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# Determination of Chemical Components of *Juniperus phoenicea* Trees Grown in Al-Jabel Al-Akhdar Region (Libya)

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**Abstract:** This study was conducted to measure the chemical components (cellulose, hemicelluloses and lignin) of Juniper wood (*Juniperus phoenicea* L.) that is naturally grown in Al-Jabel Al-Akhdar (Green Mountain). Nine locations were chosen and represented by three classes of different levels of altitude: the East, Middle and West part of the Al-Jabel Al-Akhdar region. The results revealed that the mean cellulose, hemicelluloses and lignin values were 34.86, 17.21, 47.92%, respectively, based on dry weight of wood. No significant differences were observed between the levels and parts.

**Key words:** *Juniperus phoenicea* · Wood · Cellulose · Hemicelluloses · Lignin · Al-Jabel Al-Akhdar

## INTRODUCTION

The natural vegetation of Al-Jabel Akhdar (Green Mountain) area comprises most of plant forms that exist in the Mediterranean area.

*Juniperus phoenicea* L. trees are considered to be one of the most important constituents of this vegetation. It constitutes about 80% of the total number of the trees and evergreen shrubs that exist in Al-Jabel Al-Akhdar area [1]. Therefore these trees were chosen to be the focus of this study.

Al-Jabel Al-Akhdar area has unique ecological characteristics because it is an area of evergreen forest along the area that extends beside the Mediterranean Sea from Atlas Mountain to the west until the Middle East to the north. The topography of this area includes three classes of different levels of altitude. There is a significant variation in the topography of the Al-Jabel Al-Akhdar area which includes valleys, hills and plains [2]. The topography of this area includes three classes of different levels of altitude. These levels differ from each other in their climate. The first level close to sea shore represents plain lands and Mediterranean climate. The mean of its height above sea level does not exceed 200 m. The second level, with its maximum height of about 460 m above sea level, represents an intermediate case between the first and the third levels. The maximum height of the third level of the mountain is about 880 m above the sea level. This level is characterized by cold winter climate but is hot in most of its parts during summer [3].

In order for the success of this study, it was necessary to study the trees of interest in the three classes of different levels of altitude and three directions or parts in each level.

Alfitori *et al.* [4] conducted a research in 2011 which focused on the determination of biomass and study of wood properties of *Juniperus phoenicea* trees grown in Al-Jabel Al-Akhdar Region (Libya). In contrast, the objective of this current study was to determine the chemical components (cellulose, hemicelluloses and lignin) for the same species of trees where nine trees representing the three classes of different levels of altitude (the east, middle and west parts of Al-Jabel Al-Akhdar region ) were chosen.

## MATERIALS AND METHODS

**Trees:** One tree from each of the nine locations (i.e. nine trees) of *Juniperus phoenicea* L. was selected from Al-Jabel Al-Akhdar area (Libya) for investigation into

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Table 1: Locations from where samples were taken in Al-Jabel Al-Akhdar area

| Level | Part | Name of the location | Latitude and longitude coordinates | Elevation above sea level (m) |
|---|---|---|---|---|
| First | East | Al-Aslaab | 32° 55' 448" | 36 |
| | | | 22° 08' 586" | |
| | Middle | Alhamama - Raas Amer | 32° 55' 316" | 42 |
| | | | 21° 39' 405" | |
| | West | Wadi Al-Jabel -Botraba | 32° 35' 17" | 86 |
| | | | 20° 44' 14" | |
| Second | East | Sidi Khaled | 32° 48' 54" | 447 |
| | | | 22 20' 36" | |
| | Middle | Al-Wasita - Silion | 32° 47' 346" | 342 |
| | | | 21° 39' 357" | |
| | West | Wadi Al-Akii | 32° 30' 462" | 412 |
| | | | 21° 10' 543" | |
| Third | East | Al-Daher Al-Ahmer | 32° 40' 804" | 458 |
| | | | 22° 23' 821" | |
| | Middle | Ashnishen | 32° 36' 435" | 780 |
| | | | 21° 56' 000" | |
| | West | Gerdes - Zawiat Alqasoor | 32° 20' 273" | 565 |
| | | | 20° 55' 297" | |

