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Feasibility study of areca sheet waste as a biomass for downdraft gasifier.

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Abstract:

People have a crucial need of energy to cook. Presently, in developing countries like India this requirement is rectified by openly burning wood derived products in fires and wooden stoves. Many of the developing countries create large amount of agro wastes but they are used inefficiently creating extensive pollution to the environment. In order to explore the significance of areca nut waste as an alternative feed for gasifier. Based on the current cultivated area, the estimated recyclable biomass production from areca nut is about 4.5–5.4 million tones once a year in India and about 9.0–10.8 million tones within the world. The results thus obtained were then compared with the commercially available biomass and therefore the comparison results were quiet satisfactory. Hence, it can be concluded that biomass produced from areca sheets is used as a feed for gasifier.

KEYWORDS: Areca nut waste, biomass, gasifier

Introduction:

In green energy resources the Biomass plays a vital role nowadays. The green power can be generated by using this is 70% of population getting 32% of primary power in Biomass technique only. It is easily available and affordable resources because areca nuts are a major production in India, develop a future energy. Solid Biomass having differing types which as wood, rice husk, Municipal refuse. During this we are using areca nuts wastes; the most common process of gasification is converting organic carbonaceous material or fossil fuels into gaseous fuel call gas. The main problem in open burning of areca nut wastes is environmental pollution. During this process result, becoming mixer of gases may be obtained they're CO, CO2, H2, CH4, N2 and vapor. During the process, here to find the proximate and ultimate analysis of areca nuts to find the nitrogen, oxygen, carbon and hydrogen and also find the kinematic study of areca wastes by muffle furnace to heat up to 700°C. In kinematic study, to find the degradation of materials with respect to temperature.

In India, the areca wastes are simply dumped into the land or simply burning into the open fields. This open burning cause's air pollution leads to global warming. Especially the areca wastes consists huge amount of poly phenol and cellulose content, it takes long time to decompose under normal soil conditions.

Gasifier:

Gasifier equipment is usually classified as up draft gasifier, down draft gasifier, cross draft gasifier supported the direction of oxygen flow. It's mostly determined by the fuel, its final available form, its size, moisture content and ash content. Varieties of gasifier mostly employed in entrained bed gasification process and moving bed gasification process. It gasifies fuel interaction with air, oxygen and steam. So the gasifiers are classified. They are

- Updraft gasifier
- Downdraft gasifier
- Cross draft gasifier

Downdraft gasifier:

Updraft gasifier there's a controversy of tar entrainment within the product gas leaving steam. The produced gas is taken out from the underside, hence the fuel and gas moved within the same direction. On this fashion down, the acid and tarry distillation product from the fuel must undergo a glowing bed of charcoal and that they are converted into permanent gases, H_2, CO_2, and CH_4. Main merit of downdraft gasifier lies within the possibility on creating tar less gas for engine operation.

Muffle furnace:

A muffle furnace is a equipment with an closed chamber, the walls which radiantly heat the contents of the chamber, so the particles being heated has no contact with the flame. Muffle furnace are more often used in lab as a compact meaning of producing extremely more temperature atmosphere. They are produced to test the characteristics of particles at extremely high and precise temperature. Muffle furnace is also called as retort furnace.

A muffle furnace is a section of oven type equipment that can reach high temperatures. It usually works by putting a hot temperature heating coil in an insulated material. The insulation effectively acts as a muffle, preventing heat from escapin

Figure 1. MUFFLE URNACE – CENTRE FOR RURAL ENERGY, GANDHIGRAM RURAL INSTITUTE-GANDHIGRAM.

Technical Specification of Muffle Furnace:

MODEL	BST/MF/900
MAXIMUM TEMPERATURE	900 °C
WORKING TEMPERATURE	800°C
TEMPERATURE ACCURACY	+/- 1°C (+/- 1.8°F)

MATERIALS AND METHODS:

The test was carried out by using muffle furnace model **BST/MF/900 in centre for Rural Energy, Gandhi gram.**

Sample preparation:

Air free samples of areca nut waste and rice husk were taken, spread in open space. The areca nut wastes are cut by scissors to reduce the size of the waste and the rice husk is taken for comparison studies.

