Addoun N et al. Adv Appl Chem Biochem 2018(1): 37-39.
https://doi.org/10.33513/ACBC/1801-05

OCIMUM

Advances in Applied Chemistry and Biochemistry

Opinion Article

Ethnic Medicine and Ethnobotany Concept to Identify and Characterize New Polysaccharide-Based Drug from Arid and Semi-Arid Lands

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Received Date: 19 December, 2018
Accepted Date: 23 December, 2018
Published Date: 28 December, 2018

Citation

Addoun N, Delattre C, Boual Z, El Hadj MDO, Michaud P, et al. (2018) Ethnic Medicine and Ethnobotany Concept to Identify and Characterize New Polysaccharide-Based Drug from Arid and Semi-Arid Lands. Adv Appl Chem Biochem 2018(1): 37-39.

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Keywords

Arid Lands; Ethnobotany; Plants; Polysaccharide

Opinion

Polysaccharides are highly variable and complex biomolecules whose inventory of structures is still very incomplete since nature still preserves unexplored biotopes. Plants are an integral part of the daily life of human being regardless of culture, time, or knowledge development of a country. Widely distributed throughout the world, natural medicine is an ancestral knowledge handed down for centuries from generation to generation by those commonly referred to as "nganga" healers, shamans, or traditional healers. Also called alternative medicine, traditional medicine or complementary medicine remains associated for millennia to myths, legends, rituals and beliefs. This paper gives an opinion regarding ethnobotanic approach associated to the structural variability of some polysaccharides, with the purpose to design the polysaccharide-based drugs of tomorrow. Traditional healers practice unconventional medicine based on approaches considered traditional in many communities, such as in Asia, India, Africa and South America. This medicinal practice is used to prevent or treat certain diseases or disorders but can also improves in some cases the quality of life, using the biodiversity of medicinal plants. It is therefore through an ethnobotanist approach that biomolecules (e.g. polysaccharides) of pharmaceutical interest can be discovered [1]. This approach involves the screening of medicinal plants that are known and recognized for their therapeutic effects (Figure 1). The second step is to identify the biological effects by performing tests on decoctions prepared from these plants. Once the identification is validated, specific extractions of active biomolecules are carried out in order to characterize and optimize their biological effectiveness. In the longer term, if the development of a new drug is considered, cytotoxicity and biocompatibility tests must be validated at the human cell level before clinical studies can be performed [2]. Consequently, the delay between the traditional practitioner and the placing on the market of a new active biomolecule is particularly long.

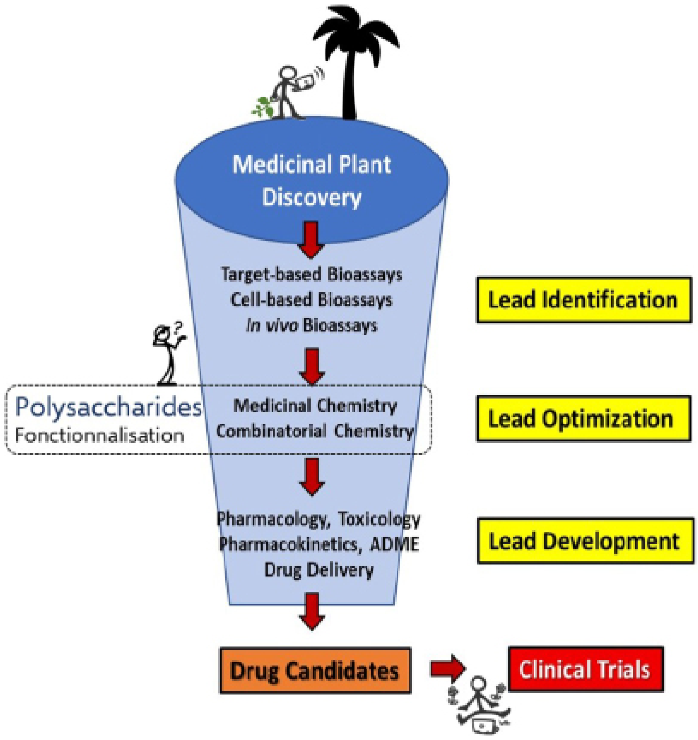

Figure 1: Strategy for finding and developing new active polysaccharides from medicinal plants, adapted from Qazi Majak and Molvi Khurshid [2].

