EXPERIMENTAL RESULTS FOR PROXIMATE ANALYSIS AND ESTIMATIAS RESIDUAL BIOMASS ONS FOR ELEMENTAL COMPOSITION AND HHV: BOCAIÚVA (SHELL) AND CRAMBE (BAGASSE)

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ABSTRACT

This paper presents results of experimental evaluation, and estimates of the energy characteristics for typical residual biomass in Brazil´s Central West at Mato Grosso do Sul state, namely, Bocaiúva/Macaúba shell (Acrocomia aculeata) and Crambe bagasse (Crambe abyssinica). During the process to obtain the main raw material (bocaíuva food pulp and Crambe oil), the resulting co-products represent 17,66% and 67,30% of the original biomass, respectively for Bocaiúva shell and Crambe bagasse. The methodology has support on ABNT technical standards for proximate analysis, and scientific literature correlations for elemental composition and HHV - Higher Heating Value.

These equations, for biomass analysis, allows quickly and inexpensive estimations for elemental composition and HHV taking into account proximate analysis results for the biomass samples. Appropriate instruments were used to perform the measurement of quantities of interest, which they are, melting pot, analytic balance, greenhouse recirculation, desiccators and muffle furnace. Results are analyzed and discussed for specific mass (kg/m³), proximate analysis (moisture, volatile matter, ash and fixed carbon contents, %), elemental composition (%) and HHV (kJ/kg) for both residual biomass samples evaluated in this work. Preliminary study credits for crambe bagasse a HHV around 22.00 MJ/kg, a value higher than most of other residual biomass from agricultural crops: rice husk (12.92 MJ/kg), soybean hulls (16.92 MJ/kg) and sugarcane bagasse (17.33 MJ/kg).

Keywords*: Biomass, Biofuels, Renewable energy, Thermal energy, Combustion*

1 INTRODUCTION

In 2012 about 23.9% of Brazil's electricity was generated from thermoelectric sources, of which 30.4% was biomass. Much of the biomass used for energy production is derived through agricultural residues such as bagasse, rice Husk and corn stover (BEN 2013). Among the types of existing biomass, one it has been widely used is the residual biomass.

The renewable energy generation from biomass residues from agricultural and industrial energy processes is researched by various institutions worldwide. This concept is being considered for both systems that generate and consume large volumes of primary and final energy and independent power producers which typically use biomass residues from their processes to meet their energy needs.

From agricultural crops in Brasil´s Central West, included Mato Grosso do Sul state, Crambe is one that generate significant amounts of residual biomass (Crambe bagasse) that can be used as energy source for power generation.

Bocaiúva (Acrocomia aculeata) is a native fruit regional species at Brazil, also found in Central West, included Mato Grosso do Sul state. It has different names depending on the region, in São Paulo and Minas Gerais is known as Macaúba, Coco-slimy, Mocajá, Mocajuba, macaw are other names that refer to the same fruit (ARISTONE, 2005)

In this work, bagasse from Crambe and shells from Bocaiúva are evaluated as promising regional sources of residual biomasses for energy conversion purposes into thermal energy or charcoal.

Figure 1: Bocaiúva (left) and Crambe (right), in natura.

2 METHODOLOGY

Crambe bagasse was obtained after oil extraction, from in natura Crambe, by using an oil extractor ECIRTEC MPE-40PI.Particle size reduction used a Wiley mill SOLAB SI31.

Drying of samples was performed in a greenhouse Sppencer scientific 420-1d. Ash and volatile matter analysis was conducted in a muffle furnace Novus N1100. Samples resting to return in ambient temperature, before weighing, used glass desiccators. Weighing used a Mark S3102- Precision Balance 3100g (0.01 g), from Bell Engineering.

The proximate analysis was performed based on NBR 8112 (ABNT, 1986) and it determines the level of fixed Carbon, volatile matter, ash and moisture. The volatile matter expresses the amount of mass which volatilizes during heating. The ash content refers to the mass of the sample that does not undergo combustion. The moisture shows the amount of water present in the sample at ambient temperature and pressure, it can be expressed on a wet and dry basis (Nogueira, 2003).

Preliminary results showed the relationship between the samples total drying times, which must be determined to each different sample under analysis, according to NBR 8118 (ABNT, 1986). For the Bocaiúva shell, it was obtained a total drying time of 30 minutes and for the Crambe bagasse, a total drying was 40 minutes.

3. RESULTS AND DISCUSSION

Table (1) and (2) present proximate analysis results for Bocaiúva shells and Crambe bagasse, respectively.

Moisture Content in wet basis (wb, %)	Moisture Content in dry basis (db, %)	Volatile Matter (%)	Ash Content (%)	Fixed Carbon content (%)
7.00	7.53	73.33	3.26	23.41
7.00	7.53	75.00	4.40	20.60
7.00	7.53	75.82	3.00	21.18
8.00	8.70	75.56	4.00	20.44
7.00	7.53	75.27	3.00	21.73
7.00	7.53	74.44	3.26	22.30
8.00	8.70	77.27	3.37	19.36
7.00	7.53	75.00	4.35	20.65
8.00	8.70	74.16	4.30	21.54
8.00	8.70	73.33	2.20	24.47
7.40 ± 0.52	7.99 ± 0.60	74.92 ± 1.19	3.51 ± 0.73	21.36 ± 1.51

Table 1:Proximate analysis results – Bocaiúva shell

Moisture Content in wet basis (wb, %)	Moisture Content in dry basis (db, %)	Volatile Matter (%)	Ash Content (%)	Fixed Carbon content (%)
9.00	9.89	76.92	6.59	16.49
8.00	8.70	79.35	6.52	14.13
9.00	9.89	75.82	6.59	17.59
8.00	8.70	76.09	7.61	16.30
8.00	8.70	77.17	5.43	17.40
8.00	8.70	76.09	5.43	18.48
8.00	8.70	77.00	7.61	11.04
7.00	7.53	77.00	8.60	14.40
7.00	7.53	76.00	8.42	15.58
8.00	8.70	76.00	8.60	15.40
8.00 ± 0.67	8.70 ± 0.79	76.74 ± 1.05	7.14 ± 1.21	15.68 ± 2.14

Table 2: Proximate analysis results – Crambe bagasse

4. CONCLUSIONS

Moisture content was lower than 10% for both residual biomasses, below the standard values indicated in the literature review.

Mean values obtained for volatile matter content were higher that 70%, indicating good biomass combustion readiness. Its values were also higher when compared to other residual biomasses from agricultural.

Ashes mean values were respectively, for Bocaiúva shell and Crambe bagasse, 3.51% and 7.14%. An interesting good result for Bocaiúva shell and in the limits for Crambe bagasse, once that values above 7% jeopardize the combustion process (Vale *et al*, 2011) and may not cause to much trouble in the maintenance due to ash clog.

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