- Tare the electronic balancer in order to get accurate measurements.
- Take the initial weight of crucible without biomass as w1 grams.
- Take the weight of crucible with biomass as w2 grams.
- Calculate the weight of biomass
    - W1= 37.5g
    - W2= 56.84g
    - W3= 47.89g
    - W4 = 39.769g
    - W5 = 38.607g

Weight of biomass= (w2-w1) grams.

- Kept the crucible as open with biomass in the hot air oven at a temperature range 110oC for 10 minutes with the help of stop clock. in order to calculate the moisture content present in the biomass.
- Cool the biomass for required time. Take the weight as w3 grams.
- Calculate the moisture content of biomass

$$\% \text{ of Moisture} = [(W2-W3)/(W2-W1)] *100$$

- Kept the crucible as closed (volatile matter not to be escaped) with biomass in the muffle furnace at a temperature range 400oC for 15 minutes with the help of stop clock. In order to calculate the volatile matter present in the biomass.
- Cool the biomass for required time. Take the weight as w4.
- Calculate the volatile matter present in the biomass

$$\% \text{ of Volatile Matter} = [(W3-W4)/ (W2-W1)]*100$$

Set the temperature of muffle furnace at 600^0c

- Kept the crucible as open in muffle furnace for 10 minute. To Calculate the ash content present in the biomass
- Cool the biomass for required time. Take the weight as w5

- Calculate the ash content in the biomass.

$$\% \text{ of Ash} = [(W5-W1)/(W2-W1)]*100$$

- Finally calculate the amount so fixed carbon present in the biomass.

% of Fixed Carbon = 100 – (% of Moisture + % of Volatile matter + % of Ash)

Now find the percentage of carbon, hydrogen, nitrogen, oxygen which is

% Carbon = 0.97 *fixed carbon + 0.7(volatile matter - 0.1 ash)

– moisture content (0.6 - 0.1* moisture content).

% Hydrogen = 0.36* fixed carbon + 0.086 (volatile matter – 0.1 ash)

-0.0035* moisture content^2.

% Nitrogen = 2.10 – 0.020* volatile matter

% Oxygen = 100 – (carbon + hydrogen + nitrogen + ash)

1. Percentage of moisture content: **% of moisture content =** [(W2-W3) / (W2-W1)] * 100

= (33.822 – 47.89) / (56.87 – 37.5) *100

= 0.463 * 100

= 5.43%

2. % of Volatile matter = [(W3-W4)/ (W2-W1)] * 100

= (47.89-39.769) / (56.87 – 37.5) * 100

= 0.419 * 100

= 41.9%.

3. % of Ash content = [(W5-W1) / (W2-W1)] * 100

= (38.607-37.50) / (56.87-37.5) *100 = 0.057 *100

= 5.7%.

4. Fixed carbon:

% of fixed carbon = 100-(% of moisture + % of volatile matter + % of ash)

= 100-(5.43+ 41.9 + 5.7)

= 46.9%

Calculation of ultimate analysis:

1. **Percentage of carbon** = 0.91*FC +0.7(VM+0.1 ASH)- Moisture(0.6-0.01Moisture)

   = 0.91*5.99+0.7(41.9+ 0.1*5.7)-46.3(0.6-0.1*46.3)

   = 68.394%

2. **Percentage of Hydrogen** = 0.036*FC+0.086(VM=0.1 ASH)-0.0035MOISTURE^2 (0.6-0.1Moisture).

   = 2.844%

3. **Percentage of Nitrogen** = 2.10+ 0.020VM**.**

   = 2.938%

4. **Percentage of Oxygen** = 100-(% of hydrogen + % of nitrogen+ % of ASH)

   =20.107%.

Figure 2. Muffle furnace at 800 °C

Figure 3A Sample of areca nut waste after analysis… Figure 3.Sample of areca nut waste before analysis

Proximate and ultimate analysis value of rice husk. (By using above same formulas).

W1= 37.5

W2= 56.84

W3= 47.89

W4 = 39.769

W5 = 38.607

Moisture content = 7.393%

Volatile matter = 50.901%

Fixed carbon = 29.136 %

Ash Content = 12.57 %

Carbon = 46.81%

Hydrogen = 8.460 %

Nitrogen = 1.081 %
Oxygen = 14.50 %

Results and discussion:

During the proximate and ultimate analysis of areca nut waste and rice husk, the values of moisture content, fixed carbon and hydrogen content quite satisfactory to produce biomass for gasifier, the following graph (bar chart) between the rice husk and areca nut are given below to compare the properties of areca nut waste with rice husk.

