

Exploring the Potential of Castor Oil for Biodiesel Production: Process Optimization and Fuel Property Evaluation

Lasitha Madhusanka^{*1,2}, Indunil Chamara², Lakshan Priyankara^{1,3}, Isuranga Abejewa¹, Chanika Kariyawasam¹, Helitha Nilmalgoda^{1,2}, Chanaka Galpaya¹, and Kaveenga Koswattage^{1,3}

¹ Centre for Nanodevice Fabrication and Characterization, Faculty of Technology, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka

² Department of Biosystems Technology, Faculty of Technology, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka

³ Department of Engineering Technology, Faculty of Technology, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka

INTRODUCTION & AIM

- Biodiesel offers a cleaner and renewable alternative to petroleum-based diesel fuel.
- Edible oils raise concerns regarding food security and production cost. Castor oil is a promising non-edible feedstock with high oil yield and adaptability to marginal lands.
- To optimize biodiesel production from castor oil using alkaline transesterification and evaluate the fuel properties according to ASTM standards.

OBJECTIVES

Broad Objective

To investigate the potential of castor oil as a feedstock for biodiesel production and evaluate the quality of the produced biodiesel.

Specific Objectives

- Produce biodiesel via alkaline transesterification.
- Optimize biodiesel production conditions.
- Determine key fuel properties of the produced biodiesel.
- Assess compliance with ASTM D6751 biodiesel standards.

