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FRUIT WALL ANATOMICAL STRUCTURE OF THE GENUS *BETULA* SECTION *LENTA* (BETULACEAE)

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Abstract. The fruits of the *Lentae* are referred to lower syncarpous nuts. Unlike most birches, the three-lobed scales in section *Lentae* stay attached to the axis for a long time. The fruit wall is differentiated into epicarp (derivative of outer tissues of inferior ovary, the tissues of receptacular origin) and the pericarp itself (mesocarp and the endocarp derivating from the ovary wall). The epicarp consists of two zones: epidermis and subepidermal zone. Two-four layers of larger sclerenchymatous cells represent the mesocarp. Several layers of parenchymatous cells, which are squeezed and partly obliterated by fruit maturity, compose endocarp. The morphogenetic type of fruit of the genus *Betula* section *Lentae* is the pyrenarium of the *Olea*-type.

Key words: *Betula, Lentae*, birch, fruit, pericarp, anatomy

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Introduction

The family Betulaceae s.l. consists of 6 genera and about 130 species (Chen *et al.* 1999). They are typical boreal plants (excepting *Alnus acuminata* Kunth). Generally the birch family has been studied in details, but the anatomical structure of the pericarp still remains underinvestigated. The genus *Betula* includes about 60 species (the number varies from 35 to 150 according to the source); they are common in the boreal, temperate and to a less extend in subtropical regions of Eurasia and North America. According to the latest revision of the genus *Betula* (Ashburner & McAllister 2013), the genus is divided into four subgenera: *Nipponobetula* A.K. Skvortsov (monotypic), *Aspera* Nakai (sections *Asperae* (Nakai) Kuzen and *Lentae* Regel), *Acuminata* Regel (monotypic) and *Betula* (4 sections). It was shown as the result of a combined analysis of morphological and paleobotanical data that recent representatives of the genus *Betula* section *Lentae* are closer to the ancestors of the genus described from the early Tertiary period (Ashburner & McAllister 2013). Based on AFLP markers Schenk *et al.* (2008) have revealed that only *Betula* section *Lentae* forms a well-supported group.

Representatives of the section Lentae are trees or large shrubs with dioecious flowers, clustered in catkins, like all other birches. Male catkins are terminal and pendulous female catkins are erect (Fig. 1). Inferior ovary is dimerous, with two threadlike stigmas divided at the base. Anemochorous winged and "nutlike" fruits, subtended by three-lobed scales comprising the catkins (Korchagina 1991). The fruits are referred to lower syncarpous nuts (Bobrov *et al.* 2009). Unlike most birches, the three-lobed scales in representatives of the section *Lentae*, don't fall down together with fruits but stay attached to the axis for a long time, sometimes during the winter period.

Material and methods

The anatomical structure of the fruit of four species of birches from section *Lentae* – *Betula alleghaniensis* Britton, *B. grossa* Siebold et Zucc., *B. lenta* L. and *B. medwediewii* Regel were studied using standard methods (Barykina *et al.* 2000) to reveal the zones of lignification in fruit wall by the reaction of phloroglucinol and hydrochloric acid. Material for research was received from Komarov Botanical Institute (LE).

Fig. 1. Common view of fruit catkins of *Betula grossa.*

Results and discussion

The fruits of the section *Lentae* species have two narrow lateral wings adhering to the styles. Their width varies from 0.5 mm (*B. medwediewii*; Fig. 2) to 0.8 mm (*B. lenta*). While the fruits' size ranges from 2.2×3.5 mm in *B. alleghaensis* (Fig. 3) to 3.5×4 mm in *B. grossa.*

In the representatives of the genus *Betula*, like other members of the birch family, the fruit wall is differentiated into epicarp (derivative of outer tissues of inferior ovary, the tissues of receptacular origin) and the pericarp itself (mesocarp and the endocarp derivating from the ovary wall) (Yatsenko *et al.* 2009; Yatsenko 2011). The epicarp consists of two zones. The outer zone is epidermis composed by one layer of small cells with transparent walls and dark content inside, and the next zone is subepidermal zone consisting of cells with transparent thickened walls. Two-four layers of larger sclerenchymatous cells represent the mesocarp. Several layers of parenchymatous cells, which are squeezed and partly obliterated by fruit maturity, compose endocarp (Fig. 4 A). At early development stages the endocarp fills in almost the entire cavity and remains not squeezed until maturity in sterile fruits. Maturing embryo grows and compressing the endocarp. Anatomically, the studied species of *Betula* section *Lentae* differ by the thickness of the mesocarp. It is thinnest in *B. medwediewii* (two layers; Fig. 4 C) and thickest in *B. alleghaensis* (four layers; Fig. 4 B). The external surface of the epicarp cells in *B. grossa* (Fig. 4 D) has notable wrinkled structure.

