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The potential of oil palm loose fruits waste as a resources for the food and energy industries

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Samarinda, 2nd November 2022

Background

Indonesia has around 14,663.6 hectares of oil palm plantations

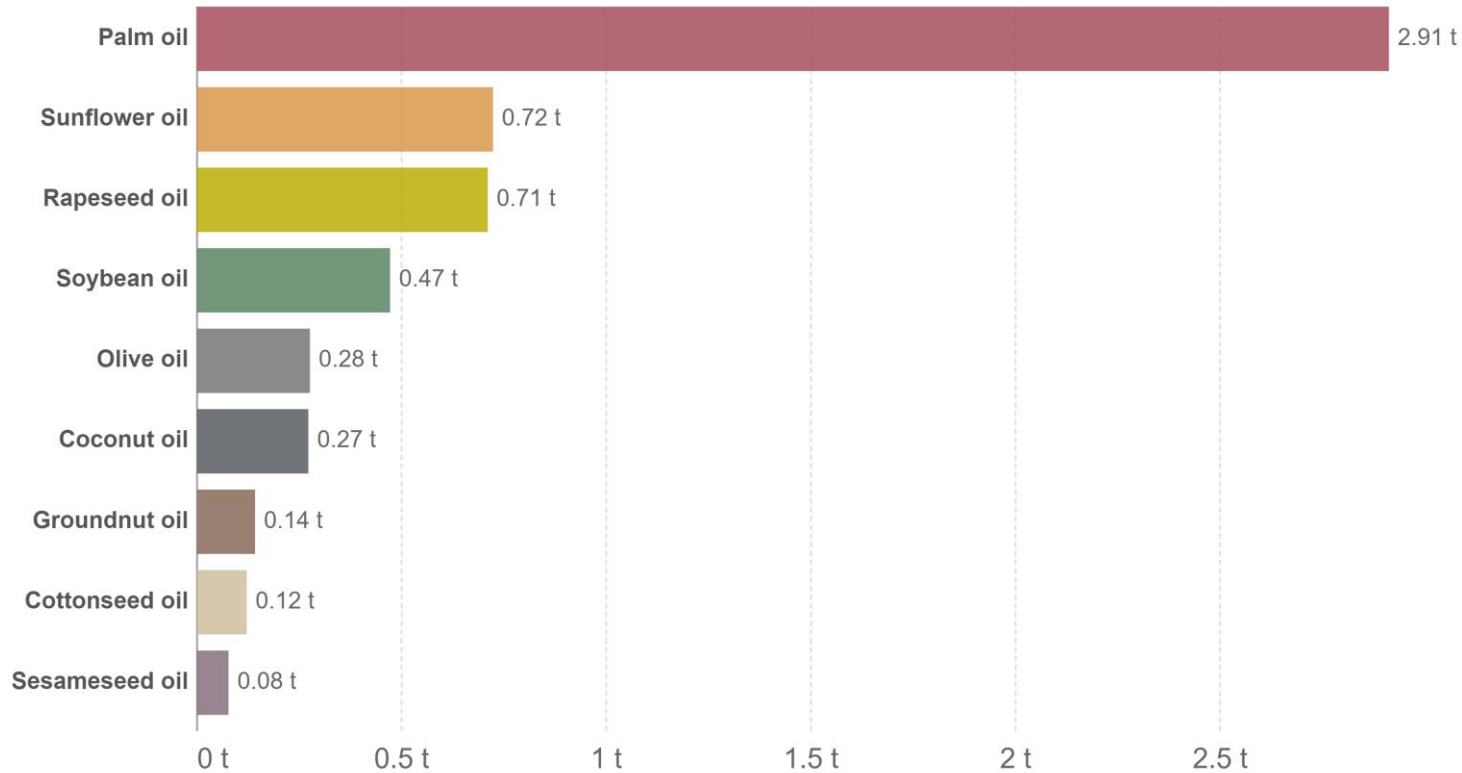


Palm oil contributes a foreign exchange around US\$ 22-23 miliar per year, in 2021 was US\$ 30 miliar



Oil yield by crop type, World, 2019

Global oil yields are measured as the average amount of vegetable oil produced per hectare of land. This is different from the total yield of the crop since only a fraction is available as vegetable oil.



