence of regulatory laws, enforcement, and oversight of the ultraceutical industry promotes the production and adulteration of the products being sold; thus, encouraging their trade throughout online retail stores including Alibaba, GNC, eBay, and Amazon [7-10]. This is a major area of sales for unregulated ultraceutical sales in the United States. In March 2019, over 10,000 and 10,938 male enhancement nutraceuticals were advertised on Amazon and eBay, respectively [8,9].

Abstract
Attention to ultraceuticals has become extremely prevalent. A large surge of male enhancement ultraceuticals has hit the U.S. market through online retail stores such as eBay, Amazon, GNC, and Alibaba that consist of unverified therapeutic label claims. The issue at hand is the increase in the production, marketing and sale of adulterated products from these online retail stores that falsify the safety, efficacy, and therapeutic claims on their websites. These products are further provoked to continue their false claims due to the absence of strict regulatory laws to govern label claims, manufacturing, and marketing in U.S. and global markets. The online retail stores that sponsor and advertise the sales of these ultraceuticals neglect the literature that show many of the products were discovered to be counterfeit, mislabeled, or adulterated with active pharmaceutical ingredients (API). Ultimately, regulatory authorities should instill regulations in order to monitor, examine, and test the ultraceutical market and the research community should draw public attention to the possible effects of these products on consumers.

Keywords: Ultraceuticals; Adulteration; Counterfeit; Nutraceuticals; Male enhancement; Online retail stores

Introduction & Background Problem
Natural, organic, chemical free, and homeopathic, are all buzzwords consumers tend to associate with safety and efficacy. In many cases, such marketing terminology is misleading and deceitful [1]. Many people seek out this terminology when purchasing dietary supplements and vitamins. Health organizations and researchers have attempted to introduce policies to regulate these industries and have largely failed due to a lack of interest [2-5]. Ultraceutical formulations are expanding widely to include products that include male-enhancement, weight loss, and cognitive enhancement products. The U.S. Food and Drug Administration (FDA) have very limited control over dietary supplements. The FDA only regulations the labeling of these products in the United States, requiring a disclaimer label stating “This statement has not been evaluated by the FDA. This product is not intended to prevent, cure or treat any disease” [6]. Despite this, the advertised claims, trade names, and even the shape of the pills suggest therapeutic effects as seen on their online retail stores.
Table 1: Ten top-selling products of male enhancement ultraceuticals on Amazon retail online store in the United States (February 2019) [8].

<table>
<thead>
<tr>
<th>Product</th>
<th>Brand Name</th>
<th>Ingredients</th>
<th>Claim</th>
</tr>
</thead>
</table>
| 1       | Prime Labs Men’s Testosterone Booster | Tongkat Ali Extract, saw palmetto extract, orchic substance wild yam extract, sarsaparilla, nettle extract, boron, magnesium stearate, silicon dioxide, hydroxypropyl methylcellulose, microcrystalline cellulose, stearic acid | - Optimizes physical performance  
- Stronger and leaner muscles  
- Improves mood  
- Healthy natural formula |
| 2       | Leyzene   | Icariin, arginine HCl, royal jelly, ginseng, black pepper extract, guconolactone, magnesium stearate, and gelatin Capsule | - Boost sexual performance level  
- Increase pumps and fullness  
- More vascularity  
- Maximize sexual performance time  
- Surge endurance levels |
| 3       | Horny Coat Weed Herbal Complex | Horny Goat Weed extract, maca root, tongkat All, ginseng, L-Arginine | - Natural supplement for men and women  
- Infused with pure potent enhancers  
- Promotes healthy blood circulation |
| 4       | Organic Maca Root | Organic Maca Root, Black Pepper Extract, Vegetable Cellulose Capsule | - Natural boost  
- Increases passion and performance  
- Superior absorbance and benefits |
| 5       | AlphaMan XL | Macuna Pruriens (L-Dopa), Polypodium Vulgare, Yohimbe Bark, Saw Palmetto, Muira Puama, L-Arginine & Panax Ginseng | - Sexual organs size increase  
- Increasing stamina |
| 6       | Golden X | zinc, maca root, horny goat weed, ginseng, Tribulus terrestris and pomegranate, Schisandra Berry | - Improved sex drive  
- Energy and stamina boost  
- No side effects |
| 7       | BigRize | boosts testosterone, fast and long acting | - Highest quality herbal supplement |
| 8       | boostULTIMATE Testosterone Booster Pills | Ginseng, Muira Puma, and Maca, L-Arginine | - Boost sexual performance  
- Testosterone boosters help with building men’s drive and enhancing endurance |
| 9       | Boost Elite Test Booster | Tribulus Terrestris Extract, Horny Goat Weed, Fenugreek Extract, Maca Root, Zinc Citrate, DIM, Panax Ginseng, Tongkat Ali Extract, & Yohimbe Bark Extract | - Boosts sexual passion |
| 10      | High T Black Natural Testosterone Booster | Nitric oxide, arginine Alpha-Ketoglutarate, citrulline-malate, beta alanine, caffeine anhydrous, eurycoma longifolia, raspberry ketone, rhodiola rosea, and testofen fenugreek extract. | - Powerful libido  
- Workout enhancing properties  
- Helps bring back youthful energy and performance in and out of the bedroom with long term use |

