

Study of Some New Entolomes Species for Fungal Flora of Morocco

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Abstract— In this study, four species of *Entolomataceae* family, were studied namely *Entoloma papillatum*, *Entoloma rhodopolium*, *Nolanea hirtipes* and *N. cucullata* are harvested for the first time in Morocco. The genus *Entoloma* species were encountered in *Quercus suber* in the forest of Mamora (Northwestern Morocco) and those of the *Nolanea* genus under *Quercus rotundifolia* in the forest El Harcha (Northeast of the Central Plateau).

Keywords— *Entolomataceae*, *Entoloma*, *Nolanea*, *Mamora*, *Morocco*.

I. INTRODUCTION

The genera *Entoloma* (Fr. ex Rabenh.) P. Kumm., (1871) and *Nolanea* (Fr.) P. Kumm., (1871), belong to the *Entolomataceae* family (Order of Agaricales, Subclass Agaricomycetidae, Class of Agaricomycetes, Sub Division of Agaricomycotina, Division of Basidiomycota, Kingdom of Fungi) (Kirk *et al.*, 2008).

Most of entolome species of *Entolomataceae* are saprophytes; they develop on organic debris such as twigs, dead leaves and the corpses. However, there also exist lignivores species that live in symbiosis with different autotrophic plants (Perraudin, 2002), case of *Entoloma lividoalbum* (Kühner & Romagn.) M. M. Moser., (1978), *Entoloma nidorosum* (Fr.) Qué., (1872), (= *Entoloma rhodopolium* (Fr.) P. Kumm., 1871) and *Entoloma politum* (Pers.) Donk, (1979) which are ectomycorrhizal fungi (Nounsi *et al.*, 2014).

The entolome are characterized by a silhouette type of pleurotoïde, omphaloïde, collybioïde, mycenoïde ou tricholomatoïde and fibrillose cap, squamulose and rough. Due to the great heterogeneity silhouettes of entolomes, the microscopic characters are fundamentals to determine the different species (Noordeloos, 1992).

Entoloma is the second biggest genera of the Agaricales. It is monophyletic and presents highly variable morphological characters (Co-David *et al.*, 2009). This genera represented by 1500 species, is well distributed all over the world, from the Arctic to tropical habitats (Romagnesi & Gilles, (1979) ; Horak (1980, 2008) ; Noordeloos, (1981, 1992, 2004) ; Largent, (1994) ;

Manimohan *et al.*, (2006); Gates & Noordeloos, (2007, 2009); Noordeloos & Hausknecht, (2007)). The genus *Entoloma* is characterized by pink spores, angular and polygonal. These spores' forms are considered as important elements in determining the entolomes (Noordeloos, (1992); Manimohan *et al.*, (2006); Gates & Noordeloos, (2007); Horak, (2008) and Noordeloos & Gates (2009)).

Fries (1821) erected *Nolanea* as a "tribe" of *Agaricus* due to their pink spores. Whereas other authors have considered, according to microscopic characters as a genera (Dennis, (1953, 1970); Pegler, (1983, 1997); Largent & Baroni, (1988) and Largent, (1994)) or sub genera (Noordeloos (1981, 1992 and 2004)).

The species of the *Nolanea* genus are cosmopolitans and easily recognized as species belonging to the family of *Entolomataceae* (Agaricales) owing to their angular and pink basidiospores (Henkel *et al.*, 2014). They are mainly saprotrophic (Largent, 1994) and have a conical to convex cap, adnate lamina (they can be a little decurrent) and a fragile and often hollow stipe (Dennis, (1953, 1970); Pegler, (1983, 1997) and Largent, (1994)).

In this work, four species of *Entoloma* and *Nolanea* genera have been studied namely *Entoloma papillatum*, *Nolanea hirtipes* and *N. cucullata* collected for the first time in Morocco.

II. MATERIALS AND METHODS

Prospecting, carried out from winter to spring between 2010 and 2012, in the cork oak forest of Mamora (northwestern Morocco) and El Harcha forest (northeast of the central plateau) allowed us to encounter species of the genera *Entoloma* (Fr. ex Rabenh.) P. Kumm., (1871) and *Nolanea* (Fr.) P. Kumm., (1871). The specimens of these species were collected and brought back to the laboratory. Microscopic descriptions of carpophores focused on the morphological characters (shape, color, size, appearance...) well as other particularities of the cap and stipe (odor, taste ...). This description is completed by a microscopic description of spores and cuts at the hymenium, the cuticle, flesh and stipe. The dimensions of spores, cystidia,

basidia and sometimes sterigmata are measured via a micrometer wide-field eyepiece 10× (18mm) at scale 10 mm divided into 100 graduations (0.1mm). The microscopic observations have been conducted using an optical microscope (magnification × 400). The mounting liquid is tap water. The shape of the spores is obtained by calculating the quotient of the Bas (1969) according to the following ratio, $Q = \text{length (L)} / \text{width (l)}$.