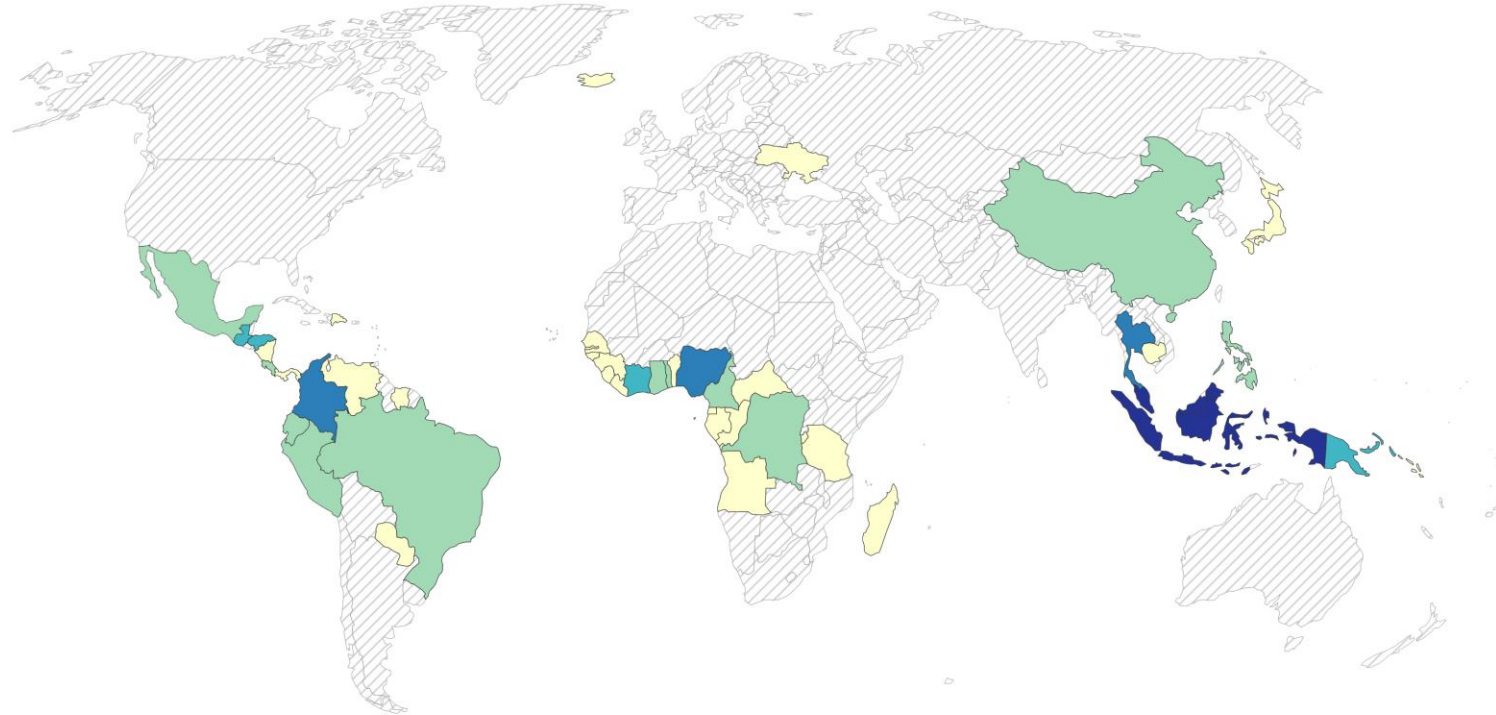
Source: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
OurWorldInData.org/crop-yields • CC BY

Palm oil achieves a much higher yield, means that it accounts for a very high share of oil *production* without taking up much land.

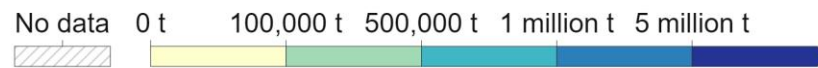
To limit our environmental impact, reducing the amount of land we devote to agriculture is key. To make space for biodiversity. The less land we need for farming, the better.

Oil palm production, 2019

Oil palm production is measured in tonnes.

