

# STUDY OF THE LICHENS OF THE MEHDIA' KASBAH, HISTORICAL MONUMENT OF KENITRA, MOROCCO

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DOI: [10.5281/zenodo.13267908](https://doi.org/10.5281/zenodo.13267908)

## Abstract

The aim of this study is to inventory and describe the lichenic flora that colonizes the Kasbah walls of Mehdia (Ksar Moulay Ismail), a historical monument in Kenitra. The Kasbah of Mehdia had an aesthetic and architectural value and has suffered over time various alterations. Building materials around the world are exposed to various degradation factors and alteration caused by the climate, living things (biological) and time. The alterations of the monuments can be grouped into three main categories: physical, chemical and biological. The lichen species encountered are *Dirina ceratoniae* Mont., (1849), *Dirinamassiliensis* f. *massiliensis* Durieu & Mont., (1848), *Roccellaphycopsis* (Ach.) Ach., (1810) and *Verrucaria minor* Breuss, (2007). These species can cause with other environmental factors the deterioration of building materials of the Kasbah. Lichens can be the cause of modifications of the surfaces of the stones of the monuments by the bio geophysical and bio geochemical processes. Bio-geophysical changes are caused by hyphal penetration beneath the stone surface and contraction and expansion of the lichen and chemical alterations produced by lichens are due to the substances they secrete: oxalic acid, the carbon dioxide produced by respiration.

**Keywords:** Kenitra, Kasbah of Mehdia, Morocco, Monument, Lichen and Deterioration.

## 1. INTRODUCTION

The Kasbah of Mehdia is one of the historical symbols of the city of Kenitra. It is located 8 km from Kenitra on the left bank of the mouth of Oued Sebou and occupies an area of about 40 hectares. The Kasbah was built in the sixth century BC by the suffete Hannon, the first magistrate of Carthage, and was restored in 1185 by Sultan Yacoub El Mansour [1], by Sultan Moulay El Hassan and by his successor Moulay Abdelaziz in 1895 [2].

Kasbah Mehdia had an aesthetic and architectural value and has suffered over time various alterations. Building materials around the world are exposed to various degradation factors and alteration: the climate, living things (biological) and time [3]. The alterations of the monuments can be grouped into three main categories: physical, chemical and biological.

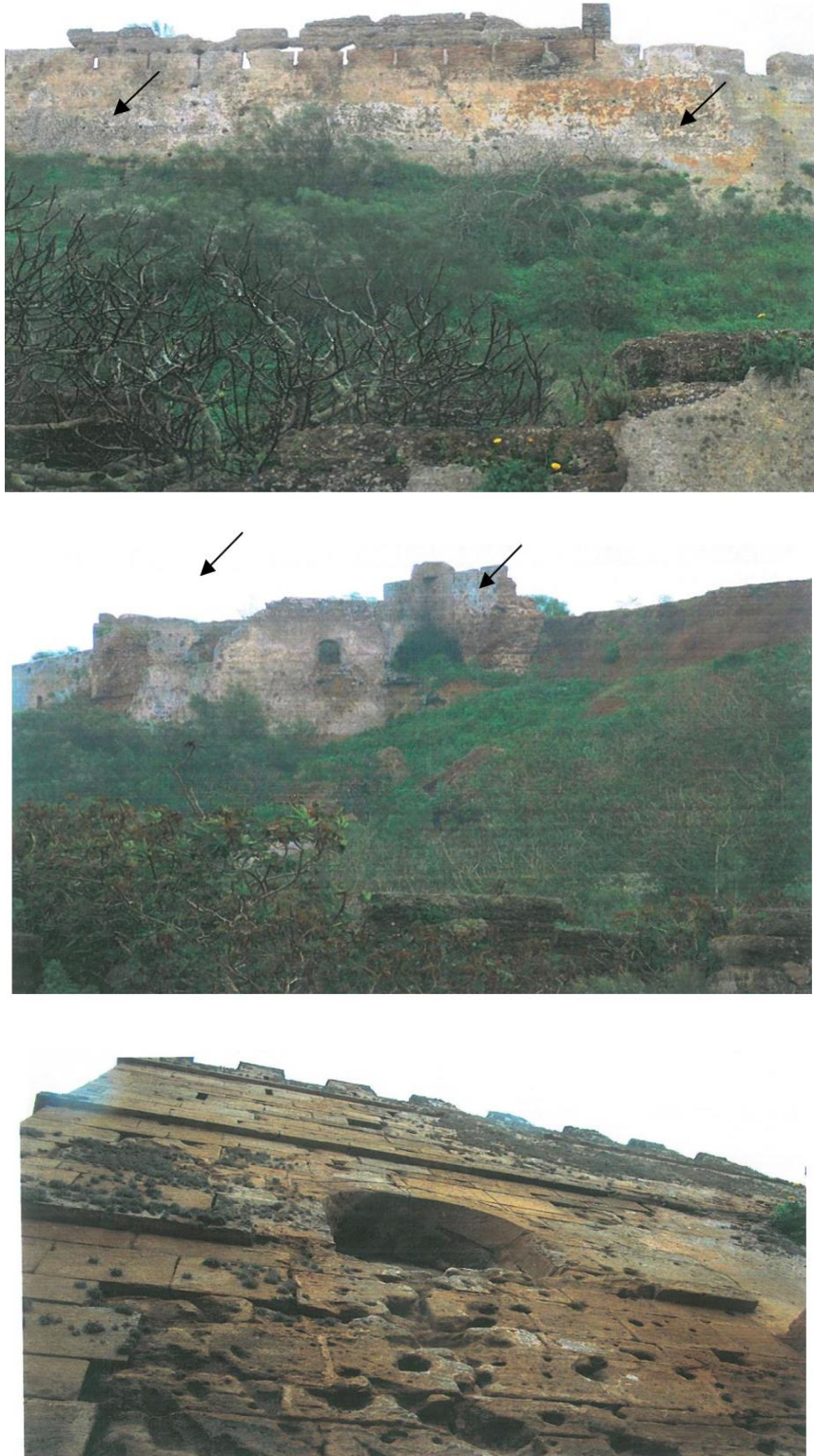
The present study aims to inventory and study the lichens that colonize the building materials of the Kasbah of Mehdia.

