

KINETIKA SIFAT FISIK, LAJU PEMBENTUKAN INTI, DAN PERTUMBUHAN KRISTAL PADA PENGOLAHAN GULA SEMUT DARI NIRA SEGAR MENGGUNAKAN KRISTALISATOR PUTAR

INTISARI

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Gula semut merupakan produk gula berbahan nira palma berbentuk butiran yang diperoleh dari proses evaporasi dan kristalisasi. Penelitian ini dilakukan sebagai pengembangan proses pengolahan gula semut secara konvensional. Tujuan dilakukannya penelitian ini adalah menganalisis kinetika sifat fisik, laju pembentukan inti, laju pertumbuhan kristal dan karakterisasi gula semut dari nira kelapa segar menggunakan *pan evaporator* dan kristalisator putar.

Proses evaporasi gula semut dilakukan menggunakan *pan evaporator* hingga didapat nira lewat jenuh dan dilanjutkan proses kristalisasi menggunakan kristalisator putar hingga didapat gula berbentuk butiran. Variasi perlakuan yang digunakan yaitu kapasitas nira (6, 9, dan 12 liter) dan produk akhir (murni dan empon-empon). Parameter yang dicari pada penelitian ini meliputi konstanta sifat fisik (suhu, brix, dan densitas), laju pembentukan inti, laju pertumbuhan kristal, *fineness modulus*, diameter partikel, warna, rendemen, dan kadar air.

Hasil penelitian menunjukkan pada proses evaporasi konstanta perubahan suhu, brix, dan densitas sebesar $0,13 \pm 0,01$ - $0,33 \pm 0,01$ /menit; $2,34 \times 10^{-10} \pm 6,09 \times 10^{-11}$ - $4,84 \times 10^{-9} \pm 4,34 \times 10^{-10}$ /menit; dan $2,01 \times 10^{-10} \pm 2,93 \times 10^{-11}$ - $3,80 \times 10^{-9} \pm 4,67 \times 10^{-10}$ /menit. Pada proses kristalisasi konstanta perubahan suhu dan densitas sebesar $0,09 \pm 0,01$ - $0,15 \pm 0,02$ /menit dan $0,09 \pm 0,00$ - $0,13 \pm 0,00$ /menit. Laju pembentukan inti, laju pertumbuhan kristal, *fineness modulus*, diameter partikel, rendemen, dan kadar air gula semut yang didapat sebesar $1,21 \pm 0,26$ - $2,49 \pm 0,36$ jumlah/jam; $1,37 \pm 0,03$ - $1,78 \pm 0,25$ mm/jam; $4,22 \pm 0,02$ - $4,49 \pm 0,02$; $1,94 \pm 0,03$ - $2,35 \pm 0,03$ mm; $14,06 \pm 1,16$ - $19,82 \pm 1,19$ %; $1,16 \pm 0,08$ - $2,38 \pm 0,24$ %; dan warna gula semut kuning kecokelatan.

Kata kunci: evaporasi, gula semut, kinetika, kristalisasi, nira kelapa

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KINETICS OF PHYSICAL PROPERTIES, NUCLEATION RATE, AND CRYSTAL GROWTH IN THE PROCESSING OF PALM SUGAR FROM FRESH COCONUT SAP USING ROTARY CRYSTALLIZER

ABSTRACT

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Palm sugar is a sugar product made from palm sap in the form of granules obtained from evaporation and crystallization process. This research was conducted as the development of conventional palm sugar processing. The purpose of this research was to analyze the kinetics of physical properties, nucleation rate, crystal growth rate, and characterization of palm sugar from fresh coconut sap using pan evaporator and rotary crystallizer.

Evaporation process of palm sugar was carried out using a pan evaporator until the juice is supersaturated and followed by crystallization process using a rotary crystallizer until granules form of a sugar were obtained. Treatment variations used were the capacity of coconut sap (6, 9, and 12 liters) and final product (pure and spices). Parameters that sought in this research were constants of physical properties (temperature, brix, and density), nucleation rate, crystal growth rate, fineness modulus, particle diameter, color, yield, and water content.

The results showed that in the evaporation process, constants changes in temperature, brix, and density were 0.13 ± 0.01 - 0.33 ± 0.01 /minute; $2.34 \times 10^{-10} \pm 6.09 \times 10^{-11}$ - $4.84 \times 10^{-9} \pm 4.34 \times 10^{-10}$ /minute; and $2.01 \times 10^{-10} \pm 2.93 \times 10^{-11}$ - $3.80 \times 10^{-9} \pm 4.67 \times 10^{-10}$ /minute. Temperature and density constants in the crystallization process were 0.09 ± 0.01 - 0.15 ± 0.02 /minute and 0.09 ± 0.00 - 0.13 ± 0.00 /minute. Nucleation rate, crystal growth rate, fineness modulus, particle diameter, yield, and water content of palm sugar were 1.21 ± 0.26 - 2.49 ± 0.36 amount/hour; 1.37 ± 0.03 - 1.78 ± 0.25 mm/hour; 4.22 ± 0.02 - 4.49 ± 0.02 ; 1.94 ± 0.03 - 2.35 ± 0.03 mm; 14.06 ± 1.16 - 19.82 ± 1.19 %; 1.16 ± 0.08 - 2.38 ± 0.24 %; and palm sugar color were tawny.

Keywords: coconut sap, crystallization, evaporation, kinetics, palm sugar

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