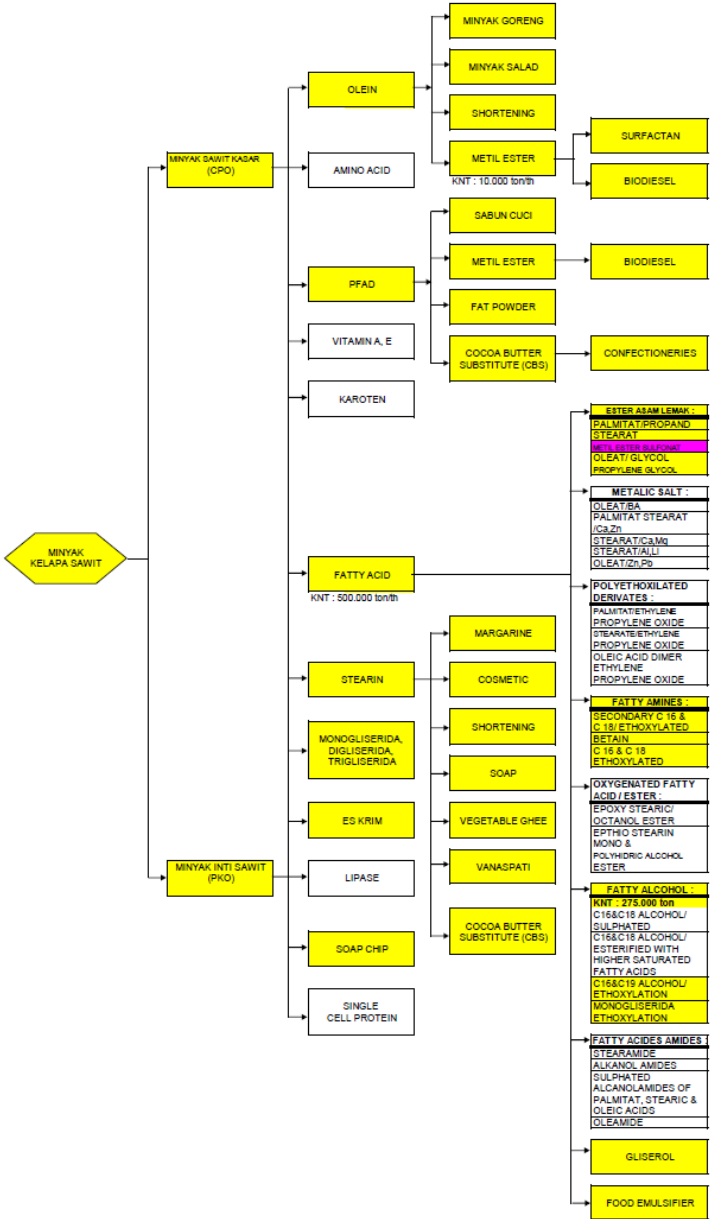


The global market is dominated by only two: Indonesia and Malaysia



Indonesia has around 39 palm oil processing plants

Palm oil-derived industrial tree



CPO is commonly used in the food industry, fuel source, and commodities (cosmetic and cleaning products, textiles, and plastics).

Oil palm fresh fruit bunches (FFB)

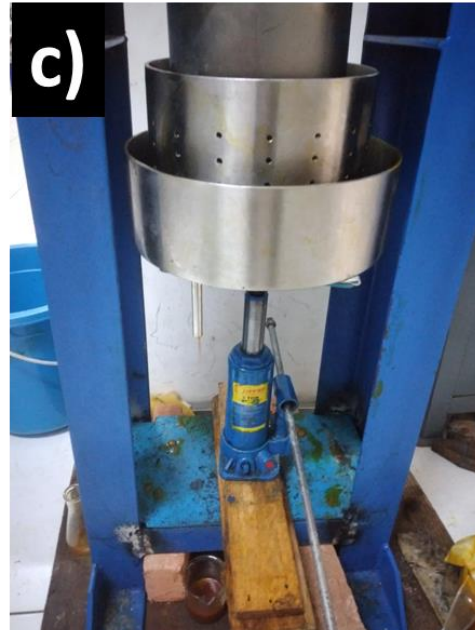


Oil palm loose fruits (LF)



Research

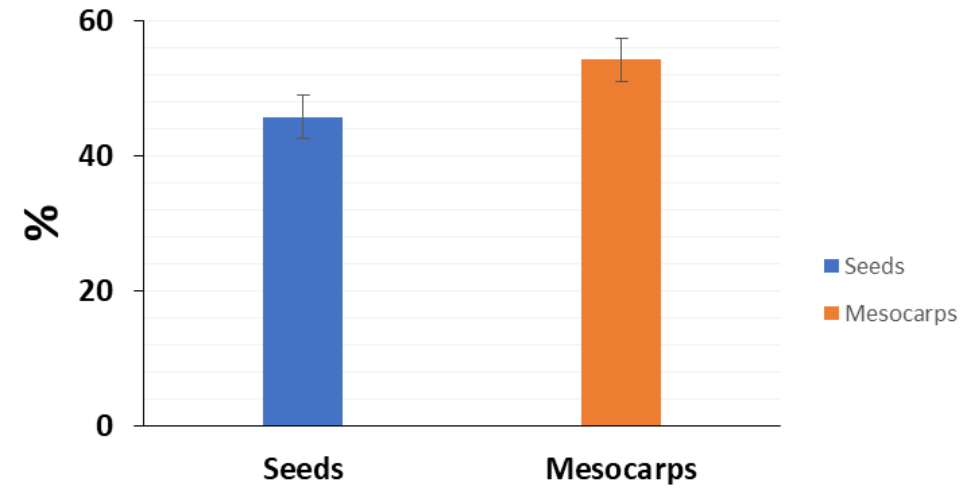
In our work, the potential of oil palm loose fruits will be investigated so that could be processed to give added economic value. The samples used in this work were oil palm fresh fruit bunches (FFB) and oil palm loose fruits (LF) with the various delay in processing time, i.e. 0, 4, 8 and 12 days