Table 2: Ten top-selling products of male enhancement ultraceuticals on eBay online store in the United States (February 2019) [9].

<table>
<thead>
<tr>
<th>Product</th>
<th>Brand Name</th>
<th>Ingredients</th>
<th>Claim</th>
</tr>
</thead>
</table>
| 1       | Kangaroo Male Sexual Performance Enhancement | Not reported | - Premium blend scientifically designed for men to increase sexual pleasure and performance.  
- Formulated to promote longer harder erections and enhance sexual activity. |
| 2       | Poseidon Platinum 3500 | Tribulus, cordyceps militaris, ginger root, cnidium, monnier extract, theobromine, rhodia, and avena sativa extract | - Not counterfeit  
- Longer and harder erection  
- Increase in time, size, and stamina |
| 3       | Zeus 1600 | Not reported | - Maximize the time of intercourse  
- Help ease premature ejaculation  
- Increase size  
- More stamina  
- No headache  
- Fast acting |
| 4       | REV72     | Ginkgo biloba, testosterone | 72-hour natural male enhancement pill that takes the worry out of what you’re putting in your body |
| 5       | Dragon 69 12000 | Not reported | - Maximize the time of intercourse  
- Help ease premature ejaculation  
- Better ejaculation control  
- Maximize in length, width, and stamina  
- All natural and no chemicals |
### Table 3: Ten top-selling products of male enhancement ultraceuticals on General Nutrition Centers (GNC) online and retail stores in the United States [February 2019] [10]

