

PURIFICATION OF PALM-BASED CRUDE DIHYDROXYSTEARIC ACID

ZULINA ABD MAURAD; ZAINAB IDRIS and HAZIMAH ABU HASSAN



Currently, the hydroxy acid provided by nature is ricinoleic acid which is obtained from castor oil. This oil is not available in Malaysia and studies were initiated to produce similar compound by other means. Palm kernel oil-based crude oleic acid ($C_{18:1}$), a low value co-product produced during the production of C_{12-14} acids, is the suitable raw material for preparing palm hydroxy acids. The oleic acid was epoxidised followed by opening of the oxirane ring, which gave 9,10-di-

hydroxystearic acid (9,10-DHSA) in a good yield. Production of this specialty fatty acid (Salmiah *et al.*, 2009) has been successfully scaled up to a 500 kg per batch using MPOB's Polyol Pilot Plant (Figure 1). The product from this plant is considered as crude 9,10-DHSA of 70% purity. An integrated purification processes: crystallisation and membrane filter were designed to produce cosmetic grade 9,10-DHSA with a purity of more than 95% (Figure 2).



Figure 1. MPOB's Polyol Pilot Plant.



Figure 2. Crystallisation system.



THE PURIFICATION PROCESS

A slurry of the crude 9,10-DHSA containing isopropanol/water (80:20) at 1:1 w/v ratio was cooled to as low as 9°C in a 100 litres capacity crystalliser tank. The 9,10-DHSA crystals formed were then separated from the isopropanol liquor using a membrane filter press (Figure 3). The solute 9,10-DHSA started to form crystal at 27°C - 28°C in the stirred crystalliser system (Figure 4). The crystallised product is a cosmetic grade 9,10-DHSA.

MARKET ANALYSIS

Based on Business Analytic Centre (2010), there are six companies producing the 9, 10-DHSA of various purities and 29 companies are involved in the marketing. Table 2 summarises the range of prices for the various grades of 9,10-DHSA available commercially. The difference in price could have been contributed by the difference in production process adopted which includes technology, raw material feedstock and grades produced. The price of 12-hydroxystearic acid, naturally available from castor oil, in China market is USD 2600 - USD 3000 t⁻¹ (minimum 10 t).

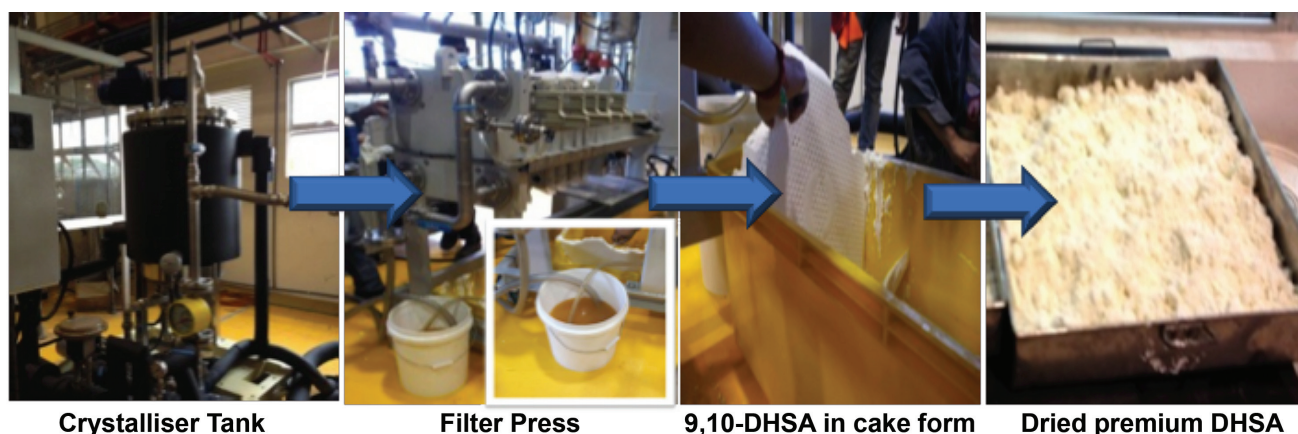


Figure 3. Purification process.