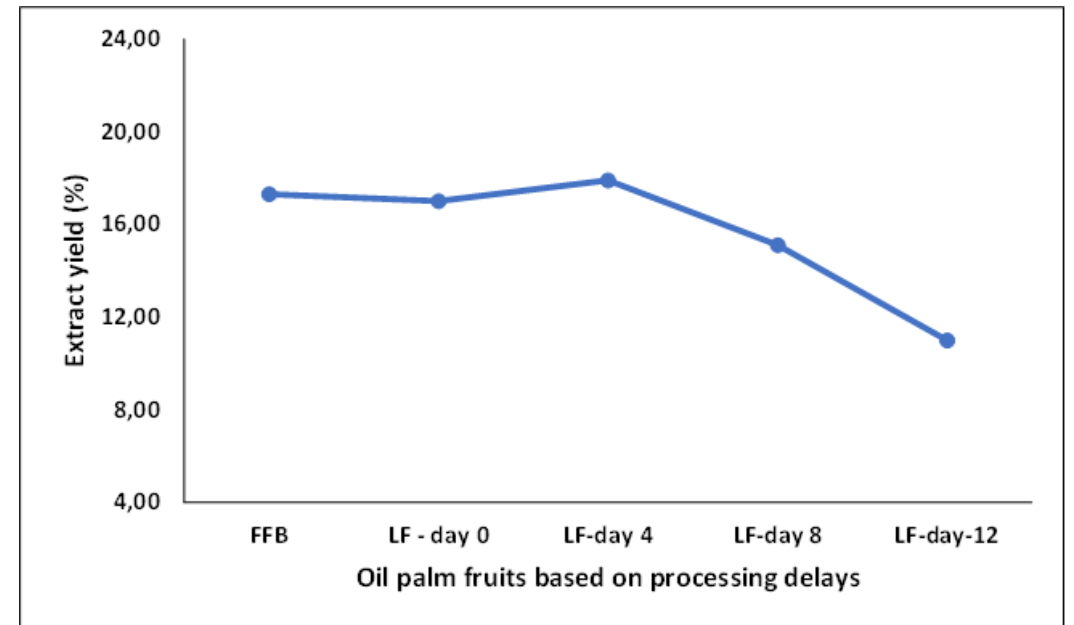
Results



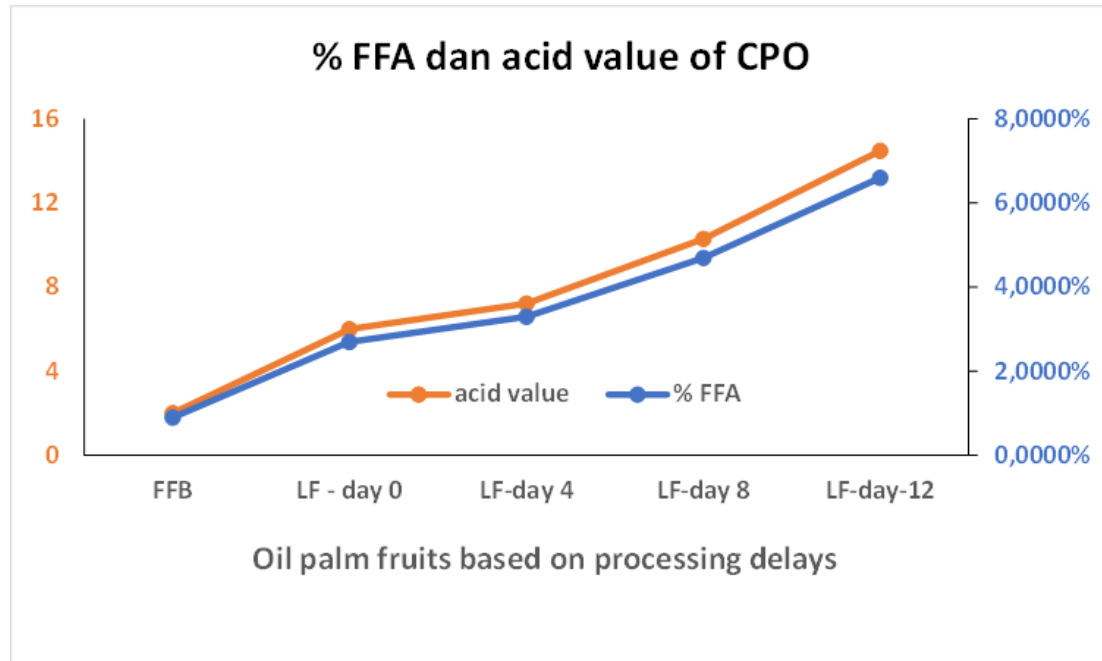
a) Fresh fruit bunch (FFB), b) Oil palm loose fruits (LF) and c) LF after 12 days