METHOD

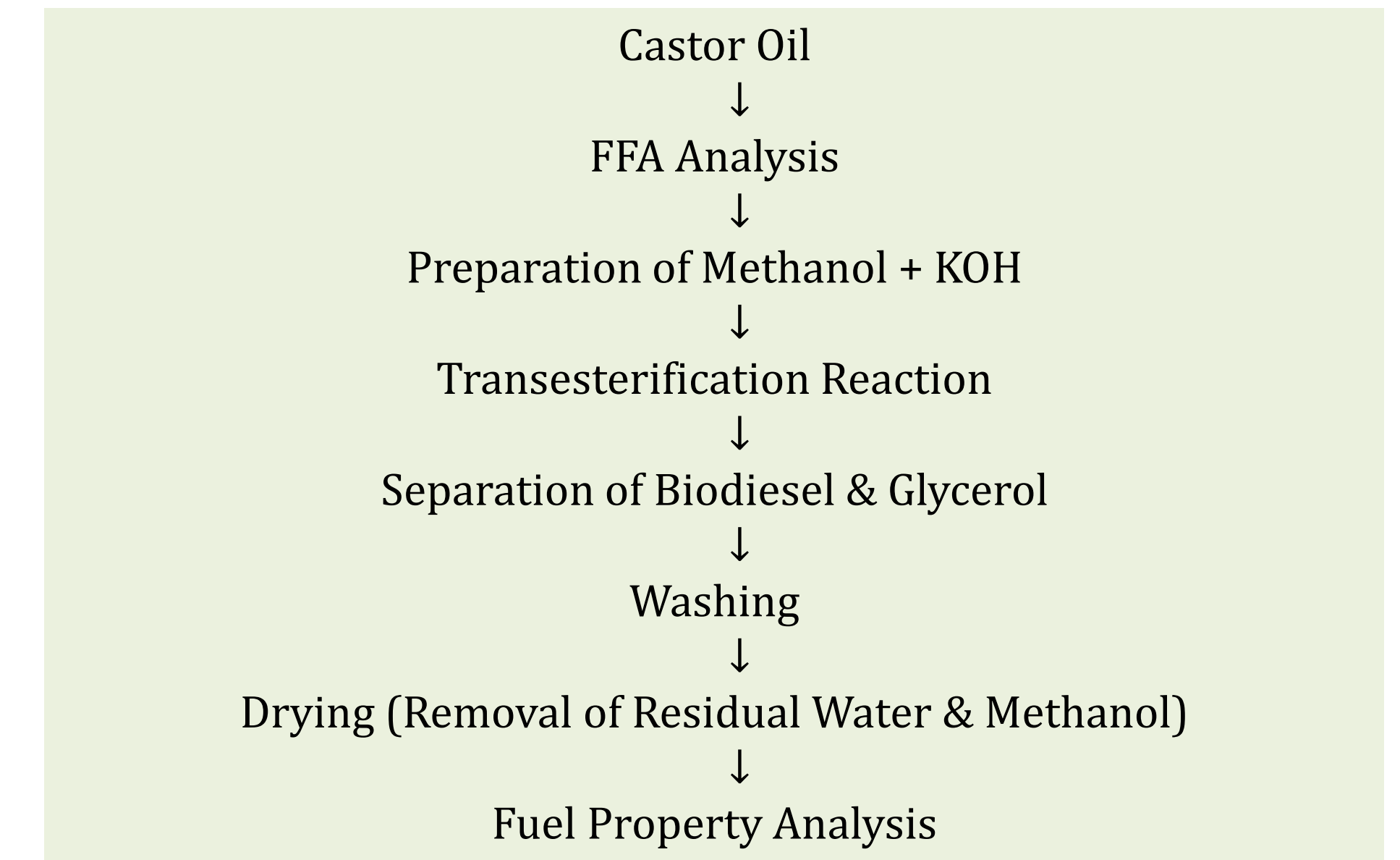


Figure 01. Experimental Procedure.

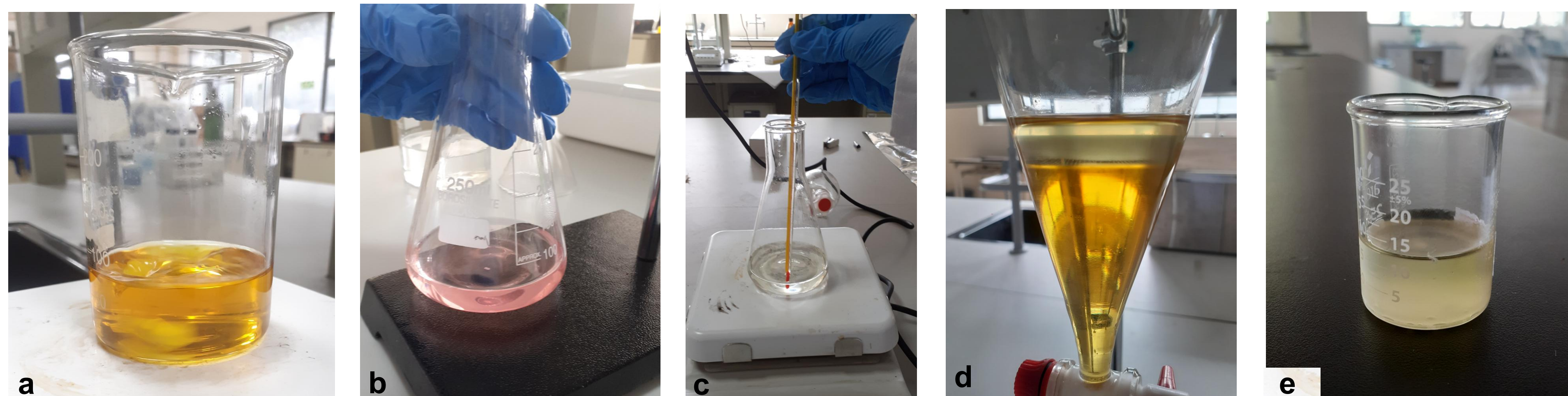


Figure 02. Biodiesel production process and final biodiesel product (a); Castor Oil (b); FFA Analysis (c); Reaction Mixture (d); Biodiesel + Glycerol (e); Purified Biodiesel