Species identification was conducted by consulting the work of Kirk *et al.*, (2008); Roux, (2006); Courtecuisse & Duhem, (2000); Noordeloos, (1981, 1992 and 2004); Roger, (1981) and Malençon & Bertault, (1970).

III. RESULTS

The species *Entoloma papillatum* and *E. rhodopolium* were collected under *Quercus suber* in Mamora forest while *Nolanea hirtipes* and *N. cucullata* were collected under *Quercus rotundifolia* in the forest El Harcha (Northeast of the Central Plateau).

Entoloma papillatum (Bres.) Dennis, (1953)

Humicolous species collected under the *Quercus suber* on february 13, 2010 in the Mamora forest.

The cap (5 cm diameter) is circular, plano convex, smooth, hilly and beige-brown to brown in the center. The flesh is more or less thin and whitish. The margin is simple and straight. The stipe (2 × 0.2 cm) is cylindrical, central, fibrillose, hollow and pale beige. The blades are adnate, tight, potbellied, uneven and pinkish color. Involves edge breaking is toothed and regular.

The basidia (39.9 µm in length and 11.65 µm in width) hyaline, clavate, tetrasporic with sterigmata of 3.9 µm. The cheilocystidia (33.3 µm in length and 9.99 µm in width) are hyaline, clavate rounded apex and thick wall. The basidiospores (from 7.3 to 9.3 µm in length and from 6.6 to 8.3 µm in width) are globular, angular and more or less thick wall.

Entoloma rhodopolium (Fr.) P. Kumm., (1871).

Humicolous species collected on February 05, 2011 and December 21, 2012 under *Quercus suber* in the Mamora forest.

The cap (6.5 cm diameter) is circular, plano convex, smooth, flared and olive-gray color. The flesh, whitish, spongy, thick in the center and thinner towards the margins. The margin is smooth and curved. The stipe, whitish, is potbellied on top (7 × 0.75 cm), mitigated at the base (0.5 cm wide), central hollow, fistulous, spongy and fibrillose. The blades are emarginate, closely spaced, broad, uneven and greyish-white at pinkish reflection. Involves edge breaking is toothed.

The basidia (36.6 µm in length and 8.32 µm in width) are hyaline, clavate, tetrasporic with sterigmata of 2,3 µm.

Basidiospores (7.3 µm in length and 6.6 µm in width) are globose, angular and more or less thick wall.

Nolanea hirtipes (Schum. ex Fr.) Kummer, (1871).

Humicolous species collected on December 13, 2010 under *Quercus rotundifolia* in El Harcha forest.

The cap (2 cm diameter) is circular, convex and smooth, with a small nipple in the center, gray and beige. The flesh is thin and beige. The margin is ridged and more or less curved. The stipe (4-5 × 0.25 cm) is cylindrical, small, central, fibrillose, hollow, smooth and grayish in color. The blades are adnate, tightened, unequal, triangular and brownish gray color. Involves edge breaking is smooth and whitish.

The basidia (43.3 × 10 µm) are tetrasporic, hyaline and clavate. The sterigmata are of 6 µm. Basidiospores (from 6.6 to 9.9 × 6.6 to 8.3 µm) are globular, angular and with very visible germinal pore.

Nolanea cucullata (J. Favre, 1955) P.D. Orton, 1960

Humicolous species collected on December 20, 2012 under *Quercus rotundifolia* in the El Harcha forest.

The cap (1-1.5 cm in diameter) is circular, conical to plano convex, smooth and has a small nipple and dark gray color. The flesh is thin and gray. The margin is ridged, rolled up and black. The stipe (2 × 0.1 cm) is cylindrical, central, small, fibrillose, full fistulous and blackish gray color. The blades are free, closely spaced, potbellied, unequal and creamy color white with pinkish reflection. Involves edge breaking is smooth and whitish.

The basidia (33.3 to 40 µm in length and 9-10 µm in width) are hyaline, clavate, tetrasporic with sterigmata of 4 µm or bisporiques with sterigmata of 6.66µm. The cheilocystidia (43.3 µm in length and 8.3 µm in width) are hyaline, cylindrical with a rounded apex and thick wall. Basidiospores (8.3 to 10 µm in length and 6.6 to 8.3 µm in width) are globose, angular and more or less thick wall.