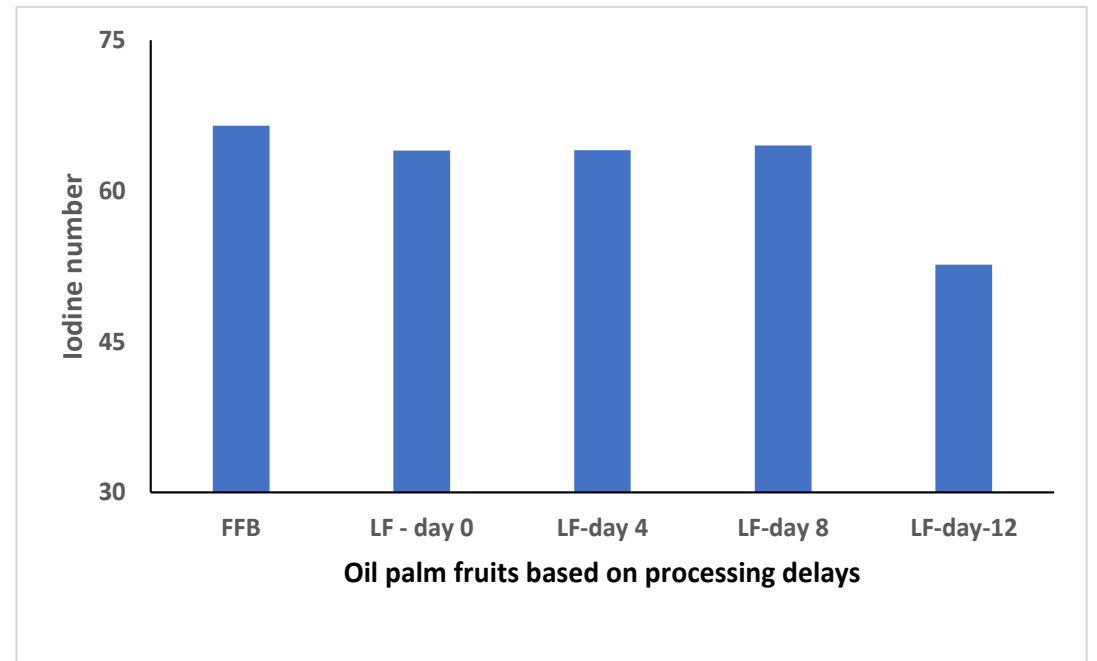
Composition of oil palm loose fruits



Results

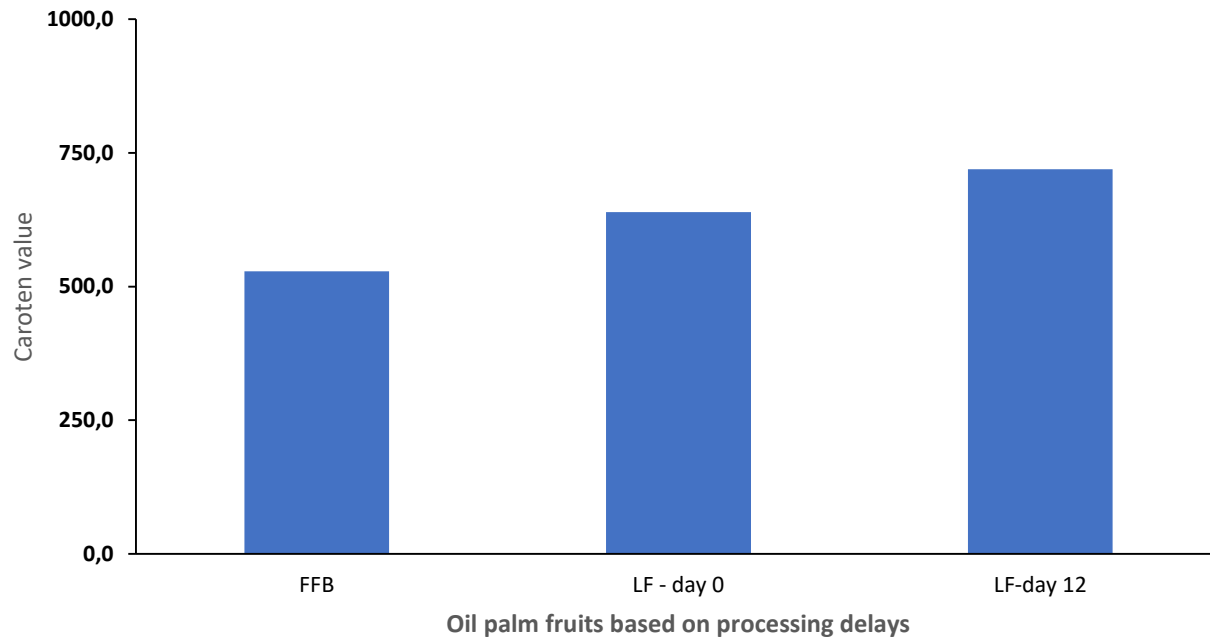


The percentage of free fatty acid and acid values of the fresh fruit bunch (FFB) and oil palm loose fruits (LF) at different processing time delays