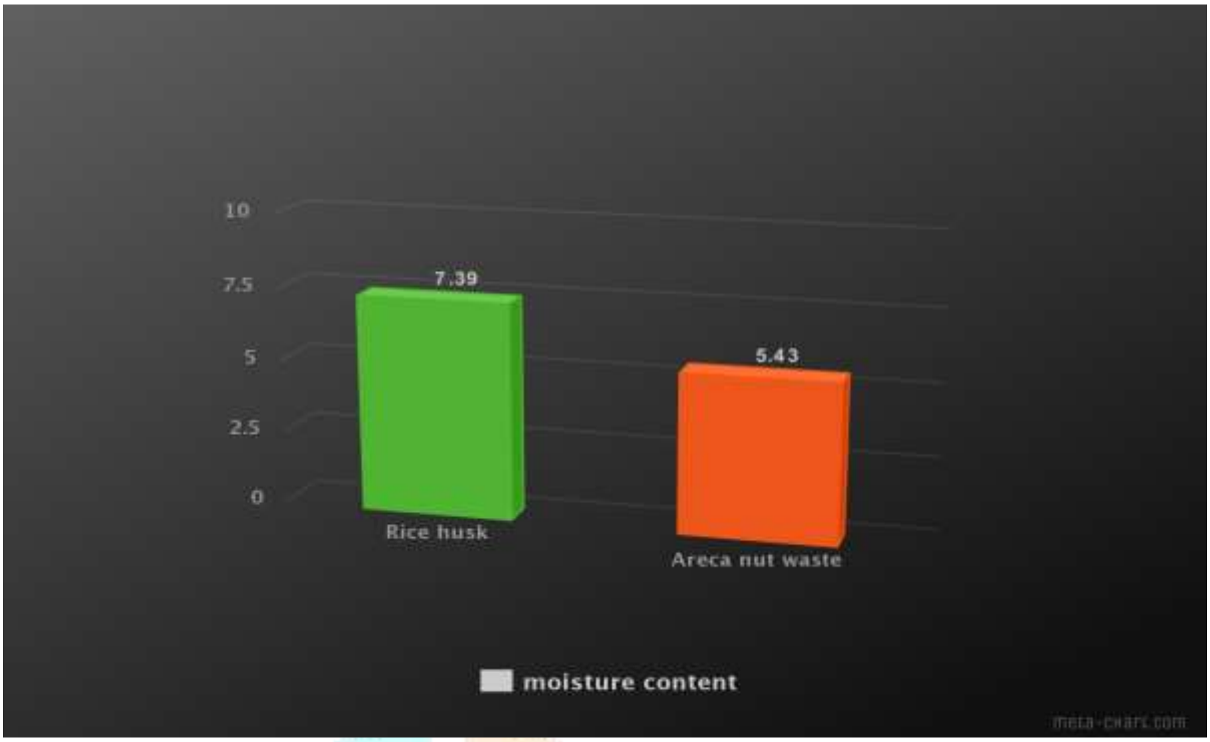

Figure 4. Comparison of moisture content between areca nut waste and rice husk

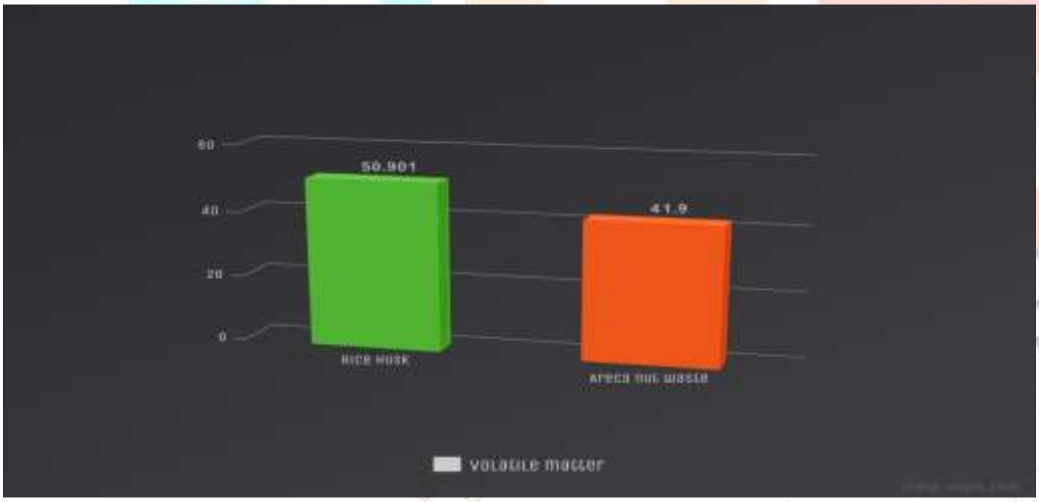

Figure 5. Comparison of Volatile matter between areca waste and rice husk.