<table>
<thead>
<tr>
<th>Product</th>
<th>Brand Name</th>
<th>Ingredients</th>
<th>Claim</th>
</tr>
</thead>
</table>
| 1       | Nugenix Ultimate Testosterone | D-Aspartic acid, fenugreek extract, epimedium sagittatum, stinging nettle, maca, mucuna pruriens extract, eurycoma longifolia extract, and boron | • Boosts free testosterone  
• Maximizes muscle and strength  
• Modulates androgenic activity |
| 2       | GNC Men’s MACA Man | Niacin, niacinamide, L-Arginine, lepidium meyenii, pausinystalia yohimba, ginkgo biloba leaf extract | • Advance sexual health  
• Fuels nitric oxide production for enhanced blood flow |
| 3       | Nugenix Total-T | L-Citrulline malate, fenugreek extract, ancient peat extract, apple fruit extract, eurycoma longifolia extract, boron glycinate | • Increase lean muscle mass  
• Boost free and total testosterone  
• Support stronger sex drive |
| 4       | GNC Men’s Arginmax | Retinyl palmitate, ascorbic acid, thiamin mononitrate, riboflavin, niacinamide, folic acid, cyanocobalamin, biotin, calcium d-Pantothenate, zinc gluconate, selenium selenate, pyridoxine HCl, L-Arginine, aerial part and root, American ginseng, and ginkgo biloba leaf extract | • Advanced sexual health formula  
• Helps support sexual desire  
• Improves sexual performance and power |
| 5       | Nugenix MAXX | Cholecalciferol, zinc l-monomethionine, fenugreek extract, ashwagandha extract, shilajit purified extract, tribulus alatus extract, eurycoma longifolia extract, rhodiola extract, maca extract, panax ginseng extract, white button mushroom extract, and black pepper extract | • Boost free testosterone  
• Support libido and energy  
• Increase muscle strength |
| 6       | Nugenix Total-T | L-Citrulline Malate, Fennugreek Extract (seed), elevATP® Blend (Ancient Peat Extract (trace minerals) and Apple Fruit Extract), Eurycoma longifolia Extract (root), Boron | • Increase lean muscle mass  
• Boost free & total testosterone  
• Support stronger sex drive |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7</strong></td>
<td><strong>GNCAMP Test 1700</strong></td>
<td>Zinc, magnesium glycinate, fenugreek seed extract, ashwagandha extract, tribulus terrestris extract, chrysin, sage leaf extract, bovine costrum, calcium hydroxyethyl butyrate monohydrate, Indole-3-carbinol, longkai ali root extract, rhaponticum carthamoides root extract, DIM, maitake mushroom mycelia powder, shiitake mushroom mycelia powder, reishi mushroom powder, velvet elk antler powder</td>
</tr>
</tbody>
</table>
|   |   | • Supports testosterone & libido  
• Fuels muscle performance |
| **8** | **GNC Men’s Staminol** | L-Arginine, kola nut powder, oat straw stems powder, gamma-amino butyric acid, nettle leaf powder, yohimbe bark extract, horny goat weed powder, muira puama root powder, damiana leaf powder, and saw palmetto berries powder |
|   |   | • Has key nutrients and exotic herbs to enhance male sexual performance  
• Supports normal prostate function and healthy urinary flow |
| **9** | **Alpha King Supreme Elite** | Vitamin D, Vitamin K2, Magnesium, ashwagandha extract, fenugreek seed liposomal extract, macuna pruriens, DIM, boron, and L-citrulline. |
|   |   | • Testosterone booster, premium drive & vitality  
• Compelling muscle & strength  
• Mind-blowing sexual performance |
| **10** | **Men’s Staminol™ Ultra** | Vitamin E, riboflavin, folate, selenium, thiamin, niacin, vitamin B-12, zinc, L-arginine, Testofen® Fenugreek Seed Extract, MegaNatural® -BP™ Grape Seed Extract, maca powder, Asian ginseng root extract, Yohimbe bark extract, Horny Goat Weed extract, Hawthorn berry extract, Ginkgo biloba leaf extract |
|   |   | • A powerful combination of ingredients, including L-arginine for intense vasodilation  
• A potent blend of herbs designed to support sexual health and vitality |

Ingredients, and low pharmaceutical quality [1,12-16]. Some products in the nutraceuticals category have been found to contain pesticides, heavy metals, and adulterants [17-20]. Adulterated products may contain incorrect parts of a plant or unreported active pharmaceutical ingredients (APIs), as documented in previous cases [12,17-20]. Herbal adulteration has also been a problem. A recent study found male enhancement supplements contained at least 1 of 5 unreported plants of concern [21]. Other cases of adulteration of male-enhancement nutraceuticals with sildenafil, vardenafil, or tadalafil have been previously reported [12]. Fraudulent adulteration may increase the therapeutic effect but is illegal, unethical, and can cause significant harm. Following consumption of the male enhancement supplement Rhino 7 Platinum 3000, a 25-year-old man required bilateral corporal shunting to alleviate his priapism that had persisted for 48 hours; A follow up appointment demonstrated he is no longer able to maintain an erection and has significant bilateral fibrosis of the corporal bodies [22].

