BAOQUALITY PROJECT

Contact
Arshidin Khassiyarov
Rhine-Waal University of Applied Sciences
arshidin.khassiyarov@hsrw.org

Briquette production from baobab *(Adansonia digitata)* fruit shells

Arshidin Khassiyarov, Rolf Rheinschmidt, Dietrich Darr, Matthias Kleinke

Tropentag 2021
University of Hohenheim, Germany

HOCHSCHULE RHEIN-WAAL
Rhine-Waal University of Applied Sciences

INTRODUCTION

- The major sources of traditional biomass in the Republic of Malawi are firewood, charcoal (Openshaw, 2010).
- With an annual deforestation rate of 2.4 percent, forest loss in Malawi is among the highest in Southern Africa (UNEP, 2002).
- The use of organic waste material as an alternative fuel can help alleviate this problem.
- Baobab fruit shells are a suitable agricultural residue, due to:
  - area-specific biomass availability;
  - related transportation cost and;
  - lack of attractive alternative uses.
- These shells are abundant in the southern region of Malawi, and along the lakeshore in the central and northern regions of the country (Sanchez, 2011).
- The purpose of the study was to identify respective advantages and disadvantages of the briquette production from baobab (*Adansonia digitata*) fruit shells, to evaluate it and to present recommendations for practice.

MATERIALS AND METHODS

- 32 kg of baobab fruits were manually separated into 4 fractions (shell, pulp, fibre, kernels).
- Four fractions and three types of baobab briquettes entered further analysis:
  - briquettes I (100% baobab shells)
  - briquettes II (50% baobab shells and 50% groundnut shells)
  - briquettes III (50% baobab shells and 50% *Piliostigma thonningii* leaves)
- Briquettes were produced using a „GONGYI SHI JINGYING MACHINERY" briquette screw press machine in Malawi
- Physical characteristics of the samples were determined using standard methods:
  - dry matter
  - ash content (dry and wet basis)
  - higher heating value
  - bulk density

Figure 1. A – baobab fruit; B – baobab fruit shells; C – baobab fruit fibres; D – baobab fruit pulp; E – baobab kernels; F & G – Examples of the baobab fruit shell briquette

RESULTS AND DISCUSSION

- The shells make up the main part of the weight of the fractions in the sample. (Figure 2)

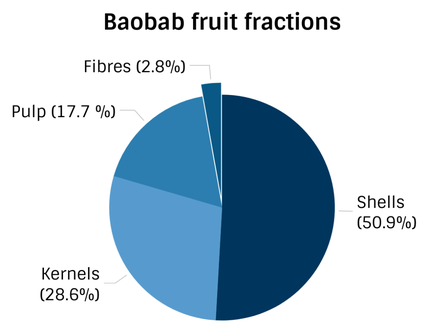

Figure 2. Baobab fruit fractions

Figure 3. Briquette production in Malawi. Picture made by Dalitso Kafumbula

- Initial analyses show a high calorific value of the briquettes at 18.75 MJ/kg. Relative to this, the calorific values of the non-briquette fractions, but also those of the briquettes with admixtures, are lower (Table 1).
- In comparison, higher heating values in biofuels should range from 14.6 to 23.3 MJ/kg dry basis, and ash content should be ranged from 0.17% to 24.36% dry weight basis (Ebeling & Jenkins, 1985).
- Heating value per volume could be increased by:
  - adding material with higher heating value, such as biomass waste with a high fat content
  - increasing the bulk density of briquettes through using a stronger briquette press
- One of the options, especially when no transport is required, can be also the use of crushed baobab shells as fuel itself, due to lower ash content and less energy needed for processing. But the market value may then be significantly lower.

Table 1. Results of analyses for different samples: fibres, pulp, kernels, shells, briquettes I (baobab shells), briquettes II (baobab shells and ground nut shells), briquettes III (baobab shells and *Piliostigma thonningii* leaves).

	Ash content (wet basis) (%)	Ash content (dry basis) (%)	Dry matter (%)	Rel. Higher heating value (%)	Bulk density (g/cm^3)
Fibres	2.3	2.5	91.4	82	-
Pulp	7.1	7.9	89.8	82	-
Kernels	7.0	7.6	91.9	77.6	-
Shells	5.3	5.7	92.4	80.6	0.52; 0.45; 0.38*
Briquettes I	15.2	16.0	94.9	100	0.90
Briquettes II	11.2	12.8	95.4	92.5	0.92
Briquettes III	12.4	13.0	94.7	67.2	0.98

*** - for the bulk density analysis baobab shells were crushed into 3 different sizes, and each size had its own bulk density: 0.52; 0.45; 0.38g/cm³ for 1 kg of crushed shells with average size of pieces 6.87, 0.67, 0.002 cm³ respectively.**

CONCLUSION

- Physical properties of baobab fractions described, and technological feasibility and fuel efficiency of baobab shell briquettes determined
- The production and utilization of baobab shell briquettes as an alternative fuel seems possible
- Further analyses required to optimize briquette composition and properties
- Briquettes from baobab shell can contribute to alleviating forest degradation and deforestation in Malawi

Acknowledgements

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the Federal Office for Agriculture and Food (BLE), which we gratefully acknowledge.

With support from
Federal Ministry of Food and Agriculture
by decision of the German Bundestag

References

Ebeling, J. M., & Jenkins, B. M. (1985). Physical and chemical properties of biomass fuels. Transactions of the ASAE, 28(3), 898-0902.
Fisher, M. (2004). Household welfare and forest dependence in Southern Malawi. Environment and Development Economics, 9(2), 135–154.
Openshaw, K. (2010). Biomass energy: Employment generation and its contribution to poverty alleviation. Biomass and Bioenergy (34): 365-378.
Sanchez, A. C. (2011). The baobab tree in Malawi. Fruits, 66(6), 405-416.
United Nations Environment Programme (UNEP) (2002), 'Africa environment outlook: past, present and future perspectives', http://www.unep.org/aeo/index.htm.