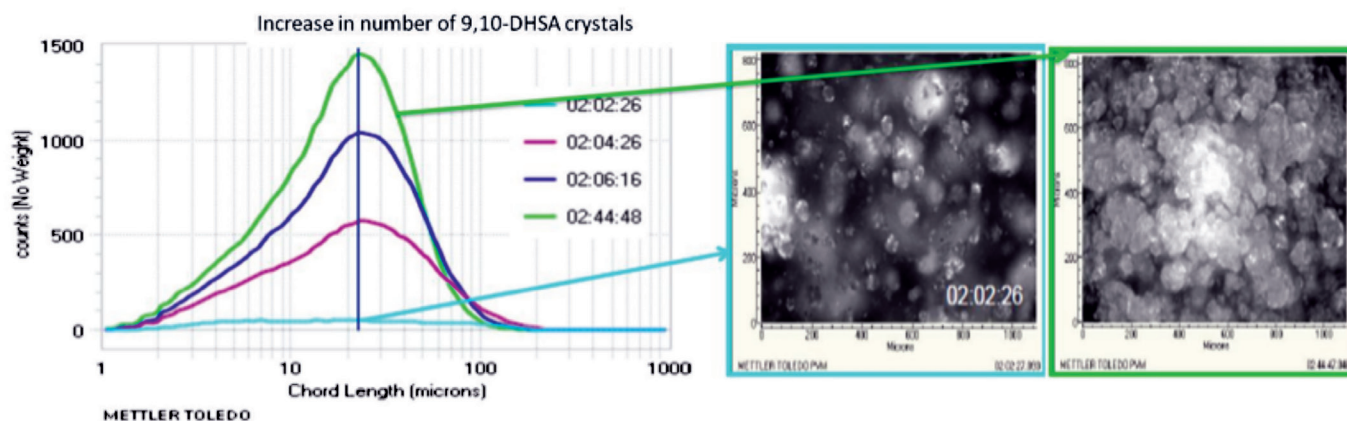


Figure 4. Nucleation process.

THE PRODUCT

TABLE 1. PROPERTIES OF CRUDE VERSUS PURIFIED 9,10-DHSA

Properties	Form	Purity, %	Particle size, mm	Specific surface area, m ² kg ⁻¹	Melting point, °C	Acid value, mg KOH g ⁻¹	Iodine value, g I ₂ 100 g ⁻¹	OHV, mg KOH g ⁻¹
Crude DHSA	Semi-solid	70-80	-	-	75-80	170	<10	240-260
Purified DHSA	Solid (crystal)	85-95	40	177	90-95	150	<6	280-310

TABLE 2. PRICES FOR VARIOUS GRADES 9,10-DHSA

Market region	Price/unit (USD)	Unit price (USD g ⁻¹)
Asian market (94% purity)	227 / 1 g	227
Asian market (94% purity)	300 / 5 g	60
Asian market (unknown purity)	520 / 1 g	520
Asian market (98% purity)	900 / 5 g	180
North American market	76 / 1 g	76
North American market	89.14 / 5 g	17.83
North American market	50.62 / 10 g	5.06
North American market (94 % purity)	29 / 1 g	29

ECONOMIC ANALYSIS

The estimated investment cost for the purification of palm-based crude dihydroxystearic acid is given below:

Item	Value
Cost of equipment	RM 400 000
Production of purified DHSA	43 200 kg yr ⁻¹
Production capacity = 60 kg batch ⁻¹	
Internal rate of return (IRR)	25%
Net present value (NPV)	RM 649 367
Payback period	3 years

REFERENCES

SALMIAH AHMAD; SOI SENG HOONG; MOHD NORHISHAM SATTAR; YUSRABBIL AMIYATI YUSOF; HAZIMAH ABU HASSAN and ROILA AWANG (2009). Palm-based hydroxy fatty acid. US patent No. 7,560,578 B2.

BUSINESS ANALYTIC CENTRE (2010). 9, 10-Di-hydroxystearic acid (CAS 120-87-6). *Market Research Report*.

For more information, kindly contact:

Director-General
MPOB
6, Persiaran Institusi,
Bandar Baru Bangi,
43000 Kajang, Selangor,
Malaysia
Tel: 03-8769 4400
Fax: 03-8925 9446
www.mpob.gov.my