An alkaloids and their cytotoxicity

Alkaloids are basic compounds, which majority of them contain a nitrogen atom localized in a heterocyclic ring (Taiz & Zeiger, 2002). Two classification systems exist for these compounds. One is based on their chemical structure. These include secondary and tertiary amines, quarternary amino compounds, neutral amino compounds, and N-oxides. Another classification system is based on their “ biogenetic origins”. These include amino-acid-derived alkaloids, purine alkaloids, aminated terpenes, and polyketide alkaloids (Roberts and Wink, 1998).

Alkaloids have been in in use for centuries as medicine through plants. These plants were known to exhibit therapeutic properties. They have been used as “ muscle relaxants tranquilizers, antitussives, painkillers, poisons, and mind-altering drugs” (Wink, 1998; Hopkins and Huner, 2004).

Alkaoids are synthesized through numerous plant biochemical pathways such as terpene (Taiz and Zeiger, 2002) and Shikimik acid pathway (Hopkins and Huner, 2004).

These compounds were produced by plants in limited quantities to combat herbivory as well as diseases (Taiz and Zeiger, 2002; Hopkins and Huner, 2004; Matsuura and Fett-Neto, 2015). Furthermore, these compounds are known to be isolated from certain plant parts such as leaves, roots, and seeds. An example of which is 1′, 2′-deoxytubulosine, a cepheline-type alkaloid, was purified from the seeds and fruits of Alangium salviifolium. (Zhou et al., 2018).

Though numerous alkaloids have been sourced from various plant species, animals are known to be a source of these bioactive compounds as well.

Njaoamine, a polycyclic alkaloid, was discovered in a poriferan known as Haliclona (Urda, Pérez, Rodríguez, Fernández, Jiménez, and Cuevas, 2018). Among invertebrates, alkaloids serve as attractants for sex and species propagation (Seneca, 2007).

Alkaloids are known to exhibit various pharmacological properties. Alkaloids have significant influence on the central nervous system as stimulants. They are also used for their “ antipsychotic and antihypertensive” properties. Additonally, they also exhibit “ anti-inflammatory, demulcent, ganglionic blocking, anti-plasmodic activity, insecticidal, and a hepatoprotective ability” (Debnath et al., 2018). Interestingly, one of their biohemical properties which has brought significant interest in research is their cytotoxicity especially among cancer cells. Studies have shown that these compounds exhibit selective cytotoxicity on various cell lines. The alkaloid 8-hydroxyl-cepheline, isolated from Alangium salviifolium, has been demonstrated to be toxic against A546, Hela, and SKOV-3 cancer cell lines (Zhou et al., 2018). Analogues of polyprenylated carbazole alkaloids exhibited inhibited cancer cell growth among HepG2, DU145, HCT-116, and HeLa cell lines (Ma et al., 2018).

Mechanisms of cytotoxicity of alkaloids have also been elucidated. Basaiyye et al (2018) demonstrated the mode of action of N-feruloytyramine derivatives in Jurkar E6-1 cancer cell line. They found out that these alkaloid derivatives induce apoptosis by interacting with oncogenes such as TNFR1, FADD, AIFM, CASP8, TP53, DFFA, and NFKB1, thus affecting their expression in cancer growth.

MTT Assay

MTT Assay, known as (3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide) tetrazolium assay is a technique used for various cytological studies in terms of cell viability and toxicity in vitro. This method was pioneered by Mosmann (1983), and it involves the reduction of a tetrazolium salt to its formazan product exhibiting a purple hue by enzymatic action of functioning cells. The formazan product is localized in lipid droplets (Stockert, Blázquez-Castro, Cañete, Horobin, and Villanueva, 2012), and its concentration is determined by spectrophotometric means. (Grela, Kozłowska, and Grabowiecka, 2018; Mosmann, 1983). The absorbance values correlate to cell metabolic and growth activity. This method has been used to evaluate the activities of potential cytotoxic agents, thus serving as foundation for assessing potential anti-cancer drugs (Lia, W. Huang, S. Huang, Du, & C. Huang, 2012; Ciapetti, Cenni, Pratelli, and Pizzoferrato, 1993; Saravanan, Sreekumar, Bansal, Raya, Rao, and Mishra, 2003).

Evolitrine

Evolitrine has been isolated from various plant species, some of which have been used in herbal medicine. Plants such as Acronychia pedunculata, Cusparia macrocarpa (Rapoport and Hiem, 1960), and Ruta montana, and Evodia littoralis are known to contain this compound. This compound consists of two methoxyl groups (Manske, 1960).

Pharmacological properties of this compound have been known in terms of anti-inflammation. A study showed that this compound was able to exhibit anti-inflammatory activity in a mouse-edema model (Lal, Bhise, Gidwani, Lakdawala, Joshi, & Patvardhan, 2005).