

Transition from Fat to Fit by Use of Heart Healthy Vegetable Oil Powder

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Introduction

Non-communicable diseases



Source: World Health Organization (2020)

Source: World Health Organization; IHME, Global Burden of Disease

Healthy cooking oil

According to American Heart Association (AHA), the healthy cooking oil must satisfy the balance between

- ✓ Monounsaturated fatty acids (MUFA)/ polyunsaturated fatty acids (PUFA) (1 to 1.5)
- ✓ ω-6/ω-3 (1 to 4)
- Presence of antioxidants



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Oil Powder : Basic Concept

- The oil powder is produced by microencapsulation process through solvent evaporation.
- Microencapsulation is defined as the process of surrounding or enveloping one substance within another substance, yielding capsules ranging from less than one micron to several hundred microns in size.
- Two phases : (a) Core material, and (b) Coating material.



Process Flowchart



Edible Oil Blending

Refined RBO without added synthetic antioxidants



Refined PO and FO without added antioxidants





PO: 20-40% FO: 5-10%

> •RBO: Rice bran oil •FO: Flaxseed oil •PO: Peanut oil

Optimized edible oil blend (OB) obtained by D-optimal mixture design Fatty acid composition and antioxidants of edible oils and oil blend

Parameters	RBO	РО	FO	OB
MUFA/PUFA	1.14	1.13	0.11	1.1
ω6/ω3	42	74.37	0.11	2.7
Total phenolic content (mg GAE/ kg)	3.42±0.5	3.46±0.2	3.98±0.3	4.67±0.3
Total tocopherol content (ppm)	827±8.7	286±4.4	128±2.42	696±0.25
Oryzanol (%g)	1.45±0.6	-	-	1.13±0.1

Thermal and oxidative stability of edible oils and oil blend

Oil samples	T _{onset} (° C)	OIT, min	Peroxide value (mEq/kg)	Totox value
RBO	239.46±0.04 ^a	32.3±0.02	1.51 ± 0.48^{f}	8.89
FO	180.14 ± 0.03^{k}	20.4±0.10	3.45 ± 0.25^{g}	11.40
РО	195.6±0.06 ^f	26.25±0.11	2.87±0.32 ^a	7.16
OB	209.21±0.05°	27.67±0.08	1.81±0.07°	9.63

Shelf-life (days) of OB at 30°C= 239 ±1.9

T_{onset} : Thermal decomposition onset temperature

OIT: Oxidation induction time TOTOX: Total oxidation

Processing of Oil Blend into Oil Powder



By D-optimal mixture design
Starch: Protein- 3:1
Milk protein isolate (MPI): Sodium caseinate- 2:1





Oil blend Oil

Oil-wall material solution



Oil powder

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Microencapsulation by Microwave Drying : Basic Concept



Properties of encapsulated oil powder



Properties	MW oil powder
Bulk density(g/mL)	0.39 ± 0.02
True density(g/mL)	1.024 ± 0.05
Flowability	Fair
Water activity	0.526
Water solubility index(%)	83.1 ± 0.02
Wettability (s)	180 ± 0.05



Light microscope image showing oil droplets in O/W emulsion



SEM images of microencapsulated oil powder

Effect of storage at 60 °C for 30 days on the peroxide value of oil blend and microencapsulated oil powder

Antioxidant properties of the encapsulated and non-encapsulated oil

Properties	Oil Blend	MW oil powder
%Inhibition (radical scavenging activity)	82.20	72.10
Total phenolic content (mgGAE/100g)	4.67	4.03



	Developed oil powder	Market oil powder
Balanced fatty acid composition	Yes	No
Added antioxidants	No	Yes
Artificial colour	No	No
Shelf life (months)	Upto 12	Upto 12

Plant Machinery for 100 kg Vegetable Oil Powder



Food Use



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WHAT TODO?