RESULTS & DISCUSSION

Graph 01: Effect of Methanol : Oil Ratio on Biodiesel Yield %

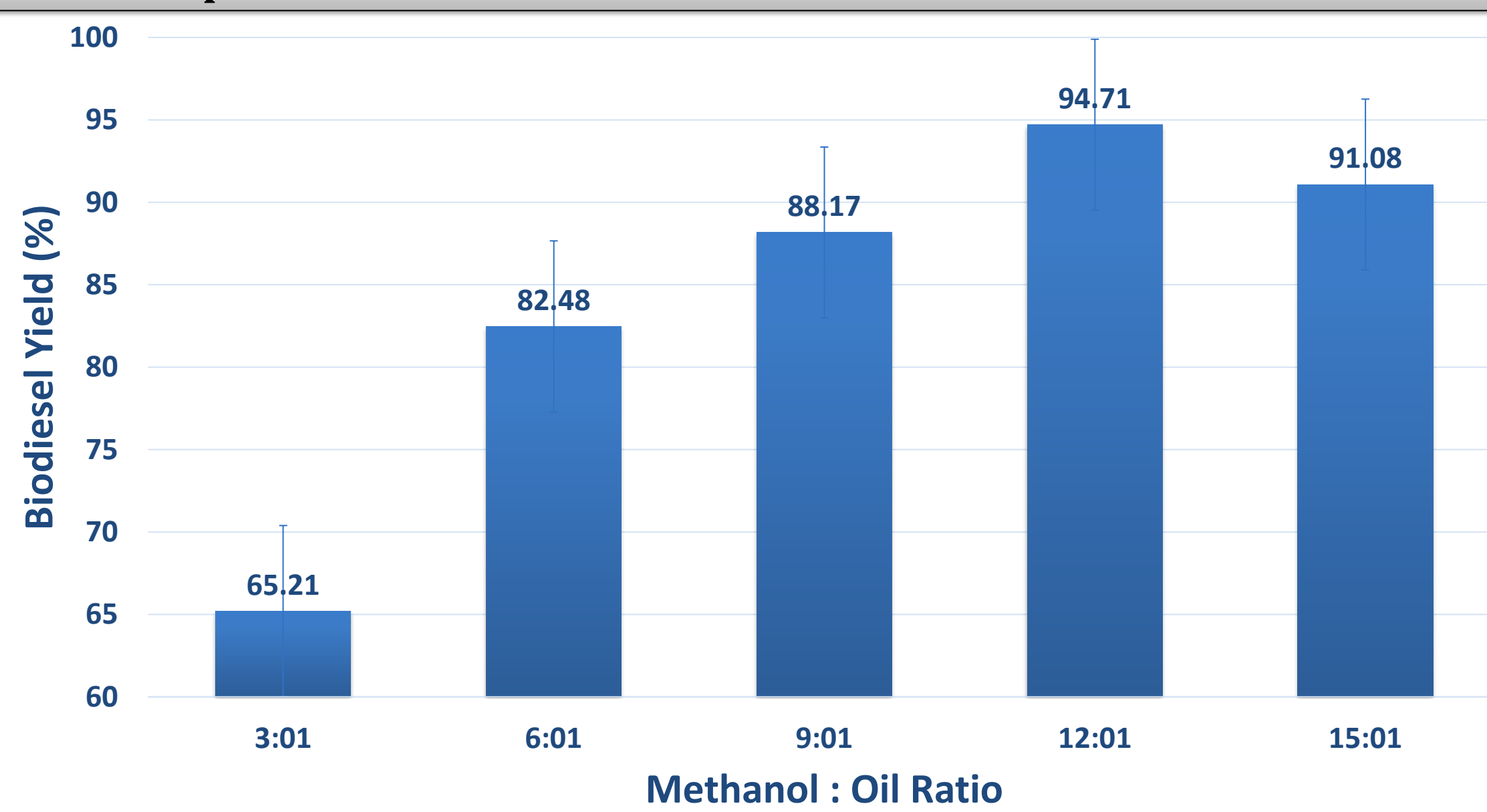


Table 01: Comparison of biodiesel properties with ASTM (D6751) standard.

Properties of Biodiesel	Caster oil Biodiesel	ASTM Standard (D6751) of Biodiesel
Calorific Value (MJ/kg)	38.249	40.5
Flash Point (°C)	194	93
Density g/cm ³ at (15°C)	0.9247	0.87-0.89
Kinematic Viscosity (mm ² /s) at (40°C)	14.045	1.9-6.0
Thermal Conductivity (mW/m-K) at 30.15°C	0.15	N/A

