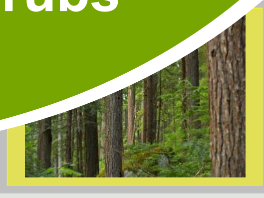
Thermochemical properties of several Portuguese and exotic woods and shrubs

José Luis LOUSADA[1]
Maria Emília SILVA[1]
Rafael SCHMITZ[2]

[1]Center for the Reserch and Technology of Agro-Environmental and Biological Sciences (CITAB) / UTAD – Vila Real, Portugal
[2]Instituto Federal de Santa Catarina IF-SC, São Miguel do Oeste, Santa Catarina, Brasil.




1 Background

In recent years it has been attended in Portugal a constant increase in demand for forest biomass for energy purposes, which may lead to an overexploitation of these resources. Only an efficient management of biomass can ensure the sustainability of the Portuguese Forest. This can be achieved by the use of biomass resources yet unexplored (shrubs) or by producing more biomass (energy crops). The aim of this study was to evaluate the thermochemical properties of various national wood species, exotic species, and shrubs, most representative of Portugal .

2 Methods




The study assessed in national softwoods, national and tropical hardwoods and shrub species.
For each species it was determined the gross calorific value-GCV (or higher heating value-HHV) and the following chemical properties: ash content, chemical composition (C, H, O, N, S), Micro and Macroelements (Na, K, Ca, Mg, Mn, Fe, Zn, Ni, Cr, Cd, Cu, P) and halogens (F, Br, Cl).

3 Results

GROSS CALORIFIC VALUE

Softwoods	GCV (kJ/kg)
Pinus pinaster	20237.9
Pseudotsuga menziesii	19660.0
Cedrus atlantica	20360.5

Shrubs	GCV (kJ/kg)
Pterospartum tridentatum	20910.3
Erica arborea	21372.5
Erica sp.	20922.3
Haquea sericea	20334.8
Cytisus striatus	20203.5
Ulex europaeus	19474.8

Hardwoods	PCS (kJ/kg)
Castanea sativa	18754.9
Eucalyptus globulus	17631.7
Fagus sylvatica	19132.5
Quercus robur	18696.8
Fraxinus angustifolia	19090.9
Prunus avium	18256.5
Salix babilonica	18279.4
Populus euro-america.	18791.2
Acer pseudoplatanus	18637.9
Chlorophora excelsa	20314.7
Entandrophragma cyli.	19053.9
Gossweilerodendron b.	20499.8
Bowdichia nitida	20809.5
Hymenaea courbaril	19296.4

ASH CONTENT

Softwoods	Ash(%)
Pinus pinaster	0.2
Pseudotsuga menziesii	0.4
Cedrus atlantica	0.4

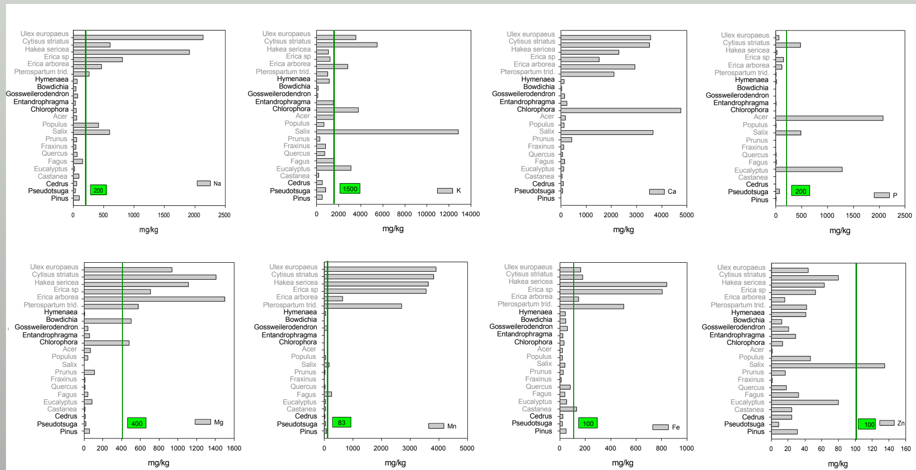
Shrubs	Ash(%)
Pterospartum tridentatum	1.5
Erica arborea	2.3
Erica sp.	2.2
Haquea sericea	1.9
Cytisus striatus	1.8
Ulex europaeus	2.8