Vegetable Oil Powder

- MUFA/PUFA & omega fatty acids balanced
- Antioxidant Rich
- Heart healthy
- Less Energy Consumption
- Nominal cost

Margarine

- Reactive Catalysts
- High Equipment Maintenance Cost
- More Energy Consumption
- Risk of Trans Fat and More Saturated Fats

Patent, Publications & Awards

Patent

Publications

Awards

कमांक : 033121037 SL No :	Journal of Food Processing and Preservation	LWT Volume 142, May 2021, 111018	
PROPERTY INDIA WITCH TRATE MARS GOVERNMENT OF INDIA GOVERNMENT OF INDIA UE RATENT OFERCE	original article ⊕ Full Access	Oxidative stability of ternary blends of	
이 문제 ENT OT ICE 다구 가지 아이지 아이지 아이지 아이지 아이지 아이지 아이지 아이지 아이지 아이	enriched vegetable oil powder and its influence on quality parameters	vegetable oils: A chemometric approach	
पेटेंट से. / Patent No. : 403632 आवेरन से. / Application No. : 201831037151	Monalisha Pattnaik 💌 Hari Niwas Mishra	Monalisha Pattnaik 우평, Hari Niwas Mishra	Development of Poly-unsaturated Fatty Acid PUFA and Antioxidant Rich Vegetable Oil Powder for Healthy Heart
फाइल करन का ताराख / Date of Filing · On 102018 पेटेरी / Patentee : INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR	Food Science +Technology	Critical Reviews in Food Science and Nutrition	SITARE-Gandhian Young Technological Innovation
प्रमाणत किया जाता है कि पटटा की, उपराप्त आवरन में वयाप्रकारत MICROENCAPSULATED OIL BLENDS AND PREPARATION OF SHELF STABLE OIL POWDER नगमक आविष्यार के लिए, पेटेंट आविषियम, 1970 के उपवयों के अनुसार आज सारीख अस्टूबर 2018 के पहले दिन से बीस वर्ष की अवधि के लिए पेटेंट आनुदत्त किया गया है। It is barghy contified that a patent has been granted to the patentee for an investion	Original article 👌 Full Access	SSR: Print (Online Journal homesaee https://www.tandfonline.com/ski/Mpr.20	Industry Research Assistance Council (BIRAC), Department of Biotechnology, Government of India.
entitled MICROENCAPSULATED OIL BLENDS AND PRENATION OF SHELF STABLE OIL POWDER as disclosed in the above mentioned application for the term of 20 years from the 1 st day of October 2018 in accordance with the provisions of the Batter Act 1070	low-fat biscuits	Amelioration of the stability of polyunsaturated fatty acids and bioactive enriched vegetable oil:	in collaboration with Foodtech Pathshala as the knowldge partner are proved to mean
	Monalisha Pattnaik 🕵 Hari Niwas Mishra First published: 25 July 2022 https://doi.org/10.1111/ijfs.15992	blending, encapsulation, and its application	Monalisha Pattnaik, Hari Niwas Mishra For Winning First Award and a Cash Prize of Rs. 75,000
INTELLECTUAL PROPERTY INDIA	OpenAcess Editrs Color Rever	A Computational Study on the Multi-Component	Transition from Fat to Fit by Dev digment of Heart-Healthy Lipoomics from Multi-source FLAx Eart-field Vgetable (ii)
TS I DESIGNS I TRADE MARKS	Microencapsulation of Bioactives from Plant-Based Food Waste and Their Applications in Functional Food	with Liposomal Membrane [†]	
Bate of Grant :: 16:08/2022 Controller of Patent	by Whonalisha Pathnaik 1 S. @ Pooja Pandey 123 S. @ Gregory J. O. Martin ³ S. @ Hari Niwas Mishra ¹ and Muthupandian Ashokkumar ^{2,7} S.	Agricultural and Food Engineering Department. Indian Institute of Technology Kharagpur, Kharagpur 721302, India Author to whom correspondence should be addressed. Presented at M2 with International Electronic Conference on Foods—Future Foods and Food Technologies for a Sustainable	
रिप्रभी - हम गेंटर के मर्वेशरण के लिए सेल, चंदे हमें कमा रखा तला में, अन्दूबर 2020 के जाते हिन की और उसके परवात सर्वक वर्ष में उसी दिन देश सिंगे Note The fees for renewal of this patient, if it is to be maintained will fail / has failen due on 1 ⁴⁸ day of October 2020 and on the same day in every year thereafter	India ² School of Chemistry, The University of Melbourne, Parkville, VIC 3010, Australia ³ Department of Chemical Engineering, The University of Melbourne, Parkville, VIC 3010, Australia	World, 15-30 October 2021; Available online: https://foods2021.sciforum.net/. Academic Editor: Christopher J. Smith	SHRI SOMALAL VYAS - SEA INNOVATION AWARDS
	* Author to whom correspondence should be addressed.	Biol, Life Sci. Forum 2021, 6(1), 103; https://doi.org/10.3390/Foods2021-10938	(SEA) of India

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Thank you all very much ...



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