A comparison of methods for eucalypt wood removal extractives

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Abstract

This paper summarizes our research findings comparing two methods of extractive removals and their interference in the determination of the chemical constituents of eucalyptus wood.This work used six clones of *Eucalyptus* sp. from different locations of Minas Gerais. The samples were submitted to two extraction methods: the first method was the extraction with acetone and the second one was the complete extraction method with ethanol / toluene, ethanol and water. As the complete extraction used a combination of solvents, more quantity of extractives of different polarities were quantified using this methods comparing with acetone method. However, the removal method of wood extractives was not significant in the determination of other chemical constituents of wood. There was no statistically significant difference between the average levels of carbohydrates or soluble lignin and total of insoluble.

Keywords: eucalyptus; extractive removal; chemical constituents

Introduction

The structural components of wood are cellulose, lignin and hemicellulose. The extractives are the components outside the cell wall, but it can impregnate, they have low or medium molecular weight and can be extracted by specific solvents such as acetone, toluene, alcohol and water [1]. Besides of this, they influence the physical properties of wood, such as color and smell, they protect the wood against microorganisms (phenolic substances, terpenoids, resin acids), they have the fuction of reserving materials (sugars, starches, waxes, fats and fatty acids) [2] . Some examples of soluble organic extractive solvents are resin and fatty acids, color pigments, unsaponifiable substances, esters and waxes; the mixture of ethanol and toluene can remove resins, oils and insoluble components in ether; ethanol solubles include resin acids, terpenes, steroids and fats; and the water solubles are inorganic salts, polysaccharides and some phenolic substances [3].

Although the extractive content of the most representative classes of extractives present in wood is not high, their total removal is not achieved in the cooking processes for the production of wood pulp cellulose [1],[4]. Thus, an interference can occur in the analysis of chemical constituents of wood that are being studied and characterized, and an industrial scale can form pitches, agglomeration of extractives in the apparatus used in the later stages of processing of wood pulp.

The choice of a more appropriate solvent to remove the extractive content in wood, pulp, paper and pitch based on the different solubility of the extract and relate to factors such as risks to human health, environmental, toxicity and financial costs. This study aimed to evaluate the method of extraction using acetone and total extraction methodology with alcohol: toluene 1:2, ethanol and hot water respectively, in the determination of extractives in eucalyptus and its effects on the quantification of its chemical constituents, since the extractive content is an important parameter in the selection of quality wood samples used in the production of pulp.

Experimental

This work used six clones of *Eucalyptus* sp. from different locations of Minas Gerais.

Tappi standard procedures [5] were used for wood preparation according to TAPPI T 257 cm-85. The complete extraction method with alcohol / toluene, ethanol 95% and hot water were measured according to TAPPI T 264 cm-97 and the extraction with acetone was measured according to TAPPI T 280 pm-99. The acid hydrolysis of extractive-free wood was performed according to the method TAPPI T222 om-98. Insoluble and soluble lignins were measured according to Gomide and Demuner and Goldsdchimid respectively. And the analysis of carbohydrates was determined by high performance liquid chromatography (HPLC), of the according to TAPPI T 249 cm-00.

Results and Discussion

The extractive content was strongly influenced by the used extraction method, as it can be seen in Figure 1. This change in content depending on the employed extraction method was expected, because the removal of extractives depends on the solvents that were used. The complete extraction used a combination of different polarities of solvents, so more quantities of extractives were quantified because ethanol/toluene removed more significantly no polar groups, the process with water removed polar structures and the ethanol groups with similar chemical solubility. And on the other hand, just the acetone solvent could remove only the hydrophilic extractives [6].

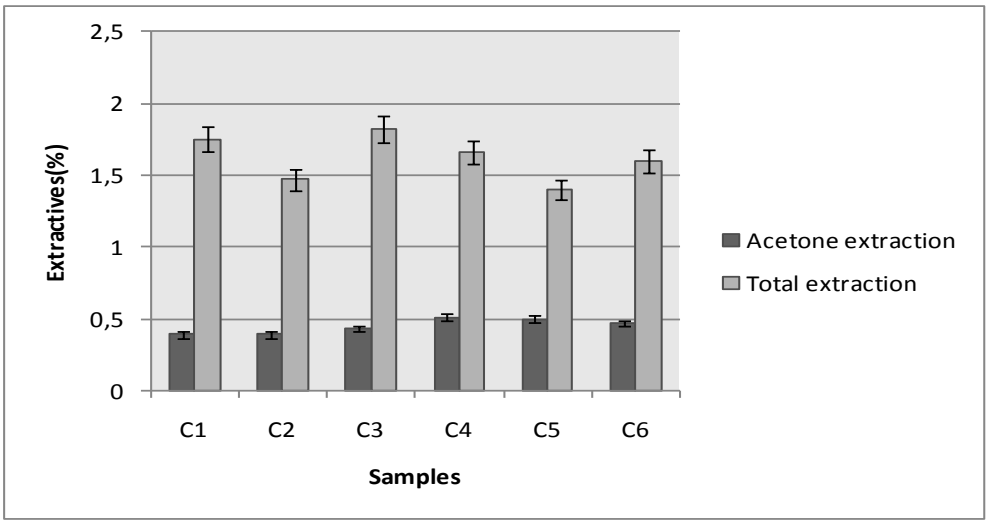

Figure 1: Comparison of quantity of extractive removal using acetone method and total method extraction.

