Parmeliaceae- An Important Family of Lichens with Medicinal Importance

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Introduction

Life always coexists with disease, death and decay. To sustain a healthy and happy life, man has been applying his knowledge to discover the remedies for prevention and treatment of diseases since the human civilisation began. Plants were the natural sources mainly on which people totally depended to fight against diseases when there was no alternative.

The Parmeliaceae is the most diverse and large family of the order Lecanoromycetes. It has 87 genera which have more than 2000 species. It is considered as the largest family of fungi which forms lichens (These are the fungi which has a symbiotic relationship with algae). The main genera in the family are: Xanthoparmelia have more than 800 species, Usnea with more than 500 species, Parmotrema with more than 350 species and Hypotrachyna with more than 190 species.

Most of the members in the family have a symbiotic relationship with algae. The majority of species in Parmeliaceae have a fruticose, subfruticose or foliose form of growth. The huge variation in morphology and complexity is observed in members of this group. The family can be found in a wide range of climatic regions and habitats and has a cosmopolitan distribution. They can be found everywhere from alpine rocks to roadside pavement, from subshrubs in the arctic tundra to tropical rainforest trees. Members of this family can be found in almost all kinds of terrestrial environments.

Characteristics of Structure

• Thallus
• Apothecia
• Spores

Thallus

Parmeliaceae thallus is mostly fruticose, foliose or subfruticose but also can be caespitose, umbilicate, peltate, subcrustose or crustose. They can be seen in different colours from green to yellow, whitish to grey, or brown to black. Many genera are lobe forming. Species are usually rhizinate on the lower surface occasionally with rhizohyphae, hypothallus, or holdfasts. Epicortex the upper surface may have non-pored or pored surface. Medulla is often loosely woven but sometimes it is solid. Lower surface is naked in only some genera for example Menegazzia, Usnea and Hypogymnia. (literature at the burkes luck lichen trail, supplied by professor dirk wessels of the university of the north)

Apothecia

Apothecia are lecanorine and they are produced along the margin or lamina and pedicellate to sessile and sometimes sunken. Thalline exciple is concolourous with the thallus. Asci are amyloid along with the majority of species having 8 spores per ascus, few species have many spores and many species of Menegazzia have 2 spores per ascus.

Spores

Ascospores are often small, simple and hyaline. Conidia usually arise laterally from the joints of conidiogenous hyphae (Parmelia type), but arise terminally from these joints in a small number of species (Psora type). The conidia can have a wide range of shapes from bacilliform to fusiform, cylindrical, bifusiform, curved, unciform, sublageniform or filiform. Pycnidia are rarely emergent from the upper cortex or immersed are produced along the margins or lamina, pyriform shaped and can be seen from black to dark-brown in colour.

This family mostly contain lichens. Lichens are fungi which forms a symbiotic relationship with green alga or blue green alga (cyanobacterium) or both. These can be found almost in all type of habitats and substrates.

Linnaeus recognised and classified nearly 80 species in 1753. Erik Acharius called the father of lichenology was the first scientist who seriously studied lichens and also described many new species but Schwendener was the one who discovered the dual nature of lichens in 1869 before that the green structures within lichen were believed to be gonads but were actually green alga. The estimated number of lichen species range from 13,000 to 30,000 worldwide. The majority of the lichens belong to family Ascomycota in which spores are produced inside asci. The evolution of lichens is very old; the oldest evidence of fossil lichen is from the Rhyne chert formation in Scotland which dates back to 400 million years ago.
In the lichen symbiosis, fungal partner is called mycobiont and algal partner is called photobiont. The mycobiont protects photobiont against dehydration and harmful UV radiations which enables the algal partner to survive in habitats which would be generally inaccessible. The mycobiont is also responsible for the shape and sexual reproductive structures of lichens. The photobiont plays its role in carrying out photosynthesis and producing carbohydrates which are metabolised by fungus. The characteristic unique secondary metabolite of lichen is actually produced by the mycobionts. If blue green alga is partner in symbiosis then the mycobiont can obtain nitrogen compounds because this alga is capable of fixing atmospheric nitrogen. Generally nutrients and water are taken directly through the surface of the lichen because of this they can even survive in low rainfall or moist regions.

Lichens are of different shapes and forms. They typically grow on bark, rock and soil but they can also grow on leaves, roof tiles, asphalt, metal surfaces and many other surfaces. Lichen body which is called thallus is composed of upper cortex containing tightly packed fungal hyphae below which is the photosynthetic algal layer. Below this layer there is loosely woven cottony layer of fungal hyphae called medulla where most of the secondary metabolites are deposited as crystals. The fungal layer determines the secondary metabolites and is useful for identification. Compared to plants, lichens grow very slowly ranging from less than a millimetre per year in case of micro-lichens to almost 10 cm per year in case of macro-lichens. Lichens are generally classified based on their growth form which is artificial classification system but used mainly for identifying lichens. The most common categories are crustose, fruticose and foliose. Crustose lichens have a thallus which forms a blotch on the substratum on which it grows and is very difficult to remove without cutting a part of it. Fruticose lichens are bushy, pendulous or upright position. They are highly branched which helps in increasing the surface area. Foliose lichens appear flattened with a distinguishable upper and lower surface and they can be easily removed using a knife.

In Australia approximately more than 3500 species of lichens have been recorded and more than 35% of these are regarded as endemic (McCarthy 2009). They are greatest in numbers in Queensland (1796 species) which also contains endemic (260 species), followed by NSW (1498 species) which contain 112 endemic species, then by Tasmania (1063 species) which contains 102 endemic species.

**Economic importance of Lichens**

Lichen is derived from the Greek word ‘Leprous’ and refers to medicine used for treatment of skin diseases because of their appearance as peeling skin. Lichens are used as source of food in many regions. For example cetraria islandica was used as food in Northern Europe and was cooked as porridge, soup, bread, salad and pudding. Some lichens known as Earth Flowers have a strong and distinct odour so they are smoked along with tobacco used in summer dances (Curtin, LSM. 1984).

Lichens such as Bryoria fremontii were mostly used as food in times of famine in North America so they were called famine food. The extracts from lichens are used to dye wool and for production of ‘Harris Tweed’ of Scotland. They are also used in the manufacture of ‘moss’ and ‘leather’ fragrances in perfumes and some type of soaps (Richardson, D. H. S. 1974). In China, lichens are used as food (Lobaria isidiophra, L. yoshimurae) and also as health promoting tea (Thamnolia subuliformis, Lethariella cashmeriana).

**Medicinal importance of Lichens**

The metabolites (mainly secondary) produced by lichen exerts wide range of medicinal and biological properties like antimycobacterial, antiproliferative, antiviral, antibiotic, anti-inflammatory, cytotoxic, algescic and antipyretic effects. Though their potential is known but they have not been explored fully (Muller, 2002). The secondary metabolites are the main compounds that are utilised for medicinal purposes (Boustie and Grube, 2005).

According to estimation more than half of the lichens are metabolites that are utilised for medicinal purposes (Boustie and Grube, 2005). The extract from acetone, chloroform, diethyl ether, petroleum ether and methanol of Parmelia sulcata Taylor, Parmelia sulcata exhibited antibacterial activity against Bacillus subtilis, Candida albicans and many other bacteria (Candan et al, 2007). Parietin and anthraquinone isolated from Caloplaca cerina methanol extract have demonstrated antifungal activity (Manojlovic, 2005). Phenolic constituents from lichen...
Parmotrema stuppeum include orsennilic acid, methyl orsennillate, lecanoric acid and atranorin exhibited antioxidant activity (Jayaprakasha and Rao, 2000).

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