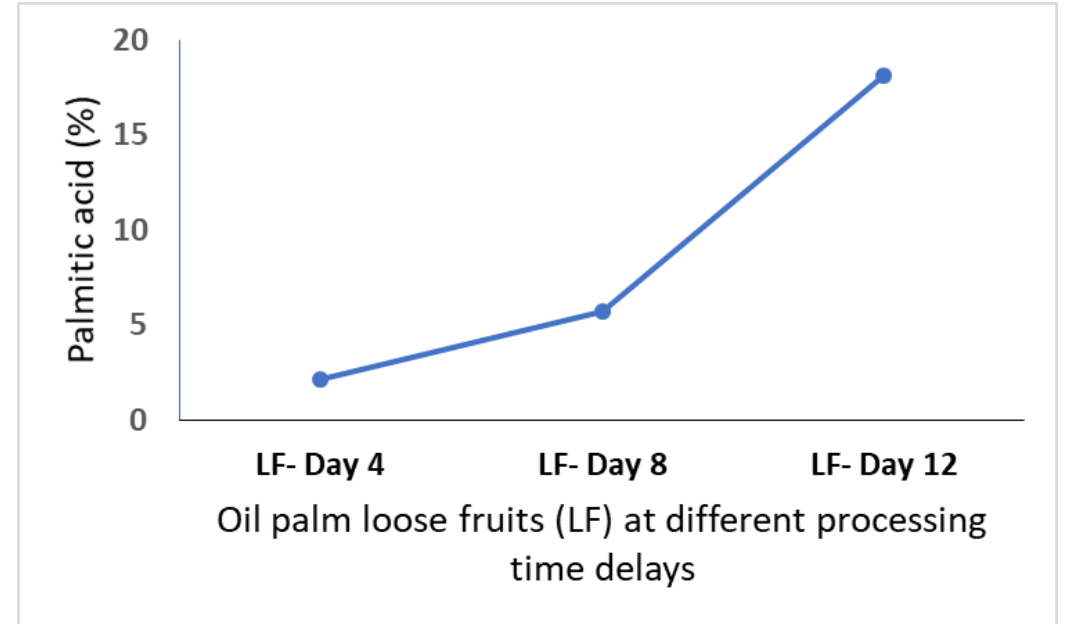


The iodine number of the fresh fruit bunch (FFB) and oil palm loose fruits (LF) at different processing time delays

Results



The carotene value of the fresh fruit bunch (FFB) and oil palm loose fruits (LF) at different processing time delays.



Palmitic acid content of oil palm loose fruits (LF) at different processing time delays.

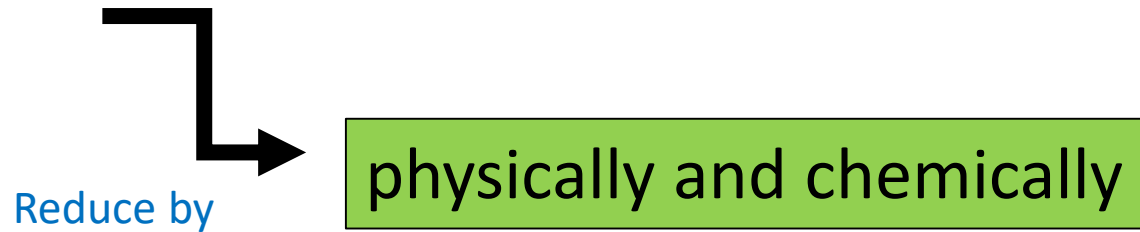
Conclusion

The oil palm loose fruits (LF) have the potential to have enhanced added value because the mesocarp can be extracted producing crude palm oil (CPO). While the seeds called kernels can be processed to produce oil kernel or palm kernel oil (PKO).

The results of the extraction of oil palm loose fruits (LF) contain high levels of carotene and palmitic acid so that they have potential as raw materials for the food and energy industries.

Challenge of the oil palm loose fruits (LF)