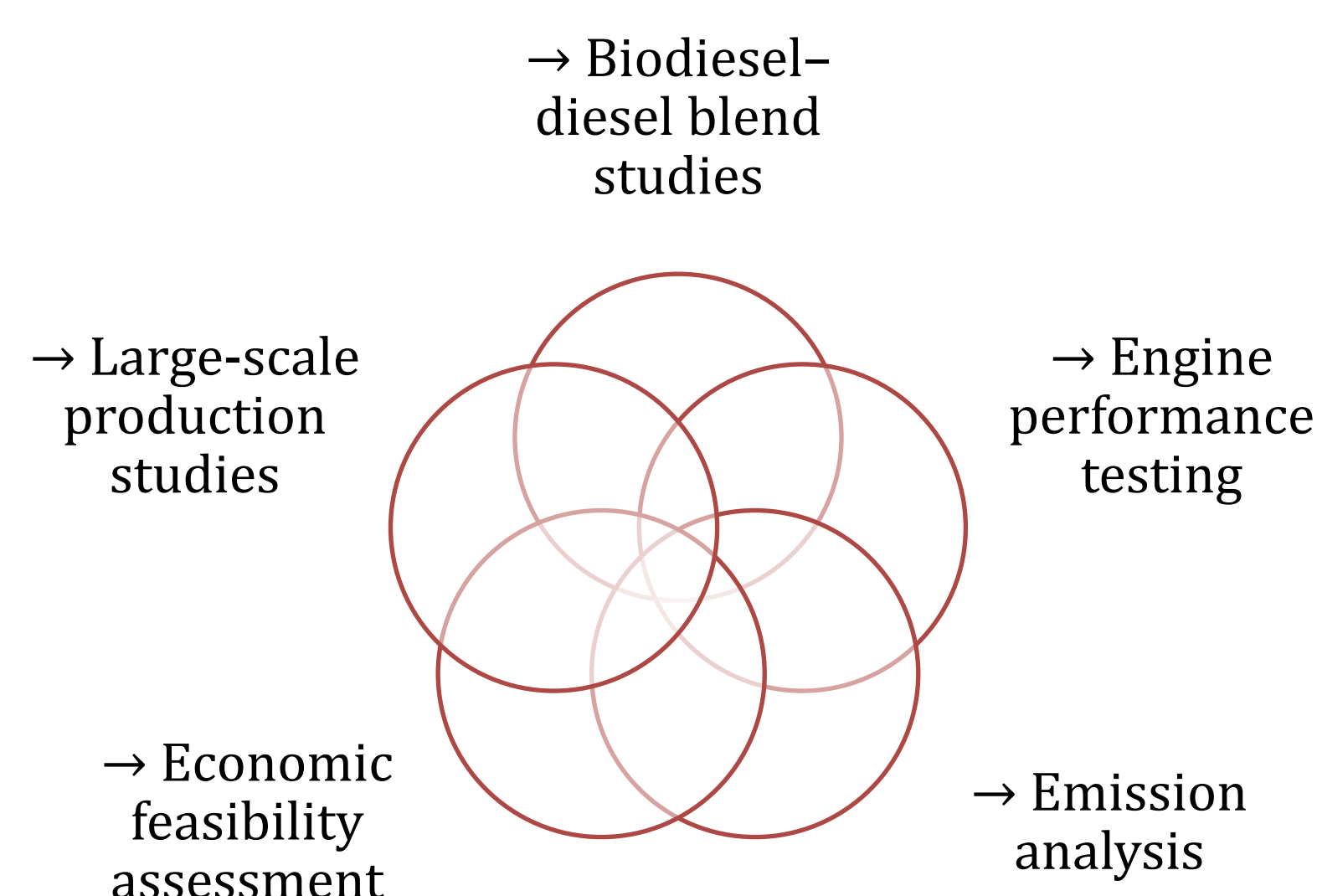
❖ Castor oil with a low FFA content (1.02%) was suitable for alkaline transesterification. The produced biodiesel showed favorable fuel characteristics, including a high flash point (194°C) and good calorific value (38.249 MJ/kg). Although the density was acceptable, the viscosity (14.045 mm²/s) exceeded ASTM D6751 limits, indicating the need for further optimization or blending with diesel. These findings demonstrate the potential of castor oil as a sustainable non-edible feedstock for biodiesel production.

CONCLUSIONS

Castor oil is a promising non-edible feedstock for biodiesel production.

- FFA content (1.02%) was suitable for alkaline transesterification.
- Optimum conditions:**
 - 2 wt% KOH
 - 12:1 methanol:oil ratio
 - 60°C
 - 90 min reaction time
- Produced biodiesel exhibited acceptable fuel properties except viscosity.
- Blending with diesel can improve practical applicability.

FUTURE WORK



REFERENCES

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