Hardwoods	Ash(%)
Castanea sativa	0.1
Eucalyptus globulus	0.5
Fagus sylvatica	0.5
Quercus robur	0.3
Fraxinus angustifolia	0.4
Prunus avium	0.1
Salix babilonica	2.4
Populus euro-america.	0.5
Acer pseudoplatanus	1.0
Chlorophora excelsa	2.8
Entandrophragma cyli.	1.0
Gossweilerodendron b.	0.4
Bowdichia nitida	0.1
Hymenaea courbaril	0.7

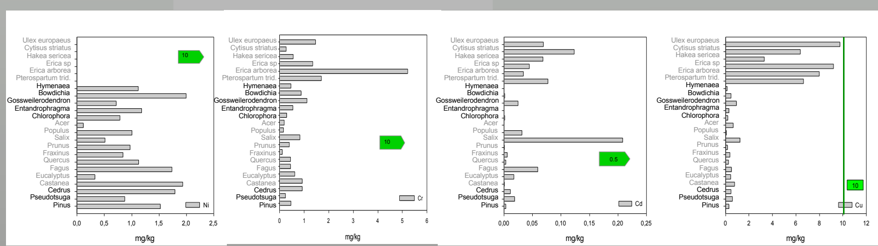
CHEMICAL ELEMENTARY COMPOSITIONS

Species	%C	%H	%O	%N	%S
Hardwoods	48.2	5.8	45.0	0.2	0.02
National	47.3	5.7	46.2	0.2	0.03
Tropical	49.9	5.9	42.9	0.3	0.02
Softwoods	48.8	5.8	44.9	0.2	0.01
Shrubs	47.7	6.4	45.0	0.8	0.07

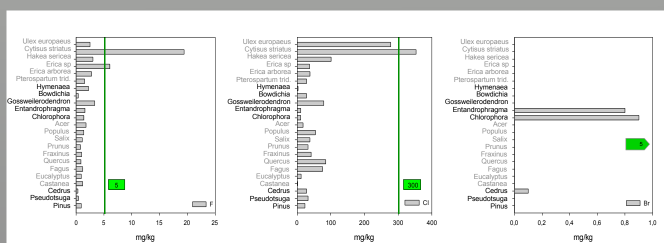
MICROELEMENTS

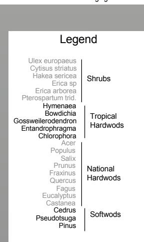


MICROELEMENTS



HALOGENS





4 Conclusion

✧Tropical hardwoods, national softwoods and shrubs have higher calorific value than the national hardwoods.

✧The different species present very similar chemical elementary compositions.

✧The shrubs present levels of Na, Ca, Mg, Mn, Fe, Cr, Cd and Cu much higher than woods (sometimes more than 40X). In turn the K, P, Zn, Ni are identical between shrubs and woods.

✧The shrubs present levels of F and Cl much higher than woods, but identical values of Br.

✧Although the shrubs show high calorific value, its use as an energy source can give rise to corrosion and accumulation of ash in burning equipment, as well as the emission of toxic compounds.

utad

CITAB

tars, and other constituents that may exceed the specified limits for intending purposes. The research and development on effective and efficient gas cleaning processes for removal of these contaminants as well as high efficient reliable gasifiers is essential for home and industrial applications especially in developing countries. It is imperative to know that principles of gasification along with gasifier designs will play important roles on the quality of product gases. The review provides in-depth information on the various designs of gasifiers and principles of gasification as a major factor in determining the calorific value of product gas. This paper also focuses on the recent trend in gas cleaning technologies. Applications of wet scrubbing technology, hot gas cleanup technology, catalysts and activated adsorbents to remove tar, ammonia and other contaminants are discussed.

Keywords: Biomass, gasification, gasifier, gas cleaning technology, tar

PP182

Thermochemical properties of several Portuguese and exotic woods and shrubs

José Luis LOUSADA1, Maria Emília SILVA1, Rafael SCHMITZ2
1Center for the Reserch and Technology of Agro-Environmental and Biological Sciences (CITAB) / University of Trás-os-Montes e Alto Douro (UTAD), Vila Real, Portugal
2Instituto Federal de Santa Catarina IF-SC, São Miguel do Oeste, Santa Catarina, Brazil.
jlousada@utad.pt

I

n recent years it has been attended in Portugal a constant increase in demand for forest biomass for energy purposes, which may lead to an overexploitation of these resources. Only an efficient management of biomass can ensure the sustainability of the Portuguese Forest. This can be achieved by the use of biomass resources yet unexplored (shrub component) or by producing more biomass (energy crops). The aim of this study was to evaluate the thermochemical properties of various national wood species, exotic species, and shrubs, most representative of Portugal.