High free fatty acid

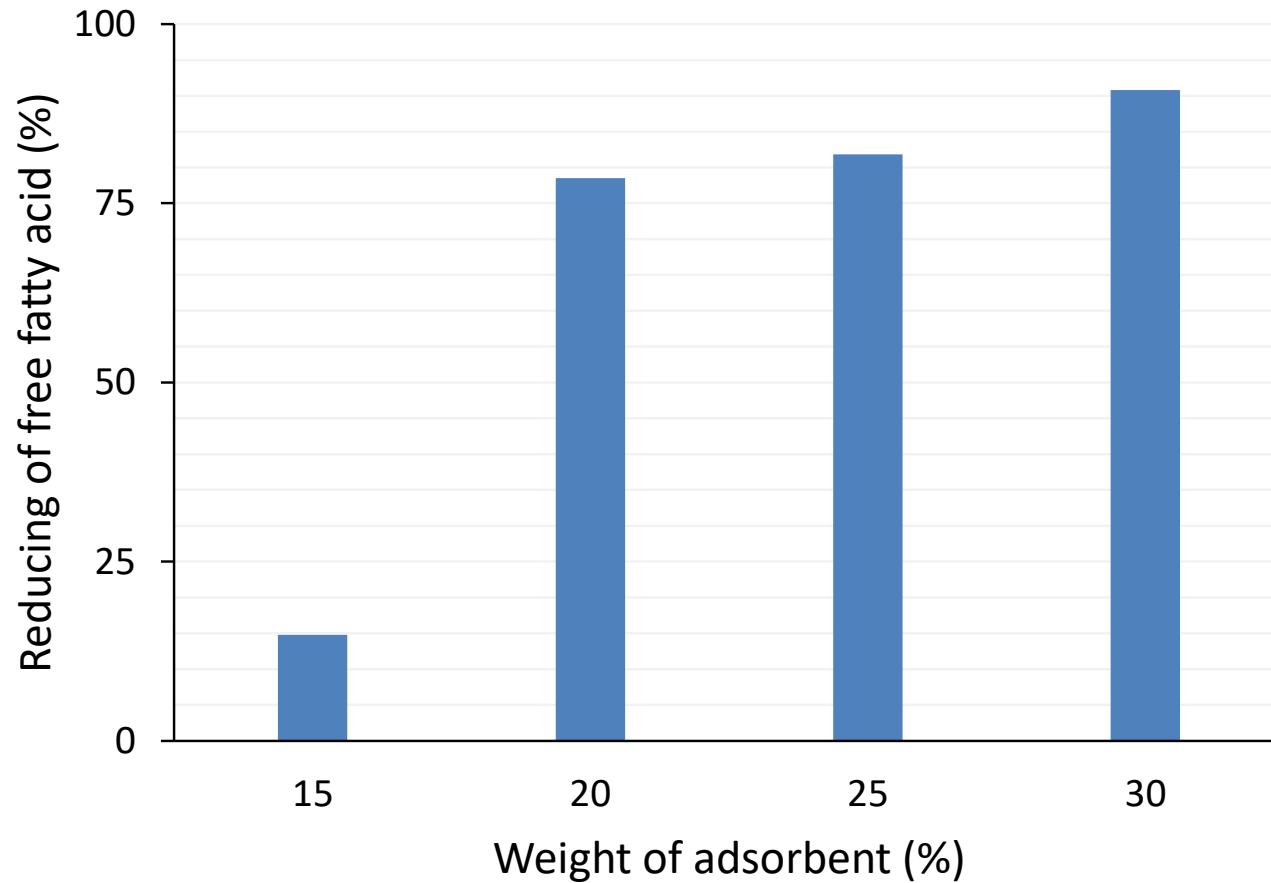


Reduce free fatty acid in oil :

- Adsorption (activated carbon, clay, chitosan, ion exchange resin IRA900C, etc)
- Catalyst (acid catalyst – H_2SO_4 , 12-Tungstophosphoric acid (TPA))
- Glycerolysis ($AlCl_3 \cdot 6H_2O$, Al_2O_3 , SnO_2 , $SbCl_3$, $HgCl_2$, FeO , etc)
- Membrane (Ultrafiltration)

Adsorbent

Activated carbon from coconut shell

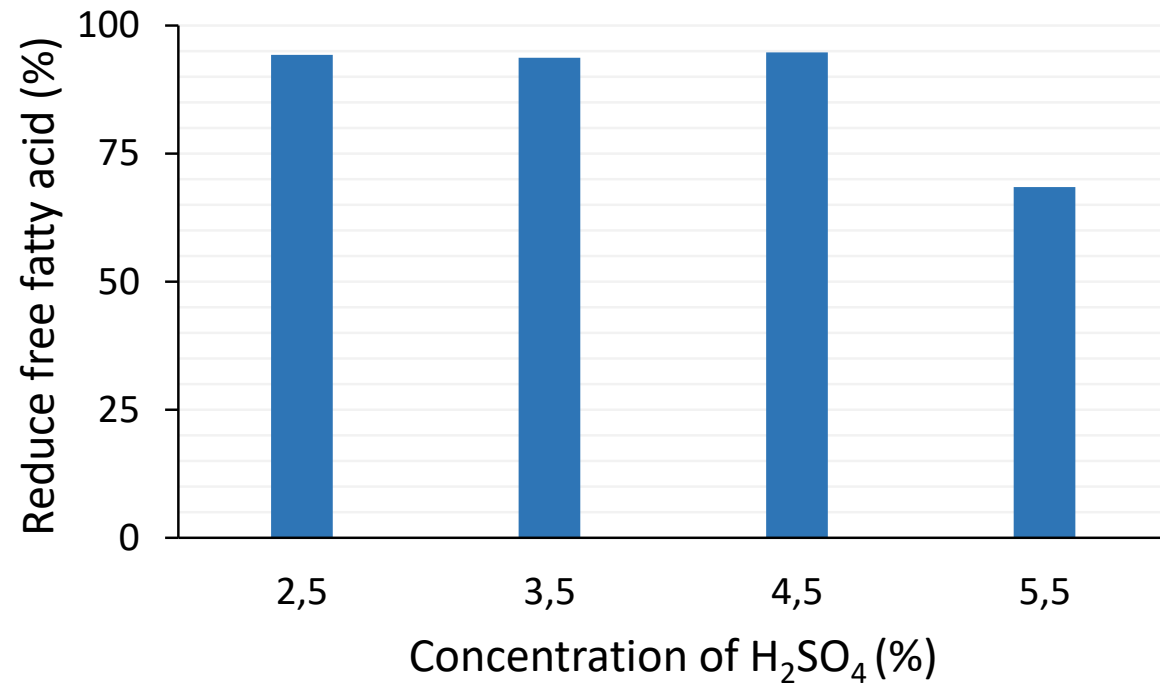


The adsorbent was carried out using `100 mesh

Mixing : 300 rpm,
temperature 80 °C; 1 hour
a)