Conclusions

According to our results, the morphogenetic type of fruit type of the genus *Betula* section *Lentae* is the pyrenarium of the *Olea*-type (Bobrov *et al.* 2009). This is an indehiscent

Fig. 2. The scale of *Betula medwediewii.*

Fig. 3. The fruit of *Betula alleghaniensis.*

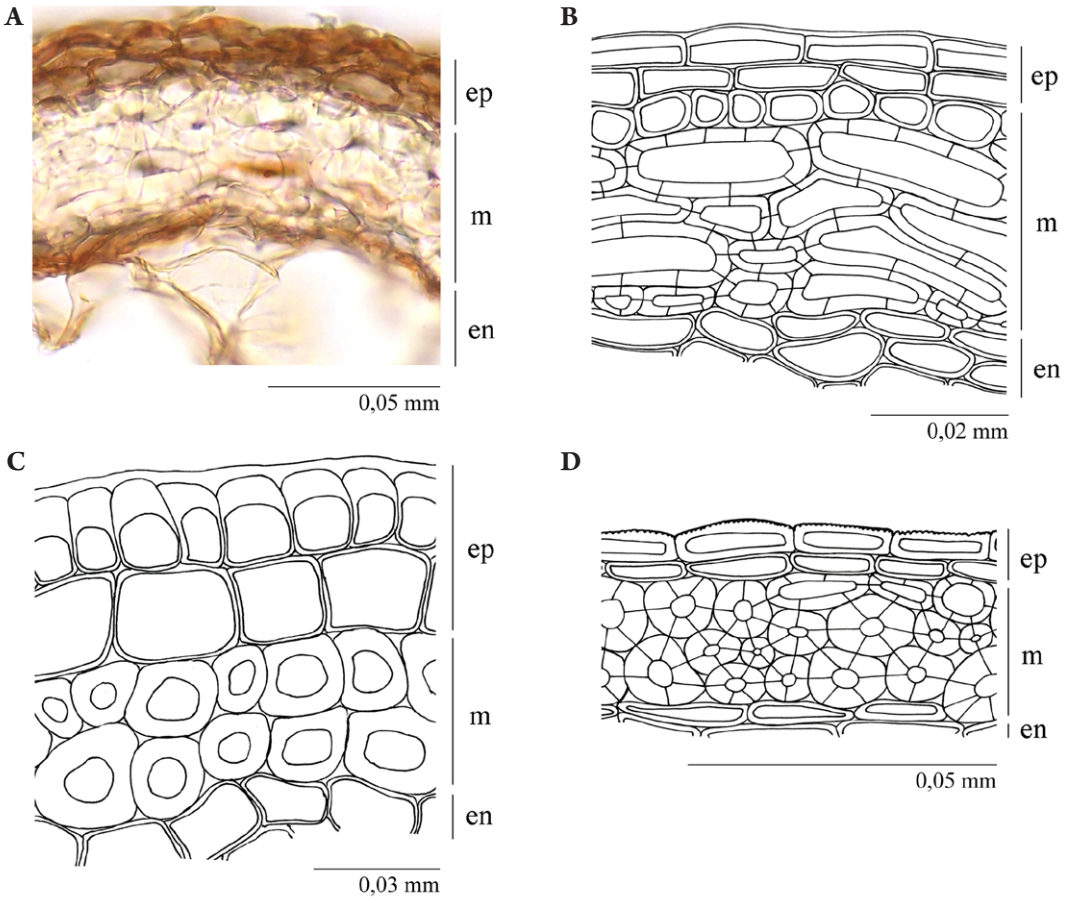

Fig. 4. Pericarp anatomy of the birch fruits: **A** – *Betula lenta*; **B** – *B. alleghaniensis*; **C** – *B. medwediewii*; **D** – *B. grossa*. **ep** – epicarp; **m** – mesocarp; **en** – endocarp.

fruit consisting of parenchymatous cells, excepting the stony mesocarp. We also find the pyrenarium of the *Olea*-type in the other genera in Betulaceae: *Alnus, Carpinus, Ostrya, Ostryopis* (Yatsenko *et al.* 2009; Yatsenko 2011; Yatsenko & Bobrov 2011). Generally the pericarp in the members of the genus *Betula* is reduced. We suppose, that it could be explained by their adaptation for anemochory. Further fruit wall anatomical studies (particularly the developmental researches) of other representatives of the family Betulaceae will provide us additional data for better understanding the origin of their fruit wall zones structure and the revealing principal modes of their evolution.

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