DISTRIBUTION OF THE EQUILIBRIUM MOISTURE CONTENT IN FOUR HARDWOODS BELOW FIBER SATURATION POINT BY MAGNETIC RESONANCE MICROIMAGING

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INTRODUCTION
FIBER SATURATION POINT

Skaar 1988

a. ABOVE $M_f$

b. AT $M_f$

c. BELOW $M_f$
<table>
<thead>
<tr>
<th>Beginning of shrinkage (%)</th>
<th>FSP (%)</th>
<th>Species</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>31</td>
<td>sugar maple</td>
<td>Hernández and Bizoñ (1994)</td>
</tr>
<tr>
<td>41</td>
<td>29</td>
<td>yellow birch</td>
<td>Almeida and Hernández (2006b)</td>
</tr>
<tr>
<td>52</td>
<td>28</td>
<td>tornillo</td>
<td>Hernández and Pontin (2006)</td>
</tr>
<tr>
<td>36</td>
<td>22.5</td>
<td>pumaquiro</td>
<td>Hernández and Pontin (2006)</td>
</tr>
<tr>
<td>77</td>
<td>21.5</td>
<td>huayruro</td>
<td>Hernández and Pontin (2006)</td>
</tr>
<tr>
<td>40</td>
<td>31</td>
<td>beech</td>
<td>Almeida and Hernández (2006a)</td>
</tr>
<tr>
<td>43</td>
<td>24</td>
<td>congona</td>
<td>Almeida and Hernández (2006a)</td>
</tr>
<tr>
<td>56</td>
<td>25</td>
<td>cachimbo</td>
<td>Almeida and Hernández (2006a)</td>
</tr>
</tbody>
</table>
WHY USE MR MICROIMAGING?

- Powerful
- Nondestructive
- Visualization of NMR parameters: proton density, $T_1$ and $T_2$
- High sensibility to $H^+$ (water) concentration
- May distinguish free and bound water
- Microimaging: high magnetic field, long time of acquisition and high costs
- Not so effective with dry wood (<15% MC)
OBJECTIVE

Use the MR microimaging technique to visualize liquid and bound water distribution in wood samples under EMC below FSP
HYPOTHESES

- At EMC, it is possible to have both liquid and bound water in the porous structure of some species, even below FSP

- This liquid water could be entrapped in the less permeable tissues in hardwoods

- Wood anatomy plays a major role in the desorption
Eucalyptus saligna
Red oak
Cachimbo
Huayruro
RESULTS
Eucalyptus saligna

I(0)

0% 100%

T₂

0 ms 6 ms

58% RH

40 µm

0.9 mm

76% RH

90% RH

90% RH

76% RH

58% RH
CONCLUSIONS

- MR microimages based on $^1$H concentration coupled with $T_2$ values distribution images constitute a powerful and non-destructive tool for mapping MC distribution on heterogeneous hardwoods, contributing to a better understand of wood-water relations.

- Liquid water may be found entrapped in wood structure below FSP under equilibrated conditions, even in small samples. In this case, wood lost bound water in the presence of liquid water, contradicting the concept of FSP.

- Parenchyma cells (axial parenchyma and rays) seem to be a reservoir of entrapped liquid water below FSP in refractory and collapse prone species, as *Eucalyptus saligna* and red oak. Occluded pits or poor communication between parenchyma and vessels might explain this fact.

- For huayruro and cachimbo wood, even at EMC, bound water was not uniformly distributed in wood structure, concentrating more in fibers for huayruro and rays for cachimbo wood. Therefore, water concentration varied according to the wood tissue, revealing that some tissues are more hygroscopic than others.
References

Thank you