IV. DISCUSSION AND CONCLUSION

In Morocco, Malençon and Bertault, (1970) studied five genera (*Rhodophyllus* Quél., (1886), *Claudopus* Gillet, (1876), *Eccilia* (Fr.) P. Kumm., (1871), *Nolanea* (Fr.) P. Kumm., (1871), *Entoloma* P. Kumm., (1871) and *Leptonia* (Fr.) P. Kumm., (1871)) belongs to the Rhodophylloideae family (Entolomataceae). These two mycologists have encountered eight species belonging to the genus *Entoloma*, three of them have been described (*Entoloma lividoalbum* (Kühner & Romagn.) Kubička, (1975), *E. politum* (Pers.) Donk, (1979) and *E. sericeum* Quél., (1872)) and five species (*Entoloma clypeatum* (L.) P. Kumm., (1871), *E. lividum* Quél., (1872), *E. nidorosum* (Fr.) Quél., (1872), *E. prunuloides* (Fr.) Quél., (1872)) and *E. rhodopolium* (Fr.) P. Kumm., (1871))

reported in different regions of Morocco (Tangier, the Rif, Central Plateau, Forest of Mamora, coastal Meseta, Middle Atlas, High Atlas). These species are also cited in other bibliographic works (El Kholfy *et al.*, (2011); Laouz *et al.*, (2012) and Haimed *et al.*, (2013)).

Other works in Morocco concerned the species of this genus. El-Assfour (2006) studied four species: *Entoloma clypeatum* (L.) P. Kumm., (1871), *E. rhodopolium* (Fr.) P. Kumm., (1871), *E. sericeum* Quél., (1872) and *E. hirtipes* (Schumach.) M.M. Moser, (1978) in the Mamora forest. Larouz, (2007) reported three species in the Middle Atlas: *Entoloma nitens* (Velen.) Noordel., (1979), *E. lividoalbum* (Kühner & Romagn.) Kubička, (1975) and *E. vernum* S. Lundell, (1937). Haimed (2007) and Haimed *et al.*, (2015) studied two species in the Moroccan central plateau (northeastern Morocco): *Entoloma mougeotii* (Fr.) Hesler, (1967) and *E. rusticoides* (Gillet) Noordel., (1981). Similarly, Outcoumit (2011) reported two species: *Entoloma lividoalbum* and *E. undatum* (Gillet) MM Moser, (1978) in the Tangier region. In this study, *Entoloma papillatum*, encountered in the forest of Mamora, is new to the Moroccan fungal flora.

The genera *Nolanea* was also studied in Morocco by Malençon and Bertault, (1970). These authors described six species (*Nolanea africana* Maire, (1928); *N. clandestina* (Fr.) P. Kumm., (1871), *N. fusciceps* (Kauffman) Largent, (1971), *N. juncina* (Kühner & Romagn.) P.D. Orton, (1960), *N. mammosum* (L.) Hesler, (1967), *N. proletaria* (Fr.) Gillet, (1876)) and reported *Nolanea staurospora* Bres., (1881) in a marshy place near to Tangier We encountered for the first time *Nolanea hirtipes* (Schumach.) P. Kumm., (1871) and *N. cucullata* (J. Favre) P.D. Orton, (1960) in the forest of El Harcha and these two species can also be considered as new ones in Morocco.

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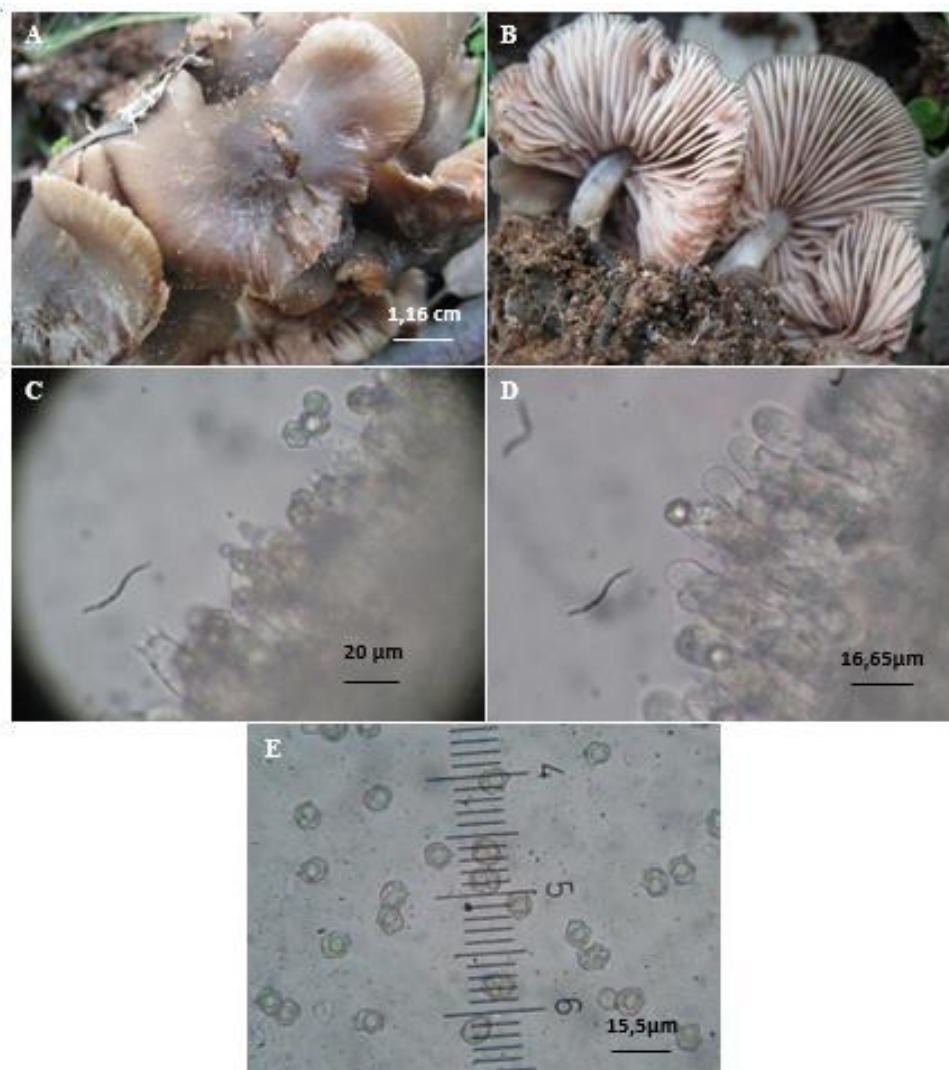