## 2. MATERIALS AND METHODS

Surveys conducted regularly during the year in the kasbah of Mehdia have identified a number of lichen species. Harvested species are brought back to the laboratory for study and analysis. To facilitate the determination of the species, it is interesting to carry out a microscopic study and to use chemical reagents, case of KOH with 10% of the sodium hypochlorite, the cotton blue in order to advance in identification keys.

### 3. RESULTS

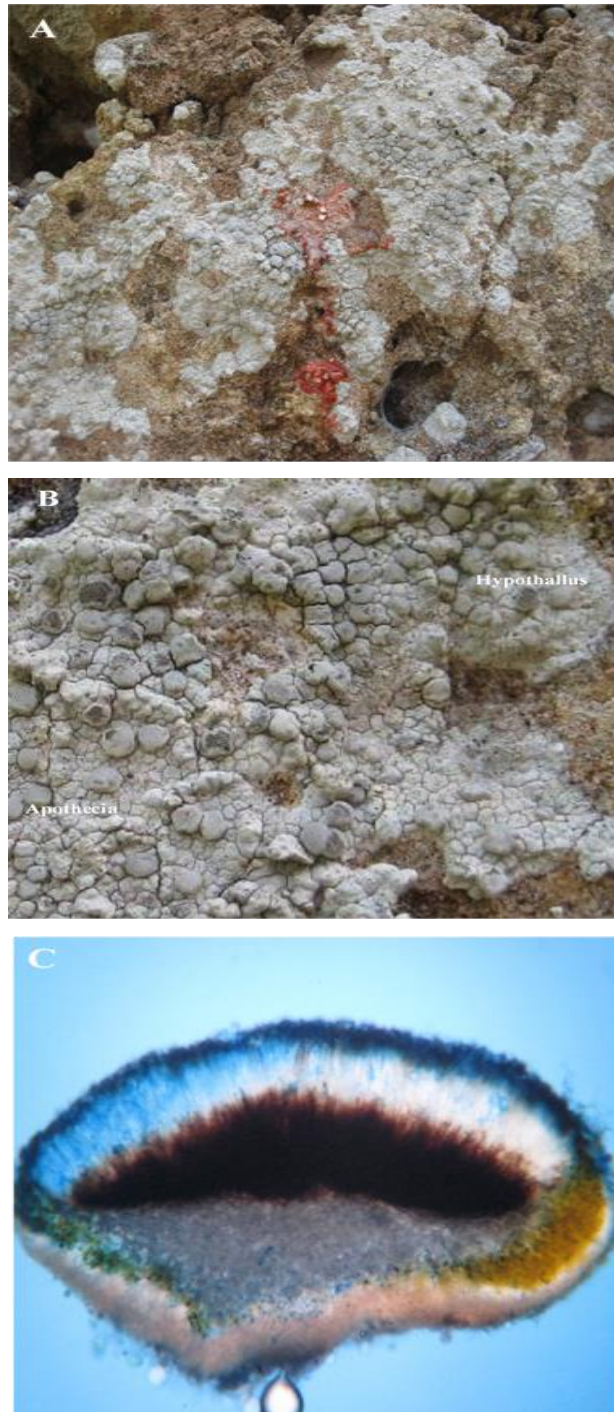
The species found in Kenitra' Kasbah (Figure 1) are *Roccella phycopsis*, *Dirina ceratoniae*, *Dirina massiliensis* f. *massiliensis* and *Verrucaria minor*.