Table 2: The mean values of the chemical components (%) of *Juniperus phoenicea* L. wood at different levels of Al-Jabel Al-Akhdar region

| | Level | | | |
|---|---|---|---|---|
| Chemical Component | First | Second | Third | F-value |
| Cellulose (%) | 47.40 | 48.45 | 47.91 | $8.58^{**}$ |
| Hemicelluloses (%) | 16.80 | 17.65 | 17.19 | $3.52^{n.s}$ |
| Lignin (%) | 35.80 | 33.90 | 34.90 | $13.50^{**}$ |

F- value = 3.24 (One way ANOVA) ; ns = Non significant difference at 0.01 and ** = highly significant

Table 3: The mean values of the chemical components (%) of *Juniperus phoenicea* L. wood at different parts of each level (east, middle and west) (east, middle and west) of Al-Jabel Al-Akhdar region

| | Parts | | | |
|---|---|---|---|---|
| Chemical Component | East | Middle | West | F-value |
| Cellulose (%) | 48.09 | 47.76 | 47.92 | $0.84^{n.s}$ |
| Hemicelluloses (%) | 17.43 | 16.79 | 17.41 | $2.62^{n.s}$ |
| Lignin (%) | 34.48 | 35.45 | 34.67 | $3.98^{**}$ |

ns = Non significant difference at 0.01 and ** = highly significant

Table 4: Chemical composition of two *Juniperus* species

| Chemical Components | *Juniperus phoenicea* | *Juniperus procera* |
|---|---|---|
| Cellulose (%) | 47.92 | 46.04 |
| Hemicelluloses (%) | 17.21 | 19.12 |
| Lignin (%) | 34.87 | 30.83 |

their chemical components. Only one tree from each location was chosen to avoid destroying a large number of trees in order to protect this natural environment. Only those trees that appeared healthy and with no visible signs of decline or damage were chosen. The age of the selected trees from which samples were taken ranged between 70 and 190 years old. Table 1 shows the characteristics of the chosen trees in the selected locations represented by levels and parts (i.e. directions). Wood discs from trunk and branches of each tree were prepared for the determination of their chemical components.

**Determination of Chemical Components of Wood:** To estimate the chemical components, woods were grinded very well. The resultant wood powder was then separated by using 40 and 60-mesh sieves. Organic solvent was then used for extraction using a mix of alcohol and benzene (1:2), after which the sample was air-dried prior to the determination of its chemical components.

**Cellulose Determination:** Cellulose was separated by concentrated nitric acid in the presence of ethyl alcohol according to the method of Browning [5].

The cellulose percentage was calculated using the following equation:

$$\text{Cellulose \%} = \frac{WC}{WO} \times 100$$

where:
WC = Cellulose weight (gm)
WO = Dry weight for wood before extraction (gm)

**Hemicelluloses Determination:** Hemicelluloses percentage was determined by hydrolysis by using 2% sulfuric acid following the method of Browning [5]. The hemicelluloses percentage was then calculated using the following equation:

$$\text{Hemicelluloses \%} = \frac{\text{WHC}}{\text{WO}} \text{ x } 100$$

where:
WHC = Shemicelluloses weight (gm)
WO = Dry weight for wood before analysis (g)

**Lignin Determination:** Lignin percentage was calculated by the taking the difference of the percentages of cellulose and hemicelluloses.

**Statistical Analysis:** Analysis of variance (ANOVA) was used to study the parameters of interest of this study. Duncan's multiple range tests was also applied to compare the means (Steel and Torrie [6].

## RESULTS AND DISCUSSION

The estimation of the chemical components (cellulose, hemicelluloses and lignin) of *Juniperus phoenicea* L. wood was conducted using the methods described above.

The result revealed significant differences in cellulose and lignin percentages between the first and second levels. However, no significant differences were found across the three levels for either cellulose or lignin. In contrast, hemicelluloses content of wood did not differ significantly between the levels.

The result revealed no significant difference in any of the chemical components values of wood among the tree parts. Based on our results, it can concluded that the data obtained from *Juniperus phoenicea* trees grown in Al-Jabel Al-Akhdar area are close to those obtained from *Juniperus procera* trees in the southwestern Saudi Arabia [7].

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