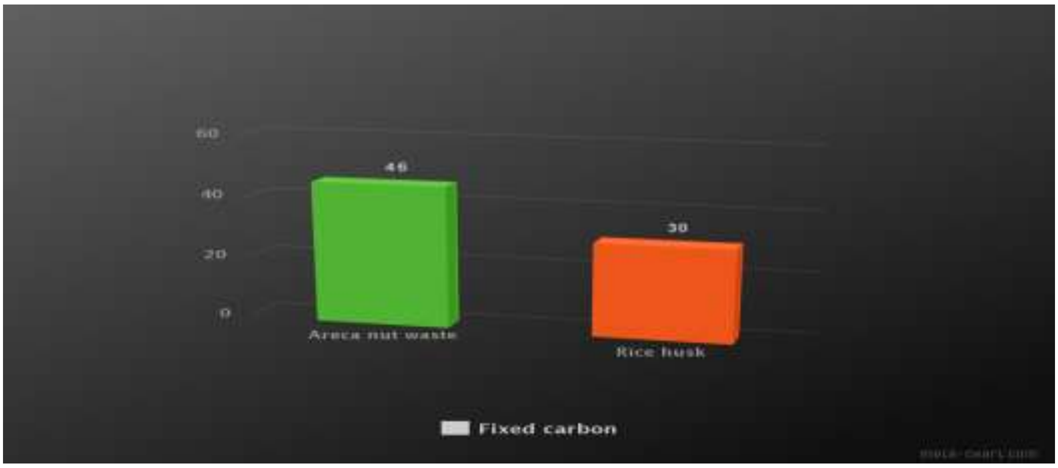

Figure 6. Comparison of Fixed carbon content between Areca nut waste and rice husk

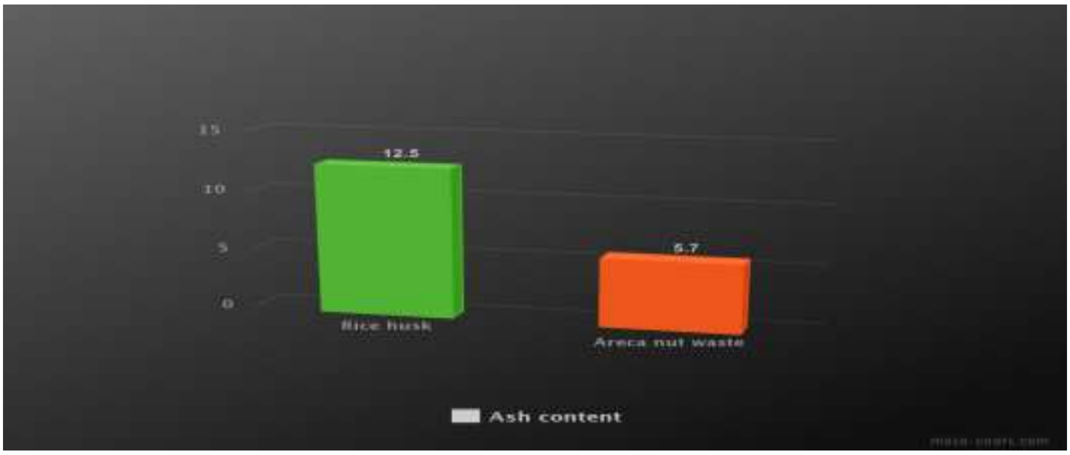

Figure 7.Comparison of ash content between areca nut waste and rice husk.