**Figure 1: Development of lichens (L) on the walls of the Kasbah of de Mehdiya (A, B and C)**

### 3.1 *Dirina ceratoniae*

This species was collected on 20/04/2013 on a limestone rock. The thallus, 4 cm in diameter, is crustacean, whitish-gray in color, with a smooth, thick, solared surface. It is limited by a whitish gray hypothalle (Figure 2 B). The thallus becomes red under the effect of sodium hypochlorite (Figure 2A). Apothecia, 1 to 1.8 mm in diameter, are whitish gray, the margin is thallus-like, the disc is covered with whitish-gray pruinias. The hypothecium is black (Figure 2 C). The asci, 24 x 4  $\mu\text{m}$ , contain 8 ascospores, elliptic and hyaline (Figure 2 D).

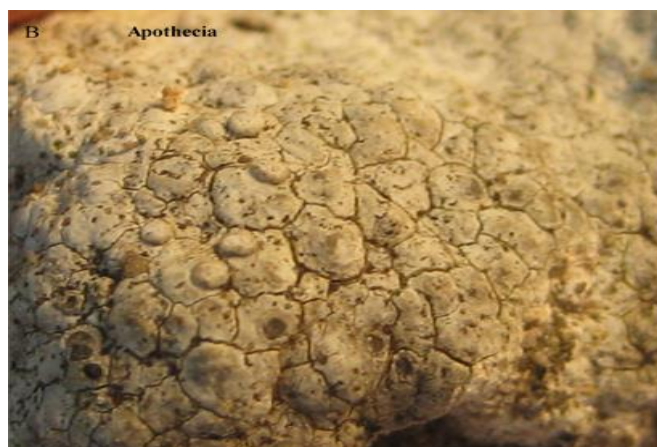


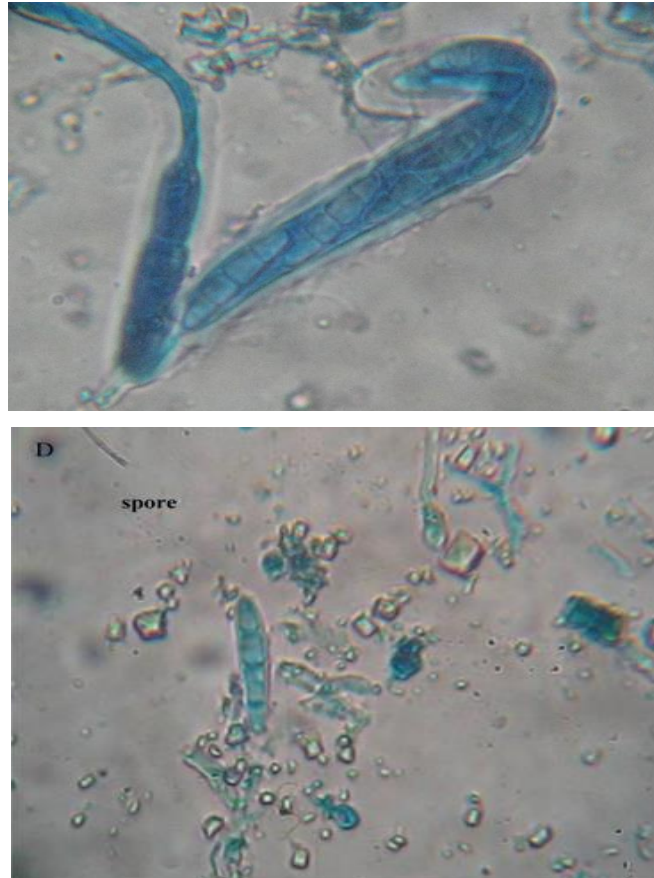


**Figure 2: *Dirina ceratoniae*: Effect of sodium hypochlorite on thallus (A), Apothecia (B), cut of apothecia (C) and spore (D).**

### 3.2 *Dirina massiliensis* morpho. *massiliensis*

This species was collected on 20/04/2013 on a limestone rock. The thallus is crustacean, measuring 2.5 cm in diameter, smooth, whitish-gray (Figure 3 A). The thallus does not react with sodium hypochlorite. Apothecia, 0.5 to 0.8 mm in diameter, are whitish gray, the margin is thalid (Figure 3B), the disc is covered with whitish gray pruinias. The mortgage is black. Asci contains 8 ascospores (Figure C); elliptical hyaline and measure (22.64x 6.32  $\mu\text{m}$ ) (Figure D).



