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Neuropharmacognosy as an Emerging Multidisciplinary Science

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ABSTRACT

Neuropharmacognosy represents the field that combines neuroscience and pharmacognosy. It allows us to better understand and use the data that pharmacognosy provides and apply them in neurosciences which may lead to new therapeutic approaches. The existence of both pharmacological and toxicological aspects of neuropharmacognosy creates more challenges. However, the methods provided by the related fields, such as chemistry and biology, let us expect more advances and hopefully new perspective that would overcome the current challenges.

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1. INTRODUCTION

The quick development of divers medical and biological fields, in addition to the advances relaized in divers therapies lead to more specializations in the existing sciences and fields of researches. Neuropharmacognosy may constitute an illustrative example of a future sceince that will emmerge among the currently existant areas. In fact, neuropharmacognosy constitute a discilpline at the interface of both pharmacognosy and neurosceinces.

The term pharmacognosy is derived from the two Greek words pharmakon, which means drug and gnosis, which means knowledge, hence pharmacognosy is the study of crude drugs of plant and animal origin [1]. Plants produce many different secondary metabolites such as flavonoids, and phrmacognosy is identifying continuously new active compounds that may represent treatments for many diseases including neurological diseases that constituite a very big health problem and certain exaples are illustrated in our paper.

The complexity of neuropharmacognosy come form the multidisciplanary caracters of both pharmacognsoy and neurosceines. Pharmacognosy[1]-[5] invloves pharmacology and phystochemistry, wherease neuroscience [6]-[10] covers neurobiology, neurophysiology and neuropharmacology. Pharmacognsoy and neurosceines include a variety of approaches such as celle culture and animal experiments, in addition to analytical methods, such as chromatography and, immunochemistry.

2. SELECTED PHARMACOLOGICAL ILLUSTRATIONS

Plants provide limitless sources of new promising products since chemical isolation and analysis methods are employed largely in phytochemistry researches, and many of the isolated compounds have proven their efficacy on many diseases. Literature points divers examples that illustrate the pharmacological and toxicological implications neuropharmacognosy would have. Pharmacological studies have shown that many compounds have potential activity on the nervous system which can lead to the development of treatments for the neurological diseases and disorders. Certain herbal drug treatments are used for mental conditions like depression, anxiety disorders, somatoform disorders, some–psychotic disorders and age-related cognitive decline [11]. Furthermore, nervous-related systems and functions such as the cerebral vascular system and the immune system can also be treated by compounds provided by pharmacognosy.

For instance, in depression, anxiety and pain, *Buchholziacoriacea*may have a stabilizing effect on the motor activity and represents a potential therapeutic agent [12]. In rats, methanolic and aqueous extracts of *Calligonum comosum* ameliorate the hepatotoxicities and neurotoxicities induced by haloperidol [13], which may lead to ameliorate the pharmacological usage of haloperidol. *Nigella glandulifera* Freyn et Sint seeds have therapeutic potentials as antidiabetes, melanogenesis inhibition, anticancer, anti-inflammatory, antithrombosis, and antiplatelet aggregation agent [14]. In Wistar albino rats hydroalcoholic extract of *Trichosanthes dioica* root has ameliorative effect against arsenic-induced myocardial toxicity [15]. Another example is Gomisin A, isolated from *Schisandra chinensis* Baill, that may have neuroprotective effects by attenuating the microglia-mediated neuroinflammatory response [16] and could have benefits for some neurodegenerative diseases. Thymol (Monoterpene phenolic compound) has been reported to prevent high fat diet-induced obesity in murine model [17], which represents a potential starting point to develop new forms of anti-obesity drugs. Importantly, one of the promising plants in neuropharmacognosy would be *Hypericum perforatum*, also known as St John's wort which represents a hot research topic for many neurologist, studies of St John's wort have led to prove its efficacy in common psychatric disorders, such as major depression, bipolar depression, social phobia, somatization disorder, obsessive-compulsive disorder and attention-deficit hyperactivity disorder, [18]. The anticonvulsant effect of *Pipermethysticum* (kava) was investigated through comparing its effect alone and in combination with diazepam, which is a synthetic anticonvulsant drug, and it was found that this combination enhanced the efficacy and reduced the secondary effects of diazepam, however the safety of this combination needs further studies [19]. However, kava has lately been implicated in several liver failure cases, and it has been banned in many countries, moreover, it has been found that the several assumed active principles of kava extracts, which are kavalactones, might inhibit several enzymes of the CYP 450 system [20]. However, the results found are still insufficient to make determined scientific deductions because of the lack of investigations and clinical studies.

