**Abstract No: MO-29**

# Development of energy briquettes using *Schleichera oleosa* (Ceylon oak) wood, *Oryza sativa* (rice husk, rice straws and rice brain) and *Saccharum officinarum* (bagasse)

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Fossil fuels and firewood are the primary household energy sources in Sri Lanka. However, due to the economic crisis and the increasing inflation, fossil fuels are no longer a preferable choice. The use of firewood also has limitations, such as household air pollution due to the accumulation of smoke and toxic compounds causing immediate health issues. One of the solutions to this problem is the use of charcoal energy briquettes. Charcoal energy briquettes are compressed blocks made from pyrolyzed biomass residues. Burning these briquettes as an energy source, minimizes household air pollution and is energy efficient and cost-effective. Sri Lanka, a tropical agricultural country with significant vegetation growth, has great potential for developing carbonized charcoal briquettes from biomass energy sources such as ceyloan oak, rice husk, rice straws, bagasse and rice brain. In this study, *Schleichera oleosa* wood (Ceylon Oak) was used as the main component of the briquettes, as it was known to have a high calorific value. Ceylon Oak is used in furniture manufacturing, producing a large amount of sawdust waste, and this sawdust could be efficiently utilized to produce briquettes. Further, rice husk, rice straws, and bagasse with high ash content were used as additives to increase the burning time of the briquettes. Rice brain was used as the binding agent. During the study, the mixing ratios of the raw materials, pressure, and moisture content were varied to enhance the efficiency of the briquettes. Biomasses were pyrolyzed (300 °C, 1 h) to produce biochar. Different biochar mixtures (particle size < 2 mm) were compressed under different pressures (10 kPa - 60 kPa) using a newly innovated compressing machine to produce briquettes (OD: 4.15 cm, Height: 3.34 ±0.48 cm). They were dried in an oven (50 °C) by varying the drying time (48 h, 72 h, 86 h, and 110 h) to change the moisture content. For each briquette produced, proximate analyses were carried out by measuring moisture (2% - 75%), volatile matter (20% - 36%), ash (10% - 30%), and fixed carbon content (38% - 70%). Calorific values were estimated based on the proximate analyses. The calorific values measured were in the range of 19,340 kJ $kg^{-1}$ – 27,983 kJ $kg^{-1}$. Cooking efficiencies calculated were in the range of 2.5 kJ $kg^{-1}$ - 27 kJ $kg^{-1}$ exhibiting the potential of using these briquettes as a household energy source. According to this study, *Schleichera oleosa* and rice brain mixture 3:1 (w/w) ratio, showed the highest heating value and the highest cooking efficiency. The addition of rice husk, rice straw, and bagasse reduced the cooking efficiency of the briquettes. This study can be further extended to optimize other parameters of the briquettes (size, moisture content, compressed pressure and mixing ratios) to further enhance the cooking efficiency and burning time.

**Keywords:** Sustainable energy, biochar, briquettes, *Schleichera oleosa (Ceylon oak)*, cooking fuel

**Acknowledgment**
Financial assistance was received from the AHEAD ELTA-ELSE grant promoting undergraduate innovations.