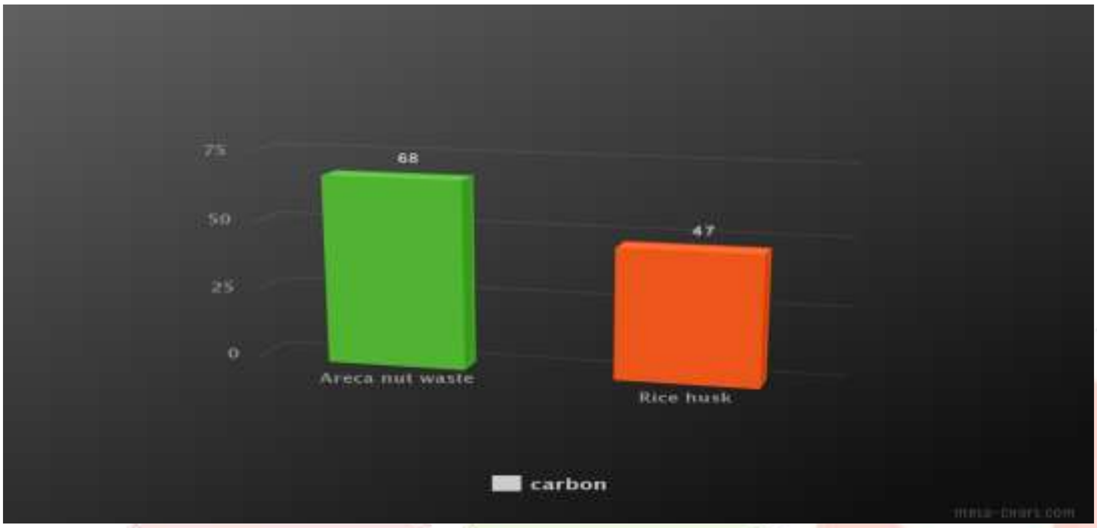

Figure 8.Comparison of carbon content between areca nut waste and rice husk.