Dry lands, i.e., arid and semi-arid zones, possess specific climates, characterized by very low rainfall and extreme temperatures, which are at the origin of the emergence of a specific flora and fauna, sometimes endemic to this environment. As is often the case, this adaptation of organisms to a singular environment has been followed by the appearance of new biological functions and specific metabolites. Far from being devoid of plant life and despite its very mineral appearance, desert areas, such as Sahara, do not avoid this rule and the characterization of its flora has already allowed to identify many species described anywhere else. The inventory of this fragile biodiversity is partly motivated by the search for new active ingredients that can eventually become one way for the preservation of species in this environment. Indeed, many plants from arid and semi-arid environments are used by local populations in traditional medicine for their therapeutic properties. The change in lifestyle of these populations and the use of modern therapeutic practices are at the origin of the gradual disappearance of these uses and part of the ethnobotanical knowledge accumulated over the centuries. The identification of plant compounds at the origin of these practices is therefore of prime interest for the preservation of this flora and its possible exploitation. Applied to polysaccharides, this observation is particularly true in the context of plants from desert environments. Indeed, plants growing in hot and arid climates must cope with sometimes very long periods of dormancy and fight against lack of water. This adaptation endowed these plants with a certain number of physiological particularities allowing them to limit the loss of water and to accumulate storage substances. Polysaccharides play a leading role in this adaptation. These polymers are for the most part hydrophilic because of their numerous hydroxyl functions. This strong affinity for water gives them the status of hydrocolloids with thickening, gelling or stabilizing properties. The physiological roles of these polysaccharides are to maintain the structure of plant tissues or store carbon substrates. These two biological functions have long been the only ones attributed to polysaccharides. However, it is now accepted that these biopolymers can also carry biological activities and be strongly involved in certain cell signaling pathways. The inventory of existing structures is still very incomplete, and its exploration is often associated with the identification of novel polysaccharides carriers of biological activities and therefore to understanding structure-function relationships, in particular to explain the uses of certain plants traditional medicine. Overall, this scientific philosophy aims to explore the potential of arid and semi-arid plants as a source of polysaccharides with original structures and, secondly, to correlate these structures with biological activities and technofunctional properties potentially recoverable. It is important to remember that the study of plant polysaccharides goes first and foremost by the awareness of the great structural variability partly related to their numerous biological functions. Most often separated into three categories, there are (i) storage polysaccharides (starch, galactomannan) (ii) structural polysaccharides (celluloses, hemicelluloses, pectins) and (iii) exudates, gums or mucilages (gum arabic). Note that the difference between gums and mucilage still remains ambiguous since the former are rather sticky and come from the area of trees, while the latter are viscous hydrocolloids from seeds or soft tissues [3]. Polysaccharides constituting the mucilage are often polar and hydrophilic with very high molecular weight and are also highly branched and composed of different monosaccharides [4]. The physiological role of mucilage is not negligible since it allows the plant to absorb and store significant amounts of water. If necessary, the gradual release of water to other tissues is possible in times of drought. Conversely, in the presence of excessive amounts of water, swelling of the mucilage can lead to tissue breakdown. Finally, polysaccharides from higher plants have structural variability and a wealth of unique physicochemical properties. Herbs and officinal plants, often containing polysaccharides, are widely used for the treatment of diseases in traditional and modern medicine (ethnobotany and ethnic medicine). The originality of studying their polysaccharides often goes through their endemism and ability to secrete mucilage through specialized cells [5]. For several years, looking for new sources of plant polysaccharides, if possible with analog structures to glycosaminoglycans, has attracted much attention. In all cases, the work involves (i) identifying and/or collecting and/or cultivating original sources (ii) developing the conditions for extraction and purification of the polysaccharides produced, (iii) characterizing the polysaccharide structure(s) (i.e., composition in monosaccharides, glycosidic bonds, analysis of the substituents, ...), and finally (iv) identifying their physicochemical properties in solution (rheological studies) as well as some of their biological properties (anti-inflammatory, anti-oxidant, anti-microbial, anti-coagulant, anti-parasitic, prebiotic, ...). Today, paying more attention for better understanding the so-called structure/function relationships by exploiting the data already available for existing molecules seems to be essential. The resolution of complex structures of polysaccharides is one of the current locks concerning their uses and valuations. Apprehending the roles of these polymers is probably one of the challenges of the coming decades. A better structural overview would make it possible to highlight new possibilities of applications but also to address more fundamental problems such as the role of certain glycoside units, constituents or specific sequences on very varied functional activities (mechanistic approach). Taking inspiration from Nature and making your own polymers (glycosaminoglycan mimetics) by enzymatic and/or chemical modifications seems to be a “first class” front of sciences. This global strategy is applied in our laboratory (Institut Pascal, Université Clermont-Auvergne) in the PHC TASSILI program of EGIDE (15MDU933) and Campus France (33195UK).

Conflicts of Interest

All authors declare no conflicts of interest in this article.

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