Although the extractive content has been influenced by the method used for determining the used genetic material it significantly influenced the content of extractive. When conducting a statistical analysis by extraction methods, taking into account only the influence of the used genetic material t-tested at 5% of probability, there is no statistical difference between the content of acetone extraction determined in each clone, and they do not differ in the content of extract quantified in complete extraction **.**

Extractives were removed before the material was hydrolyzed to avoid the interference in the process. Although extraction in acetone removed less content extractives than the complete extraction, the method of removal of wood extractives was not significant in the determination of other chemical constituents of wood, since there was no statistically significant difference by Tukey at 5% significance level, between the average levels of soluble and insoluble lignin, as it can be seen on Figure 2.

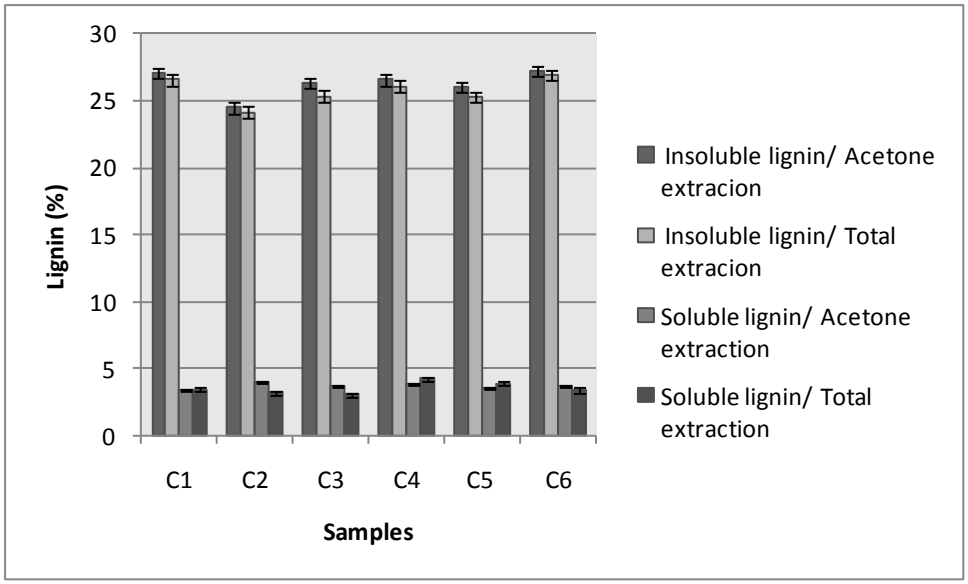

Figure 2: Comparison of the percentage of soluble and insoluble lignin extractive removal using the acetone method and the total extraction method.

Statistically significant differences were not noted between the two methods for the result of the carbohydrates of wood , by Tukey test at %5 significance level. As it can be seen from the Table1. However chemical analysis of acetyl and uronic groups were not performed. These results demonstrate that the extraction in acetone can be used for removal of extractives without significant interference in the analysis of other chemical constituints of wood.

Table 1: Comparison of quantification of the carbohydrates in the chemical constituents of wood.

Sample	% Glucose		% Xylose		% Arabinose		% Mannose		% Galactose	
	Acetone	Total	Acetone	Total	Acetone	Total	Acetone	Total	Acetone	Total
C1	44,7a	44,8a	11,43b	11,78b	0,49c	0,51c	0,44d	0,42d	1,1e	1,1e
C2	46,2a	46,6a	11,89b	12,14b	1,02c	1,05c	0,42d	0,42d	0,8e	0,8e
C3	44,4a	44,2a	11,7b	11,45b	0,56c	0,57c	0,53d	0,53d	1,7e	1,7e
C4	43,2a	43,8a	12,33b	12,68b	0,72c	0,73c	0,50d	0,46d	1,1e	1,1e
C5	44,0a	44,5a	12,93b	13,14b	0,76c	0,75c	0,51d	0,46d	0,9e	0,9e
C6	43,4a	44,0a	12,37b	12,72b	0,96c	1,02c	0,46d	0,48d	0,8e	0,8e

* Values in the same row followed by same letter do not differ statistically by Tukey test at 5% significance level.

Conclusions

It is generally concluded that the chemical composition of eucalyptus wood can be determinate by using samples free of extractives by the complete extraction method with alcohol / toluene, ethanol and water or the method with acetone without having significant difference in the results.

- The complete extraction method removed more extractivse than the method with acetone;
- Regardless of the method, the levels of soluble and insoluble carbohydrate lignins were not statistically different;
- The extraction in acetone can be used to remove wood extractives without causing

significant interference in the acid hydrolysis.

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