On the other hand, pharmacognosy may have neurotoxicological aspects that may limit the use of such therapies. However, in spite of the fact that for some therapeutic plants, the toxicity has been studied [21], further studies about the toxicological profiles of other herbal medicines are still required. These illustrative examples elucidate the growing importance neuropharmacognosy will have especially with the development of the methods applied in both pharmacognosy and neurosceinces towads more precise results and more approrraite applications. Regarding the modern pharmacology, G protein coupled receptor (GPCRs), which are important targets for a great number of drugs [22], many advances have been reported [23]-[33] which makes targetting GPCRs a worth-exploiting option for pharmacognosy especailly by taking into consederation the similarities that exist between some neurotransmitters and the natural phytochemical compounds. Yet, the reltaed pharmacovigelinec still very important since the central nervous system constitute a network within which the neurotranmitters are in countinious inetactions [34], especially for some neurological diseases such as schizophrenia and Parkinson's disease [35] , and this makes the neurotoxicology more noticeable because targeting a type of neuroreceptor or neuro-system will influence the other neurological systems [36] and vice versa, furtheremore, the nervous system has impact on the whole body functions. Thus, clinical evaluations have been carried out [11] to evaluate the effects of some herbal medicines. In addition, accurate reporting of study results related to ingredients and standardization descriptions of the phytomedicines are highly primordial [5]. Regulations and strict control of natural products is substantially important, to avoid adverse reactions that are not caused by the drug itself but by impurities, contaminants and randomly added synthetic drugs. Making global natural products quality standards and developing quality control methods to have the same definitions and standards in this field between the East, particularly China and India, and theWest.

3. TOXICOLOGICAL ASPECTS

Application of advances of researches in different related fields will provide us with more tools and approaches to further explore the neuropharmacognosy. For example, using properties of some laboratory

chemicals [37] toward the development of new animal models and celle culture systems would provide new testing systems for the therapeutic candidates that pharmacognosy provides. It is of a vital importance to be aware that herbal medicines could have interactions with other medicines that are taken contemporaneously [1]. St John's wort interacts with HIV inhibitors, digoxin,theophylline and warfarin [1]. Furthermore, ingested medicinal herbs might affect the pharmacokinetic profile of other drugs, through affecting cytochrome P450 or phosphoglycoprotein transporter systems, which may affect the bioavailability and the efficacy, and also the toxicological profiles of the drugs taken concurrently [1]. Further investigations and in-deep studies are still required to establish the toxicological profile of drugs provided by pharmacognosy researches, used alone or in combination or concurrently with other drugs,particularly their impacts on vital organs and potential pharmacokinetic or pharmacodynamic interactions and it is highly urgent to focus more on *in vitro* and *in vivo* investigations.

4. CHALLANGES AND PERSPECTIVES

The research in pharmacognosy has to overcome many struggles including the possible variation in plant extracts ingredients qualitatively and qauantitatively according to many factors, including climate changes, soil composition, cultivation and collection methods and storing conditions. In addition plant metabolites desired for their therapeutical activity are often present in relatively small quantities. For instance, an experiment that has been conducted recently on *Nigella glandulifera*Freyn & Sint seeds, which are used in folk medecine in western regions of China, and are believed to have treating effect on certain neuro-diseases, has used this herb oil-free seeds (18 kg) to obtain three pure compound in tiny quantities compared the weight of the crude drug [38]. Hence, the standard compounds required for further qualitative and quantitative analysis are unavailable , particularly for plants that are newely investigated. In addition, neuropharmacognosy might face the comlexity of neuro-diseases mechanisms, which are often just based on certain theories, and for which the underlying mecahnisms are still unknown or not fully understandood such as migraine. Plant tissue culture represents a promising solution to control the production of desired natural active compounds, in addition, the continuous and fruitful improvement achieved in genetics have allowed, through transgenic plant tissue cultures, to have more optimised control of compounds production [39].

Importantly, advance danalytical methods, such as Q/TOF tandem mass spectrometry have been widely used in pharmacognosy research, which have allowed to provide a more clear and precise identification of different plants constituents, which is very important in quality control tests. The advances achieved in analytical methods might also help to elucidate more clearly the pathway of nervous disease systems through the identification and quantification of different elemets suspected to be potentialy implicated in the pathophysiology processes, such as antibodies, neurotransmitters and their precursors, and any relevant possibly incriminated components. Moreover, marine plants and animals are usually less investigated than those of in the terrestrial environment, and it is suggested to more focus on marine organisms to have more chances to find potential active natural compounds, which, after deep comprehensive investigations for their pharmacological and toxicological profiles, might lead to a more specialised field that might be marine neuropharmacognosy.

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