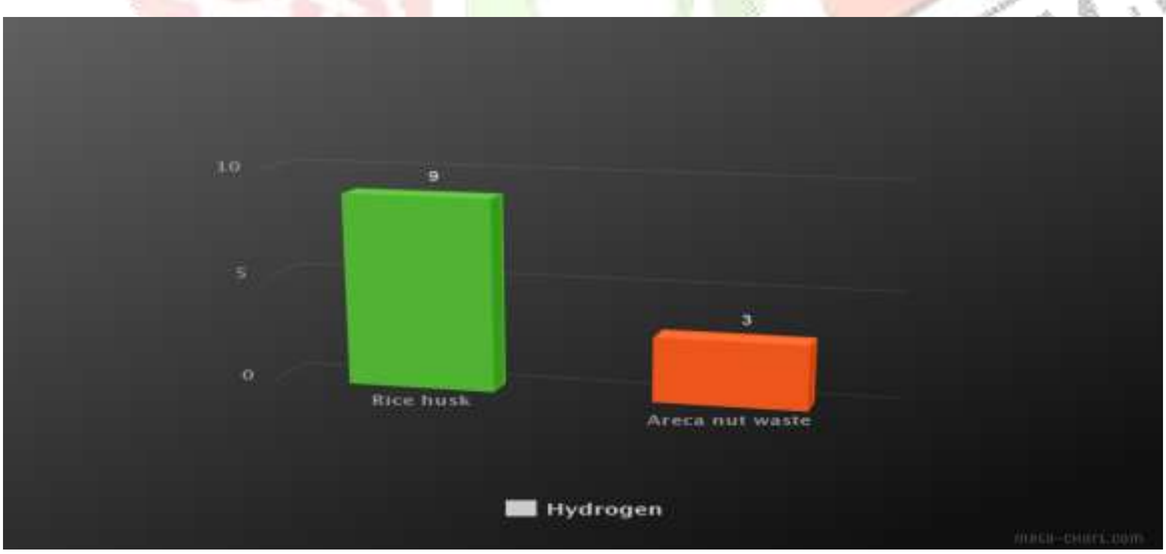

Figure 9.Comparison of hydrogen content between areca nut waste and rice husk

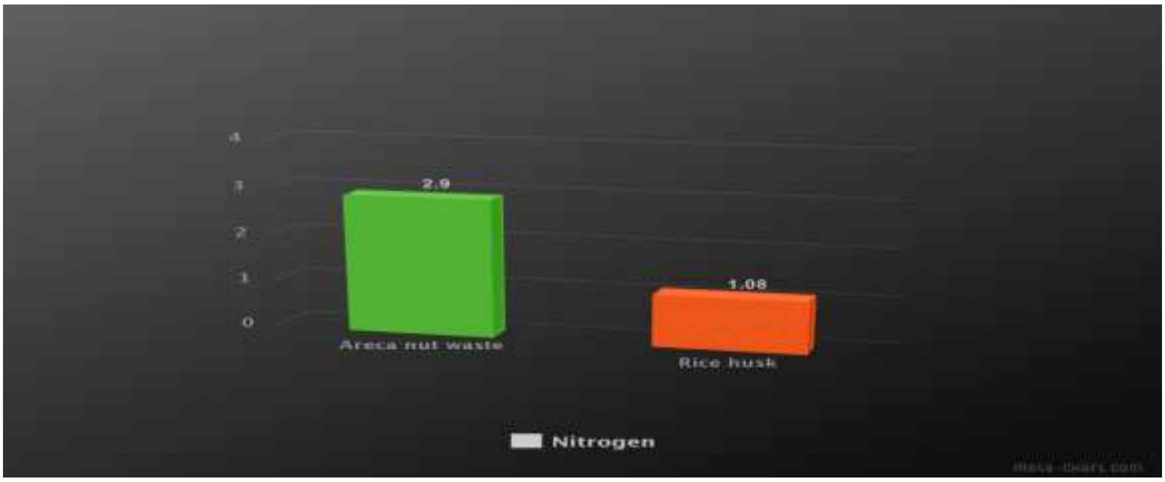

Figure 10.Comparison of Nitrogen content between areca nut waste and rice husk

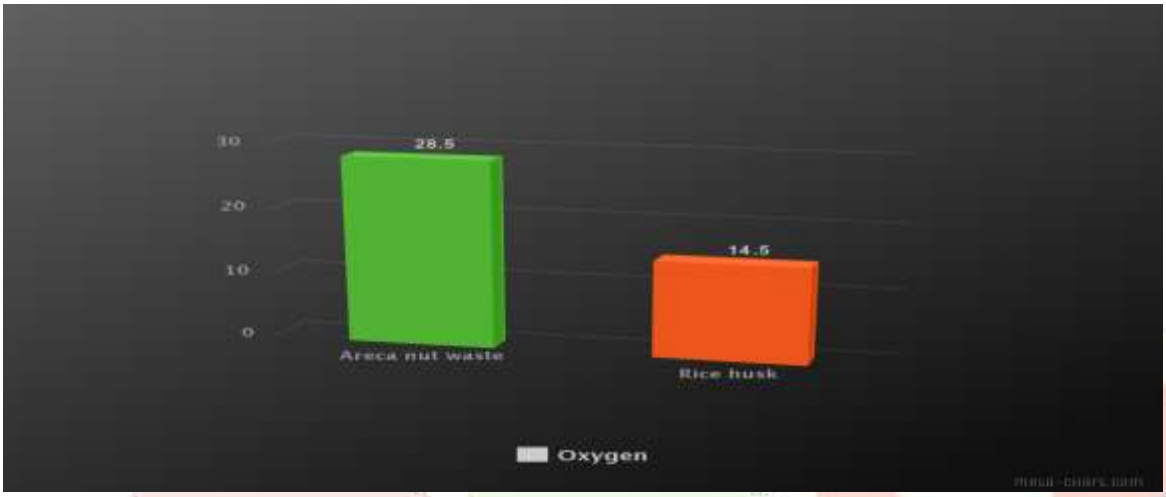

Figure 11.Comparison of oxygen content between areca nut waste and rice husk

Conclusion:

Based on the above discussion it clear that biomass produced from the areca nut waste is suitable for down draft gasifier as a feed, while comparing the values of fixed carbon, Hydrogen, Nitrogen of rice husk is quite relatable to the values of areca nut waste. Gasification is the best way to manage the areca nut waste and this gasification will also achieve the sustainable waste management.

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Data availability:

Data sharing is not applicable to this article as no new data were created or analyzed in this study.