# Adding value to Marula

GIZ/ABioSA/Jonathon Rees

ABioSA STUDENT RESEARCH

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Trishen Reddy did this research as part of his Master's degree in chemical engineering at the Vaal University of Technology. He presented his research at the first African Biotrade Festival in September 2023. Since then, he has been awarded his Master's degree cum-laude. Trishen is now working towards his PhD in chemical engineering and works as a senior process engineer in the advanced agriculture and food cluster at the Council for Scientific and Industrial Research.

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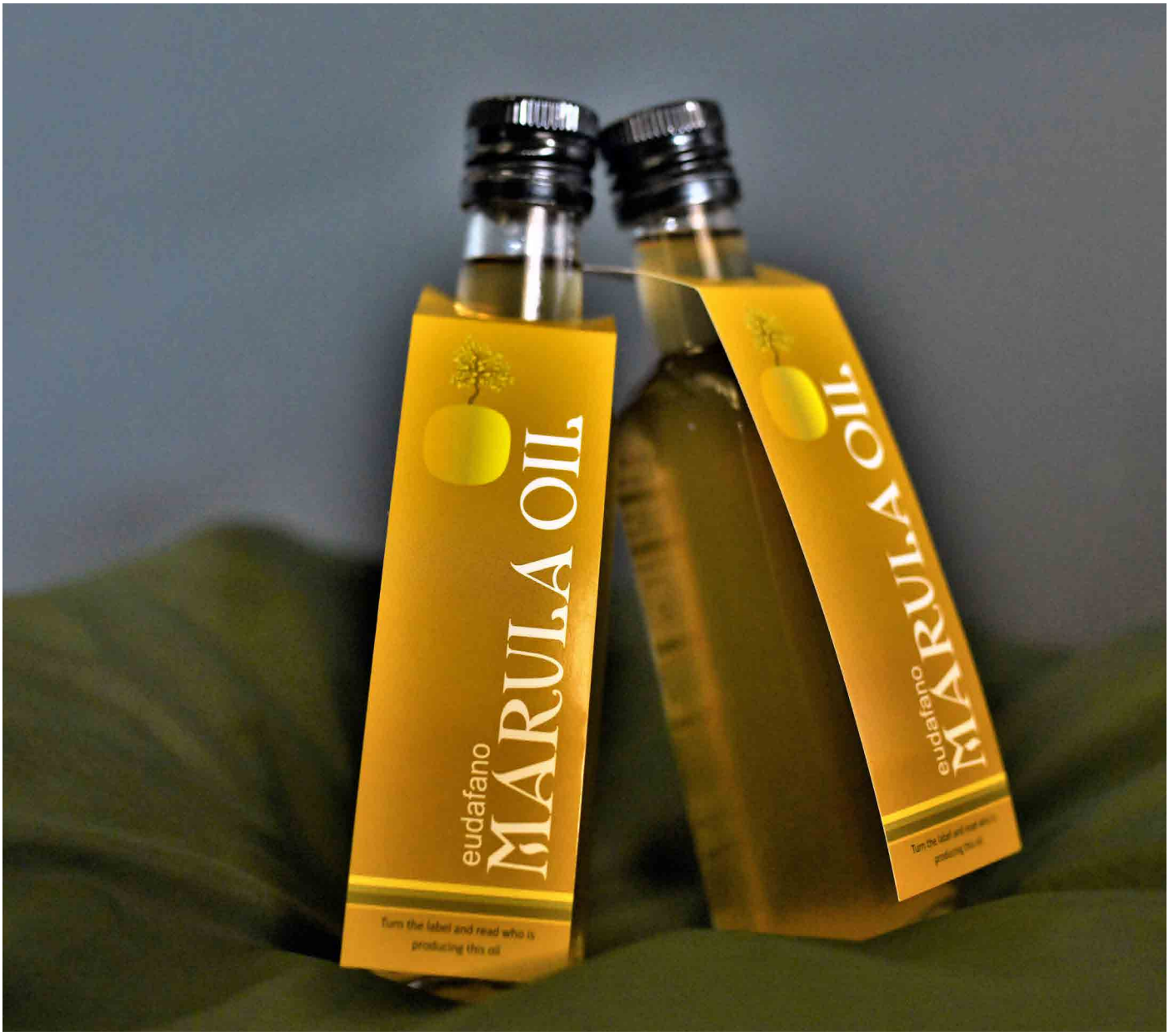


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## About Marula

Marula is one of the most economically important but underutilised indigenous species in southern Africa. It is a perennial, drought resistant fruit-bearing tree which can live up to 150 years, and has significant nutritional benefits.

The yellow fruit is traditionally used to make beer and juices, and is being explored for its flavour, fragrance and health potential in international food and beverage markets. Marula oil is pressed from the kernel for export to cosmetics producers.

Products derived from Marula can function as a safety net from failure of other crops. Sustainable domestication and cultivation practices are required for the commercialisation of Marula, and to improve genetic strains, quality and reliability.

Modern research has verified many of the beneficial properties of Marula oil and the demand for Marula oil is growing, particularly in the wellness and cosmetics industries.

Marula has been wild harvested by local communities for generations, though its commercial exploitation is relatively new.