The purpose of the undocumented APIs spiking and adulteration is for manufacturers to increase the therapeutic effects of their products; simultaneously claiming them to be of natural origin in order to market their products in a more favorable, pleasing psychological influence to consumers [17-20]. Consumers are unaware of the true ingredients within these naturally claimed products, which make them susceptible to drug-drug interactions that can cause a great risk to their health and safety. It can ultimately cause permanent damage as seen in the case of Rhino 7 Platinum 3000 [22].

Many of the male enhancement nutraceuticals sold online were found to be adulterated with reported or unreported analogues of FDA-approved prescription phosphodiesterase-5 inhibitors (PDE5i) used to treat erectile dysfunction such as sildenafil, tadalafil, or vardenafil [1,11,12,15,16]. A study conducted by Pfizer Global Security and Research and Development teams found 81% of sexual performance nutraceuticals contained adulterated PDE5is, 45% of those contained more than the highest approved strength of the drug [23]. Novel PDE5i analogues such as desmethylpioprazinyl propoxysildenafil continue to be discovered in this class of dietary supplements [24]. The presence and quantity of these adulterants is of great concern due to the known risks associated with this class of FDA approved drugs and the uncertainty of the safety of the untested PDE5i analogues. ZenMaxx, Instant Hard Rod, and RigiRx Plus were all found to contain amin o-tadalafil, an analog of tadalafil [25]. This interacts with nitrates found in some prescription drugs and may dangerously lower blood pressure [5,26,27]. These products pose a threat to patients with diabetes, high blood pressure, high cholesterol, or heart disease [28]. Many of the products described above can be seen on the FDA list of tainted products marketed as dietary supplements though, based on a survey of current literature, however, it is by no means a comprehensive list [11].

**Action required**

Nutraceuticals and ultraceuticals are advertised as purely natural products free from side effects. They are widely sold online via major retail stores such as Amazon, eBay, and Alibaba from unknown sources from all over the world, mostly with a therapeutic claim that violates FDA and DSHEA guidelines [6-9]. Literature review shows that these products are adulterated, misbranded, mislabeled, are of low pharmaceutical quality, and may be dangerous because of the presence of undeclared plant products and APIs. These products often contain disingenuous review from which consumers base their decision making [29]. Health organizations and governments are aware of the illegal manufacture and sale of adulterated and counterfeit nutraceutical formulations, yet no laws or regulations are enforced to tackle this global problem [30].
<table>
<thead>
<tr>
<th>Product</th>
<th>Brand Name</th>
<th>Ingredients</th>
<th>Claim</th>
</tr>
</thead>
</table>
| 1       | Marfly MACA | Peruvian natural maca plant | • 100% new high quality  
• All natural, experience  
• Hard erection  
• Increase ejaculation  
• Increase length, width and endurance  
• Increase sexual confidence  
• Increase orgasm  
• Prevent premature ejaculation  
• No prescription required |
| 2       | Sheng FO | Maca Root 50%, 100%, Aguaje powder, pueraria Mirifica, Mexican wild Yam, Saw palmetto, Dong Quai Root, Dandelion Root, Fenugreek seed, and Vegetarian Capsules | • 100% safe, zero additives, and zero side effects  
• The most effective penis enlargement pill currently available  
• It combines all the most potent all-natural herbal ingredients scientifically dosed to enhance penis fullness, size, and sexual satisfaction |
| 3       | Alpha Male Enhancement | 100% herbal extract complex | • 100% pure and natural  
• Promotes penis growth  
• Gain harder and longer erections  
• Increasing sperm and testosterone levels  
• Improves libido.  
• No fillers, binders, or additives |
| 4       | Okra Oyster Tablet | Abielmoschus esculentus moench, and maca | • Increases sexuality  
• Natural supplements with strong erections |
| 5       | Yohimbe Bark | Yohimbe Bark Extract | • Natural supplements prolonging erections for men  
• Androgen promoting testosterone that dilates local blood vessels and allow blood to circulate |
| 6       | Vitality Vigour Capsules | Safed Musli, Shilajit, Mucuna Prurienis, Ashwagandha, Aakaarakabba, Kokilaksha, Parasika Yavani, Jatiphala, Lavanga, Tvak, Makaradwaja, Vanga Bhma, Abhrak Bhma, Kukutand Bhma. | • Booster herbal extract supplement  
• 100% vegetarian  
• Helps boost libido levels  
• Enhance sexual capacity in both men and women |
• 100% herbal ingredients  
• Improves health  
• Boosts libido |
| 8       | Nutricelebrity Ultra Tribido | L-arginine, tribulus terrestris, lepidium meyenii, and epimedium graniflorum. | Advanced formula that promotes sexual health including desire, performance and stamina |
| 9       | Shilajit Herbal Capsule | Withania somnifera, chlorophyllum arundinaceum, curculigo orchoides, aspaltum purified, swaranmakshik bhasma. | • 100% Indian herbal and pure Ayurveda formulation  
• Improvevigor and vitality  
• Potent and world known rejuvenator  
• No preservatives, excipients, or additives used |
| 10      | Vitomanhills Men’s Health | Withania somnifera, chlorophyllum borisilianum, asparagus racemous, mucuna pruriens, ipomea digitata, hygrophiila spinosa, myristica fragrans, phaselius mungo, aspaltum, anacyclus pyrethrum, and cow milk. | • 100% pure  
• Increases sperm count & men’s health  
• Promote sexual health, fertility, and sexual performance |
Conclusions and Future Directions

