



# **Preparation and formulation of carotenoid-rich margarine from red palm oil employing **non-thermal cold plasma hydrogenation****

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# Background

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Red palm oil is rich in carotenoid and beneficial for health

It is potential to be further processed into **Red Palm Margarine** and retaining its health benefits

However, transforming oil into semi-solid margarine involves a (conventional) hydrogenation process which employs **high temperature** (destroys heat-sensitive beta-carotene) and **expensive catalyst**

The conventional method also produces **trans-fatty acids**, carcinogenic agent, which compromise the potential health benefits



# Objectives

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1. Employing a novel alternative hydrogenation process using cold plasma technology (*non-thermal dielectric barrier discharge plasma hydrogenation*) in producing **low trans-fatty acid partially hydrogenated red palm oil**.
2. Incorporating the produced hydrogenated red palm oil in the preparation and formulation of **red palm margarine**
3. Physical (thermal and crystallization behaviour) and nutritional characterization of red palm margarine
4. One patent/intellectual property right and two scientific publications



# Justification

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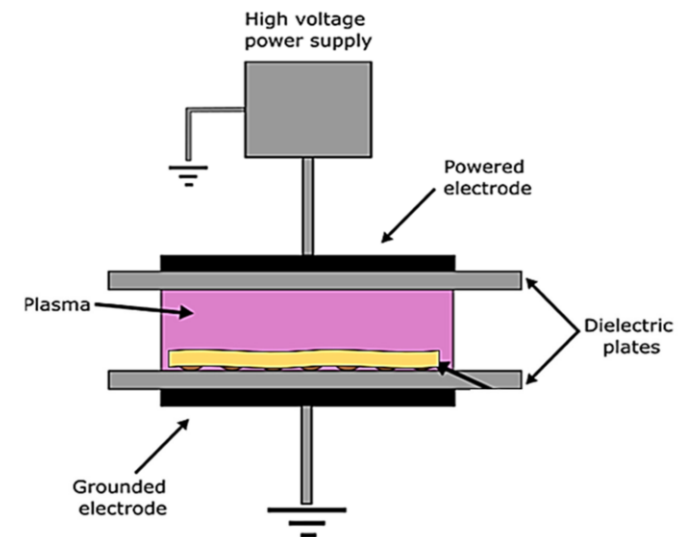
Dielectric barrier discharge (DED) plasma is a novel non-thermal plasma hydrogenation technique for vegetable oil which does not require catalyst, high pressure and high temperature. Thus, it is highly environmental friendly.<sup>1</sup>

Red palm oil has significantly higher content of phytonutrient (carotenoid, tocopherol, tocotrienol, etc) compared to commercial palm oil products that are widely available in Indonesian market.<sup>2</sup>

Red palm oil can be hydrogenated using cold plasma technology to retain its rich nutrients and further processed into margarine in order to reach wider market. **Application DED plasma for red palm oil is novel and very promising.**