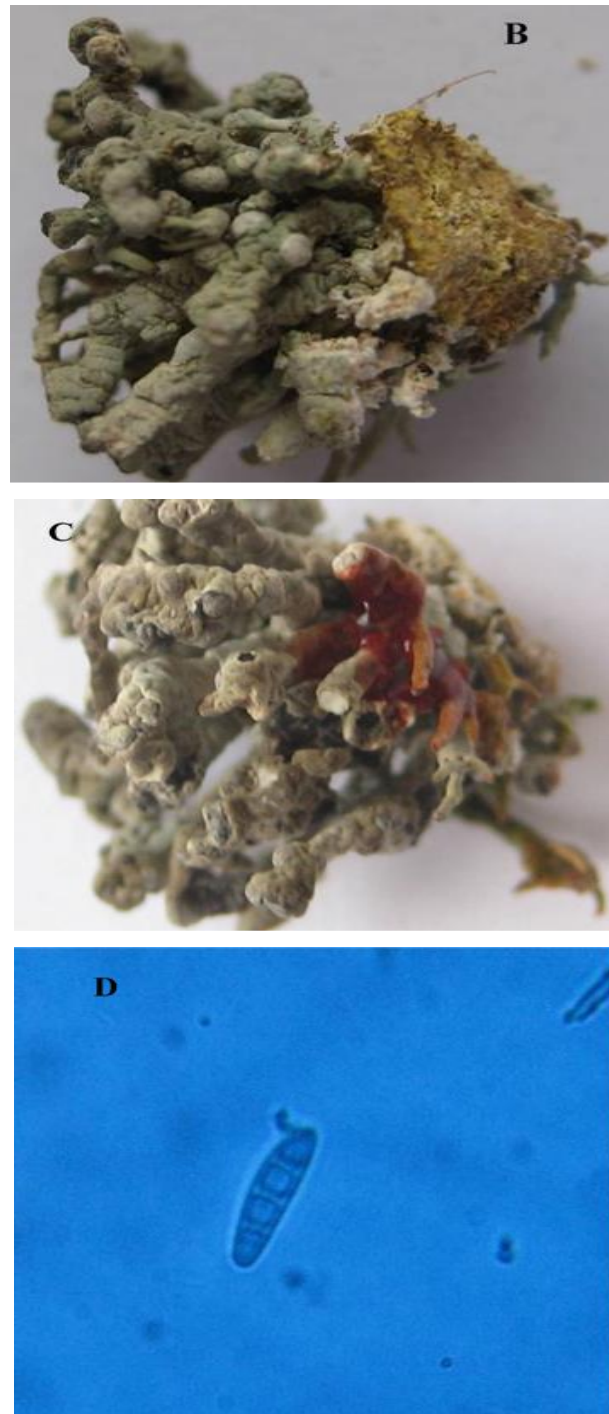


**Figure 3: *Dirina massiliensis* morpho. *massiliensis*: Thallus (A), apothecia (B), asque (C) and spore (D).**

### **3.3 *Rocella phycopsis* Ach.**

This species was harvested on 20/04/2013 on a limestone rock. The thallus is fruticulous, measuring 1 cm in length and 1.5 cm in width, of gray color, generally erect, cylindrical straps, 0.6-1 mm thick, dichotomous branches, the division being mainly towards the end (Figure 4 A); the medulla of the crampton is yellow (Figure 4 C). The thallus becomes red under the effect of sodium hypochlorite (Figure 4 B). Apothecia are terminal, measure 0.5 to 1 mm in diameter. The edge of apothecia is thallus-colored. The disc is blackish gray and covered with whitish gray pruinas. The spores (23-6.66  $\mu$ m) have 3 septa, fusiform and hyaline.