There are expanding issues around adulterated and counterfeit nutraceuticals globally. There seems to be gray areas in the U.S. market where these nutraceuticals are being sold regarding their claim, safety, efficacy, registration, sales, and regulation.

Male enhancement nutraceuticals which are sold freely online should be researched, analyzed, and evaluated with respect to claim, content, safety, and efficacy. Researchers should be encouraged to investigate the quality, safety, and efficacy of supplements suspected to have illegal therapeutic claims. Technologies should be utilized for the fast and accurate detection of adulterants and counterfeit products. These technologies include near infra-red (NIR) spectrophotometry or simple spectrophotometric analysis [1,31,32]. This problem has led to the development of innovative detection technologies including portable drug identification devices such as Si-Ware systems for online marketplace warehouses, regulatory agencies, and pharmacies along with consumers [32]. They deliver the spectral response of the light absorbed by materials for quantification, qualification or identification [32]. Moreover, the development of rapid and accurate analytical techniques is critical. A new assay has been developed to rapidly detect PDE5 inhibitors using fluorescence that can even successfully uncover new analogues in low concentrations [33]. Ultraceuticals research is critical for medical and pharmaceutical application. Such systems can be used for the fast and accurate detection of adulterants and counterfeit products in the pharmaceutical industry sector, insurance agencies, law enforcement agencies, airports and retail pharmacies along with consumers [32]. They deliver the spectral response of the light absorbed by materials for quantification, qualification or identification [32]. Moreover, the development of rapid and accurate analytical techniques is critical. A new assay has been developed to rapidly detect PDE5 inhibitors using fluorescence that can even successfully uncover new analogues in low concentrations [33]. Ultraceuticals research is critical for online marketplace warehouses, regulatory agencies, and consumers with respect to safety, efficacy and quality.

Ultimately, this problem is the result of a rapidly growing industry going unchecked. Global and national health organizations should implement new regulations or enforce existing regulations for nutraceuticals to protect consumers and hold those who profit from their manufacture, distribution, and sale accountable for adverse effects.

References

3. United Arab Emirates Ministry of Health. Ministry of Health warns about online circulation of medicines UAE: Emirates news agency (WAM); 2016.
23. Campbell N, Clark JP, Stecher VJ, Thomas JW, Gallnall AC, Donnelly BF,


32. Si-Ware Systems (SWS). Si-Ware systems introduces first fully integrated chip-sized spectral sensor for industrial and consumer markets Cairo, Egypt: Si-Ware Systems (SWS); 2019.

Our motto is to advance scientific excellence by promoting open access. We are committed in the widest possible dissemination of research and uplift future innovation.