

Chemical composition of black walnut wood

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Abstract: *Chemical composition of black walnut wood.* In this study the content of basic components in the black walnut (*Juglans nigra* L.) wood was determined. The quantity of cellulose, lignin, holocellulose and substances soluble in ethanol was analyzed. The examined wood showed high amount of holocellulose (76.4%) and low amount of lignin (21.8%). Characteristic of exotic wood, the content of pentosans was low.

Keywords: black walnut, cellulose, lignin, extractives

INTRODUCTION

Wood as an organic material is a valuable raw material for the production of household items. Since ancient times, wood has been one of the most important building materials and to this day it is used in various sectors of industry. For the last few years, a growing interest in species originating from South America, North America, Asia and Africa has been observed in Poland. Import of wood from these areas makes the wood market more attractive increasing the demand of customers of the furniture industry and construction industry, which uses exotic wood, inter alia, for the production of parquets, door, windows and floors. Exotic species show different mechanical properties compared to native species and often have impressive patterns.

The amount of imported exotic wood continues to grow (Bidzińska, Ratajczak, 2004). The main importers of black walnut are: HDE Bracia Ludwińscy based in Szczecin and DLH Poland.

Understanding the chemical composition of exotic wood allows to expand the applicability of these species in various industry sectors. The content of the main and side components of wood depends on many factors, inter alia, growth conditions. Exotic hardwood species, compared to species of the temperate zone usually contain less pentosans, and more lignin.

The aim of this study was to determine the extractives and the content of chemical components in the black walnut (*Juglans nigra* L.) wood.

MATERIAL AND METHODS

The black walnut wood is a complete substitute for the Persian walnut (*Juglans regia* L.) native to Europe. The natural areas of occurrence of *Juglans nigra* L. are central and eastern parts of North America. The heartwood of this species is pale brown, to chocolate brown with purple shade. Quite often dark streaks are visible. Due to easy processing and aesthetic values, the black walnut is one of the species widely valued in the furniture industry, carpentry and the production of artistic products, woodcarving and musical instruments.

Samples of the black walnut wood were obtained from a sales company in the form of timber and were seasoned, then cut to small pieces with the use of a chainsaw, and next grounded with a Pulverisette 15 laboratory knife mill. The grounded material was sieved in order to extract a 0.5-1.0 mm analytical fraction. In order to examine the chemical

composition, according to the methodology recommended by Prosiński (1984), the content of the following compounds was defined:

- cellulose by means of the Seifert method;
- lignin by Tappi method;
- holocellulose with the use of sodium chlorite and according to PN-92/P-50092;
- pentosans with the use of phloroglucinol;
- substances extracted with ethanol with the use of Soxhlet device.

The contents of hemicellulose and hexosanes were determined by means of mathematical calculations.

RESULTS

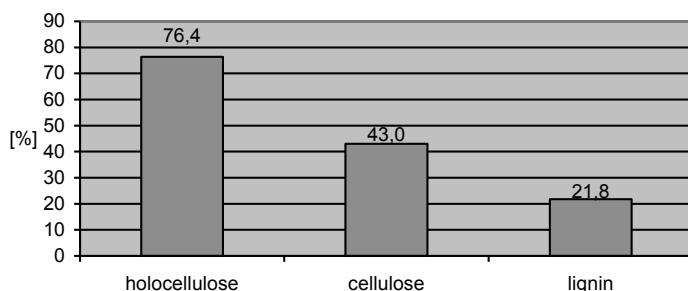


Fig. 1. The content of structural components in black walnut wood

The content of holocellulose in black walnut wood was high and amounted to 76.4% (Fig. 1). Compared to contemporary oak (Waliszewska et al. 2006), it was higher by about 10%. Also Pawlicka and Waliszewska (2011) reported smaller amounts of holocellulose for exotic wood species: koto (71.76%), sipo (64.28%) and mongoy (59.91%).

The amount of cellulose in *Juglans nigra* L. wood was 43.0% (Fig. 1). Similar amount of cellulose in exotic species (from 41.59% to 43.14%) is reported by Pawlicka and Waliszewska (2011). In the oak wood from the temperate climate, Prosiński reports 46.6% of cellulose. However, Waliszewska et al. (2006) state the amount of cellulose in exotic species at the level from 45.56% to 47.71%.

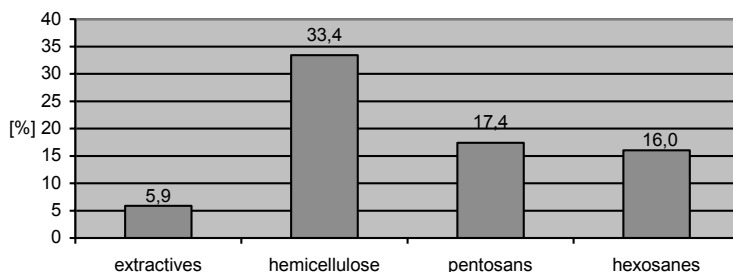


Fig. 2. The content of extractives and hemicellulose

A low amount of lignin, 21.8%, was determined in black walnut wood (Fig. 1). Exotic species are characterized by an increased amount of lignin in comparison to the amount of lignin in hardwood species of the temperate climate zone. Prosiński (1984) reported 23.8% of lignin in the wood of contemporary oak and Waliszewska et al. (2006) 24.67% of cellulose.

Exotic wood species such as teak, badi and iroko contain much more lignin, ie., 33.82%, 38.37% and 28.40% respectively (Waliszewska et al. 2006).

The amount of substances extracted with ethanol in the black walnut wood was 5.9% (Fig. 2) and was the same as in the oak wood from the temperate climate zone (Prosiński 1984).

Black walnut (*Juglans nigra* L.) contained 17.4% of pentosans (Fig. 2). It is a low content of these compounds in comparison to the amount of pentosans in contemporary oak wood. According to Prosiński (1984) the amount of pentosans in oak wood is 22.8%. A low amount of pentosans in exotic species (from 11.37% to 18.32%) is reported by Pawlicka and Waliszewska (2011). The mathematically calculated amount of hexosans in black walnut wood was 16.0%, and the total content of hemicellulose- 33.4%.

CONCLUSIONS

1. Black walnut (*Juglans nigra* L.) wood can be classified as a species with high holocellulose content.
2. Small amount of lignin amounting to 21.8% is characteristic of exotic hardwood species.
3. The amount of substances extracted with ethanol in the wood of black walnut was similar to the amount of these compounds in the wood of oak from the temperate climate zone.

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Streszczenie: *Skład chemiczny drewna orzecha amerykańskiego.* Drewno egzotyczne jest coraz bardziej popularne na polskim rynku. Ze względu na swoje odmienne właściwości, znajduje zastosowanie w wielu gałęziach przemysłu. W pracy oznaczono zawartość podstawowych składników w drewnie orzecha (*Juglans nigra* L.). Określono ilość celulozy, ligniny i holocelulozy oraz substancji rozpuszczalnych w etanolu. Badane drewno wykazywało wysoką ilość holocelulozy (76,4%) i niską ilość ligniny (21,8%). Charakterystyczna dla drewna egzotycznego, na niskim poziomie była zawartość pentozanów.

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