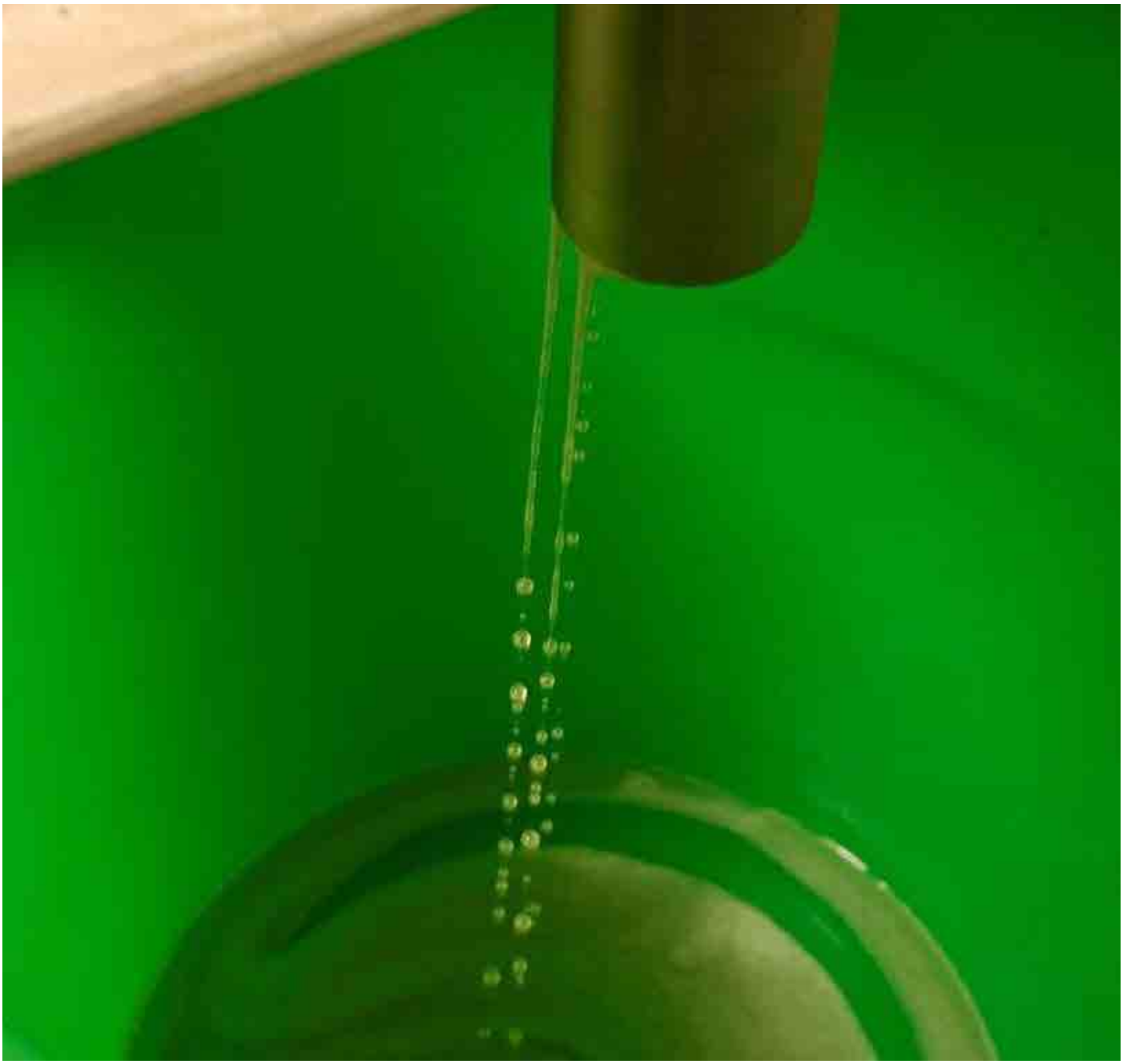
## Research summary

Reddy is investigating factors inhibiting the Marula oil sector from increasing production to meet growing international demand. There is a risk the supply of Marula may be unreliable without more formalised harvesting and extraction methods.

Ensuring sufficient volumes and quality of supply requires development of mathematical and empirical models to determine the most viable operating conditions to increase output.

The aim of Reddy's research was to develop these models to determine the solubility of Marula oil and its compounds through a supercritical fluid extraction process using carbon dioxide as a solvent. This would assist in selecting the optimal pressure and temperature for supercritical carbon dioxide extraction to achieve the highest yield.

These models will also aid in the development of scaling-up techniques from laboratory to pilot and industrial stages, and the costing of equipment and design specifications required to optimise the output of oil.



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## Research process

The main goal of Reddy's research was to create accurate models to find out how well Marula oil and its compounds dissolve in supercritical carbon dioxide, which can act like a solvent to separate different substances.

The research focused on empirical models, which are effective for measuring solubility because they are based on real experimental data.

Reddy developed six different widely used models for Marula oil solubility, selected because they relate solubility to the density of the supercritical fluid.

To find the specific values needed for these models, Reddy used data from his experiments and a tool in Microsoft Excel called the 'solver function', along with a statistical method called least squares regression.

Additionally, he used a technique called response surface methodology (RSM) to understand how different conditions affect the solubility of Marula oil in supercritical carbon dioxide. This process led to the creation of a mathematical model

## Results

The results from the study showed the six different models could effectively predict how well Marula oil dissolves in supercritical carbon dioxide.

The correlation refers to the relationship between the solubility of the Marula oil and the conditions of the supercritical carbon dioxide extraction, such as pressure and temperature.

Reddy used the response surface methodology technique to optimise the extraction process. This helped him determine the best pressure and temperature to use when extracting the oil to get the highest yield.

The findings indicated that both pressure and temperature significantly affected the extraction yield, and their interaction also played a role. The experimental results matched the predictions well, showing that the models were reliable. This means the models closely aligned with the actual results.

Reddy has had three journal articles published.