Figure: Cap surface (A), insertion of the blades (B), basidia (C), pleurocystidia (D) and basidiospores (E) of *Entoloma papillatum* ($\times 400$).



Figure: Cap surface (A), stipe and insertion of the blades (B), basidia (C) and basidiospores (D) of *Entoloma rhodopolium* ($\times 400$).

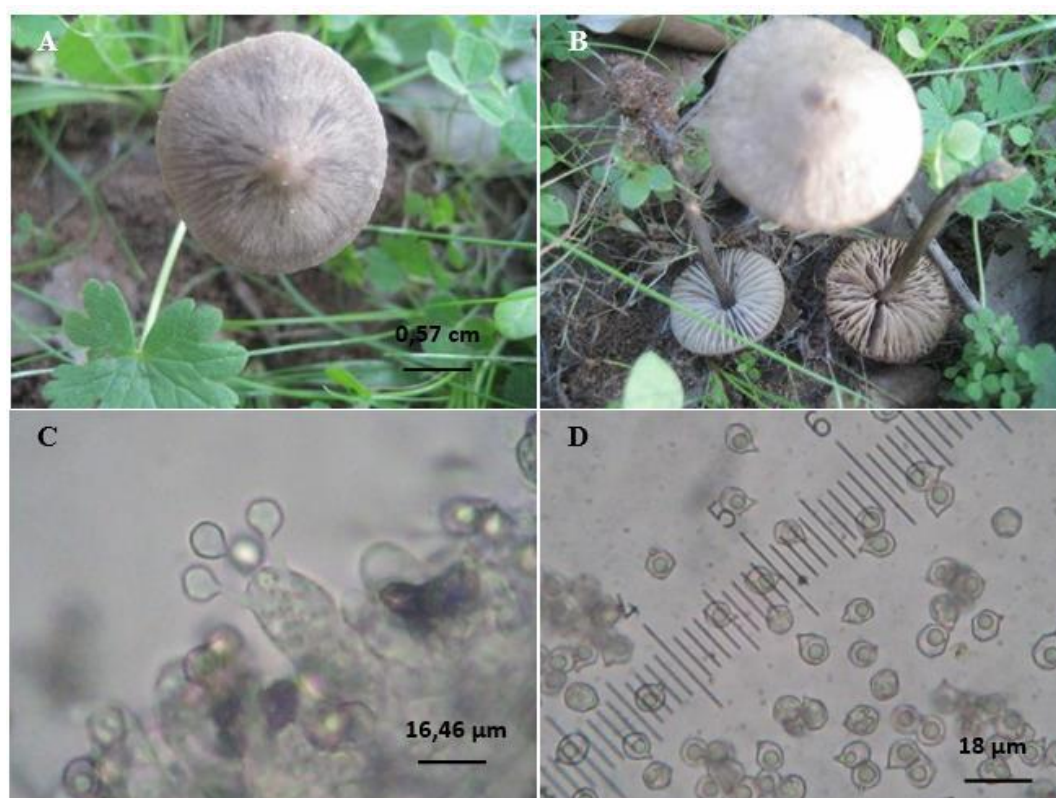


Figure1: Cap surface (A), stipe and insertion of blades (D), basidia (E) and basidiospores (F) of *Nolanea hirtipes* ($\times 400$).



Figure: Cap surface (A), insertion of blades (B), basidia (C), cheilocystidia (D) and basidiospores (E) of *Nolanea cucullata* ($\times 400$).