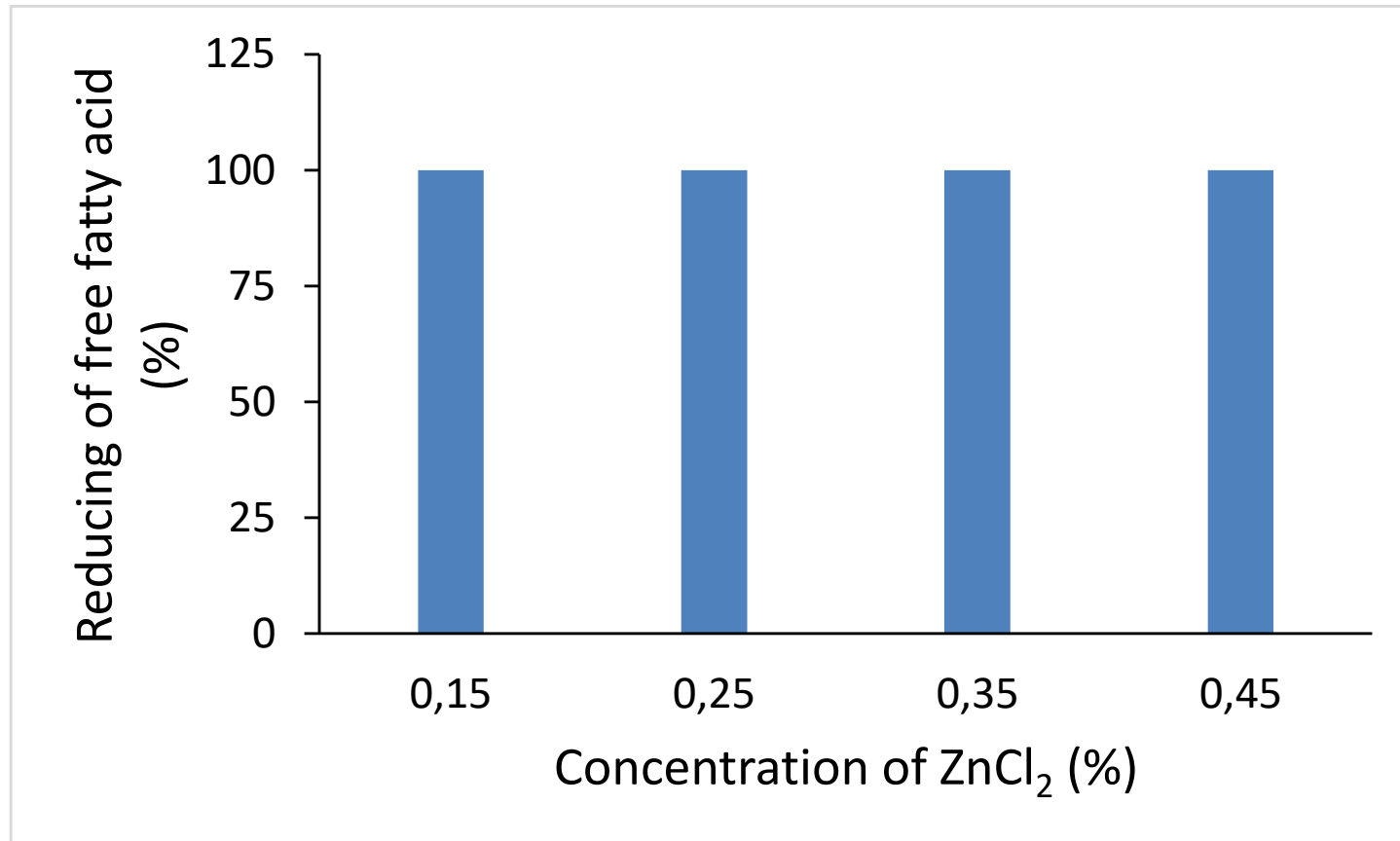
Acid catalyst



Mixing : 300 rpm,
temperature 60 °C; 8 hours



Glycerolysis



Catalyst ZnCl₂
Mixing : 300 rpm,
temperature 175 °C, 1 hour



ACKNOWLEDGEMENTS

This work was supported by Ministry of Education, Culture, Research and Technology under the program SIMLITABMAS research grant in 2022, the National Competitive Basic Research scheme number 118/E5/PG.02.00.PT/2022be utilized in glycerolysis to reduce FFA of crude palm oil.

Conclusion

The best conditions for the highest FFA conversion or reduction of 99,95% were found by glycerolysis using catalyst ZnCl_2 .

The crude glycerol as a side product of transesterification can be utilized in glycerolysis to reduce FFA of crude palm oil.

After the problem of high free fatty acid is able to overcome, then the CPO from oil palm loose fruits (LF) could be further processed to produce the food, energy or derivative products.



Thank you