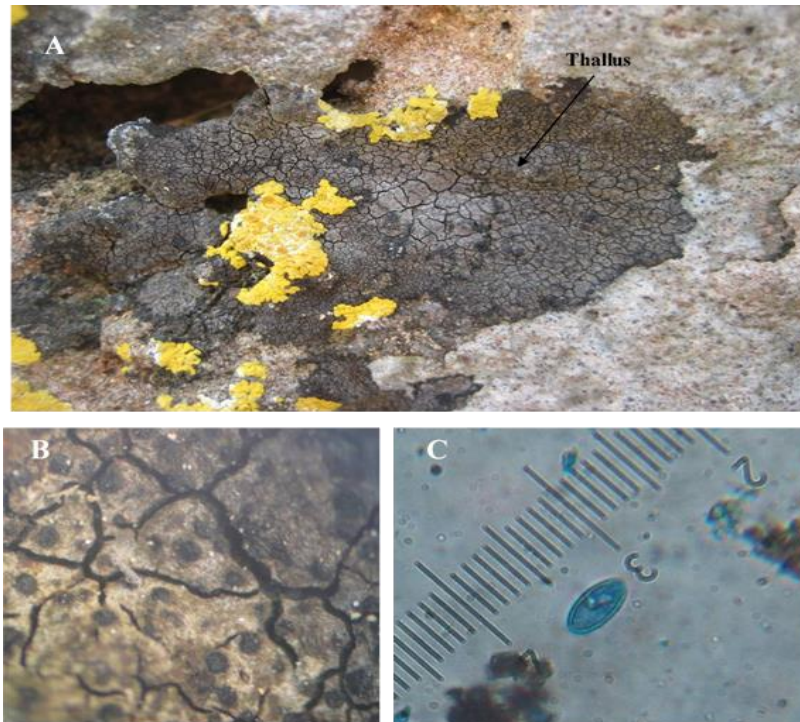




**Figure 4: *Roccella phycopsis*: Thallus with black apothecia (A), yellow spike (B), effect of sodium hypochlorite on thallus (C) and spore (D).**

### **3.4 Verrucaria minor**

The species developed on a limestone rock, harvested on 20/04/2013, the thallus is crustacean, areolate blackish brown, matte more or less smooth (Figure 5A). Areoles flat or slightly convex. The protothalle of black color. The perithecia are semi-recessed in the thallus, black in color, solitary or grouped, measuring 0.1 to 0.2 mm in diameter (Figure 5B). The asque measures 46.62-16  $\mu\text{m}$ . Each asque contains 8 ascospores, hyaline, single (Figure 5C) and measure 17.48-7.82  $\mu\text{m}$ .



**Figure 5: *Verrucaria minor*: Thallus (A), black perithecia (B) and spore (C).**

#### 4. DISCUSSION

The species found in the Kenitra Kasbah are different. *Roccella phycopsis*, *Dirina ceratoniae* are very abundant as *Dirina massiliensis* morpho. *massiliensis* and *Verrucaria minor*.

*Roccella phycopsis* has been found in the walls of the Kasbah Gate and in areas where the substrate is exposed to the humid winds of the sea. It covers a few centimetres above ground level and, according to Liscia et al. [4], thallus are always fixed vertically to the substrate.

*Dirina ceratoniae* was noted on the walls in the center of La Kasbah. *Dirina massiliensis* morpho. *massiliensis* and *Verrucaria minor* were found in the same place, fixed on the rest of the rocks inside the kasbah. Giacobini [5], reported *Dirina massiliensis* on the marble portal of Orvieto Cathedral where it causes corrosion. Seaward and Giacobini [5] confirmed the corrosive effect of this species on *Caprarola farnesis* frescoes. It has also been observed on granite, trachyte, and basalt northwest of Sardinia [4].

*Verrucaria minor* has been reported on sandstone, basalt and granite in temperate and semi-arid localities [6].

Lichens colonize different types of substrates. We find them not only on the bark of trees, rocks, soil and wood but also on mosses, evergreen leaves and on man-made substrates such as worked wood (fences, white,...) [7]. They are common organisms all around the earth, they have the ability to colonize a wide variety of stones, including materials. Lichens play an important role in the biodeterioration of stones because of their ability to grow on a variety of substrates under a wide range of environmental conditions [8; 9; 10; 11].

Lichens can be the cause of modifications of the surfaces of the stones of the monuments by the bio geophysical and bio geochemical processes. Bio-geophysical changes are caused by hyphal penetration beneath the stone surface and contraction and expansion of the lichen [12]. Chemical alterations produced by lichens are due to the substances they secrete: oxalic acid, the carbon dioxide produced by respiration [13].

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