<sup>1</sup><https://doi.org/10.1016/j.ifset.2020.102511>

<sup>2</sup><https://palmoilina.asia/sawit-hub/minyak-sawit-merah/>



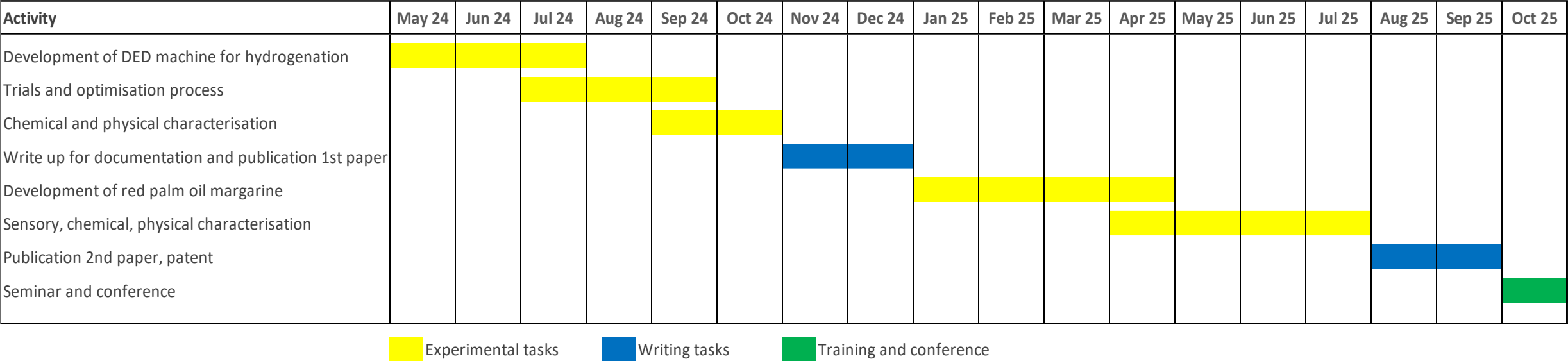
# Big Picture Proposal

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	2024	2025
OUTCOME	<ul style="list-style-type: none"><li>• Prototype of cold plasma hydrogenation machine</li><li>• Optimized hydrogenation process parameters</li><li>• Publication, HAKI</li></ul>	<ul style="list-style-type: none"><li>• Formula and production method of red palm margarine</li><li>• Nutritional, chemical and physical characterisation</li><li>• Publication, Patent</li></ul>
BUDGET	Rp 219,000,000	Rp 80,000,000

# Gantt Chart

Preparation and formulation of carotenoid-rich margarine from red palm oil employing non-thermal cold plasma hydrogenation  
Duration: May 2024 - Oct 2025





# Budgeting

Items	Unit	Qty	Price	Total
<b>Staff cost</b>				<b>70,000,000.00</b>
Project leader	Rp.	1	45,000,000.00	45,000,000.00
Member	Rp.	1	25,000,000.00	25,000,000.00
<b>Material cost</b>				<b>163,000,000.00</b>
DED plasma machine	pcs	1	120,000,000.00	120,000,000.00
He gas	canister	10	2,000,000.00	20,000,000.00
H2 gas	canister	10	2,000,000.00	20,000,000.00
Redpalm oil	liter	100	30,000.00	3,000,000.00
<b>Service cost</b>				<b>66,000,000.00</b>
GCMS analysis	package	1	15,000,000.00	15,000,000.00
LCMS analysis	package	1	10,000,000.00	10,000,000.00
DSC analysis	package	1	8,000,000.00	8,000,000.00
SFC analysis	package	1	8,000,000.00	8,000,000.00
Chemical analysis	package	1	10,000,000.00	10,000,000.00
Sensory analysis	package	1	5,000,000.00	5,000,000.00
Publication	pcs	2	5,000,000.00	10,000,000.00
			<b>Grand Total</b>	<b>299,000,000.00</b>

Significant cost is required at the initial stage of the project to build/assemble a dielectric barrier discharge plasma machine which is designed specifically for cold hydrogenation process.

# Cost and Benefit

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## Financial

New prototype machine that is potential to be scaled up into industrial scale.

The new technology is less expensive than the conventional processing (no catalyst, no high pressure and high temperature).

The new margarine product can be marketed as a premium product containing high nutrition.

Payback period can be calculated with relevant market analysis (currently not available).

## Non Financial

The new technology offers a healthier alternative to conventional hydrogenation process with lower TFA content.

With low temperature and pressure, the current proposed technology offers less energy consumption and thus more environmental friendly.



# Team Profiles

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**Yoga Pratama, PhD** is an expert in food lipids processing. He acquired his PhD in the fat crystallisation and has professional working experiences in palm refinery and margarine industry. He currently teaches food lipids technology as well as food engineering at Universitas Diponegoro.

Complete profile: <https://tp.fpp.undip.ac.id/yoga-pratama-s-tp-m-sc-phd/>

**Prof. Dr. Muhammad Nur, DEA** received a PhD in cold plasma technology and is currently the chair of the Centre of Plasma Research at Universitas Diponegoro. His researches focus on various application of cold plasma in food and non food processing. For example, ozone generator for food and medical application. He holds several patents related to cold plasma technology.

Complete profile: <https://cpr.undip.ac.id/author/mnur/>