With regard to the tree species, the study assessed the following national softwoods: Pinus pinaster, Pseudotsuga menziesii, and Cedrus atlantica; in the national hardwoods: Eucalyptus globulus, Populus euro-americana (cl. I-214), Salix alba, Quercus robur, Castanea sativa, Acer pseudoplatanus, Fraxinus angustifolia, Prunus avium, and Fagus sylvatica; and in the tropical hardwoods: Chlorophora excelsa, Entandrophragma cylindricum, Gossweilerodendron balsamiferum, Bowdichia nítida, and Hymenaea courbaril. As regards the shrub species (bushes), have been studied the Ulex europaeus, Cytisus striatus, Pterospartum tridentatum, Erica arborea, Erica sp., and Hakea sericea. For each species it was determined the gross calorific value-GCV (or higher heating value-HHV) and the following chemical properties: ash content, chemical composition (C, H, O, N, S), Micro and Macroelements (Na, K, Ca, Mg, Mn, Fe, Zn, Ni, Cr, Cd, Cu, P) and halogens (F, Br, Cl).

For the Calorific Value, the tropical hardwoods, national softwoods and shrubs have higher calorific value than the national hardwoods. In general it was found that tree species have low ash content (0.1% - 0.5%). The shrubs have much higher values (1.5% - 2.8%) as well as the Acer p. (1.0%), Entandrophragma c. (1.0%), and the Chlorophora e. (2.8%).

Concerning the elementary chemical composition, the different species present very similar chemical compositions. The only exceptions are the national hardwoods with lower levels of C, compared to the tropical hardwoods and the softwoods. The national hardwoods also present higher levels of O comparatively the tropical hardwoods. The fact that hardwoods have less C and more O, can explain its lower calorific value, in relation to other species. For micro and macro elements, the shrubs present levels of Na, Ca, Mg, Mn, Fe, Cr, Cd and Cu much higher than woods (sometimes more than 40X). In turn the K, P, Zn, Ni are identical between shrubs and woods. As regards the halogens, it is clear that shrubs present levels of F and Cl much higher than woods, but identical values of Br.

It should be noted that although the shrubs show high calorific value, its use as an energy source can give rise to corrosion and accumulation of ash in burning equipment, as well as the emission of toxic compounds.

Keywords: Utilization, Forestry biomass, energy, chemical properties.

PP183

Solvent Extraction of Oil from Bani (*Pongamia pinnata* (l.) Pierre) seeds

Ramon A. RAZAL1, Vivian C. DARACAN1, Rosalie M. CALAPIS1, Chenee Marie M. ANGON2 and Rex B. DEMAFELIS2
1 Forest Products and Paper Science Department
College of Forestry and Natural Resources, University of the Philippines Los Baños, College, Laguna, Philippines 4031
2 Chemical Engineering Department
College of Engineering and Agro-Industrial Technology, University of the Philippines, Los Baños, College, Laguna, Philippines 4031
rmcalapis@uplb.edu.ph

Pongamia pinnata (L.) Pierre seeds were extracted using Soxhlet apparatus to determine which among hexane, cyclohexane, and petroleum ether would be practical to use for solvent extraction of pongam oil. The effects of seed moisture content, seed coat and grinding on oil yield were evaluated. Hexane proved to be a practical solvent choice with its high yield and lower cost per liter for sun-dried uncoated ground seeds. Hexane provided an average of 56% oil yield. An increasing trend in %oil yield with time was observed until such a point where further increase in the soaking time resulted to insignificant changes in the %oil yield. The favorable soaking time was 8 hours for hexane extraction (corresponding to 22% oil yield). Oil yield increased as the amount of solvent increased until equilibrium was reached at a seed (mass) to solvent (volume) ratio of about 1:6 beyond which changes in oil yield were insignificant. The physico-chemical properties of the solvent-extracted oil, such as specific gravity, saponification number, iodine value, and acid value were determined, showing a specific gravity of 0.92764 ± 0.0052 at 250C, saponification value of 441.8316 mg KOH/g oil, iodine value of 151.4766 mg I/g oil, and an acid value of 80.7292.

Keywords: biodiesel, Pongamia pinnata, solvent extraction