KINETIKA SIFAT FISIK DAN KIMIA GULA SEMUT SELAMA PENGOLAHAN MENGGUNAKAN KRISTALISATOR *DOUBLE JACKET* BERPENGADUK MEKANIS DENGAN PERLAKUAN BAHAN BAKU NIRA SEGAR DAN GULA CETAK

INTISARI

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Gula semut merupakan salah satu alternatif pemanis selain gula tebu yang terbuat dari tanaman palma. Gula semut masih banyak masih banyak diproduksi secara tradisional sehingga memiliki banyak kelemahan. Penelitian ini dilakukan untuk menganalisis kinetika sifat fisik serta kimia selama proses proses pengolahan gula semut menggunakan *direct pan evaporator*, dan kristalisator *double jacket* berpengaduk mekanis. Penelitian ini juga melakukan evaluasi kualitas produk gula semut. Pembuatan gula semut dilakukan dengan perlakuan bahan baku nira segar (NS) dan gula cetak (GC) dengan 3 ulangan tiap bahan baku. Selama proses pembuatan gula semut diamati perubahan suhu, brix, densitas, gula reduksi, dan gula total yang dimodelkan menggunakan kinetika Avrami. Pemodelan dilakukan untuk mendapatkan nilai konstanta yang dapat digunakan untuk optimalisasi desain proses pembuatan gula semut. Analisis kualitas gula semut meliputi pH bahan baku, kadar air (%db), rendemen, warna (*lightness*, *redness*, dan *yellowness*), ukuran partikel (*fineness modulus*, diameter rerata, dan massa lolos ekspor), gula reduksi (bahan baku, dan produk), gula total (bahan baku, dan produk), *radical scavenging activity*, dan kadar abu. Hasil yang didapatkan nilai konstanta kinetika perubahan suhu selama proses evaporasi k_T GC (7,43±0,90×10^{-2} ºC/menit), dan k_T NS (3,63±0,05×10^{-2} ºC/menit), dan pada proses kristalisasi k_T GC (27,33±1,15×10^{-3} ºC/menit), dan k_T NS (9,03±1,42×10^{-3} ºC/menit). Nilai konstanta perubahan parameter kualitas gula semut selama proses evaporasi k_B GC (4,10±0,10×10^{-4} %/menit), dan k_B NS (0,09±0,01×10^{-4} %/menit); k_ρ GC (2,73±1,63×10^{-4} kg/m^3.menit), dan k_ρ NS (0,08 ±0,06×10^{-4} kg/m^3.menit); dan pada proses kristalisasi k_B GC (5,60±3,75×10^{-3} %/menit), dan k_B NS (2,70±1,66×10^{-3} %/menit); k_ρ GC (9,00±1,50×10^{-3} kg/m^3.menit), dan k_ρ NS (9,00±1,50×10^{-3} kg/m^3.menit), serta nilai k_{Gr} GC (33,67 ±0,58×10^{-4} %/menit), dan k_{Gr} NS (0,01 ±0,00×10^{-4} %/menit); k_{Gt} GC (40,00 ±1,00×10^{-4} %/menit), dan k_{Gt} NS (0,01 ±0,00×10^{-4} %/menit) selama proses pengolahan gula semut. Kualitas gula semut dengan bahan GC lebih baik daripada bahan NS (warna kuning kecoklatan, gula total lebih tinggi, gula reduksi lebih rendah, dan ukuran partikel lebih kecil dan seragam). Nilai G NS (0,31±0,16 mm/jam) dan G GC (0,60±0,11 mm/jam), serta Bº NS (44,74±58,91 jumlah kristal/jam) dan Bº GC (9,14±3,45 jumlah kristal/jam).

Kata kunci: gula semut, pemodelan, kualitas gula semut

PHYSICAL AND CHEMICAL PROPERTIES OF PALM SUGAR DURING THE PROCESSING USING MECHANIC STIRRED DOUBLE JACKET CRYSTALLIZER WITH FRESH COCONUT SAP AND COCONUT SUGAR INGREDIENT TREATMENT

ABSTRACT

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Palm sugar is an alternative sweetener to cane sugar made from palm plants. Palm sugar is still widely produced traditionally, so it has many weaknesses. The research was conducted to analyze the kinetics of physical and chemical properties during the palm sugar processing process using a direct pan evaporator and a mechanic stirred double jacket crystallizer. This research also evaluates the quality of palm sugar products. The production of palm sugar was carried out by treating the ingredient of fresh sap (NS) and molded sugar (GC) with three replications for each ingredient. During the process of making palm sugar, changes in temperature, brix, density, reducing sugar, and total sugar were observed, which were modeled using Avrami kinetics. Modeling is carried out to obtain constant values that can be used to optimize the design of the palm sugar manufacturing process. The quality analysis of palm sugar includes the pH of the ingredient, water content (%db), yield, color (lightness, redness, and yellowness), particle size (fineness modulus, average diameter, and mass of export pass), reducing sugar (ingredient, and product), total sugar (ingredient, and products), radical scavenging activity, and ash content. The results obtained that the value of the kinetic constant of temperature changes during the evaporation process k_T GC (7,43±0,90×10^{-2} ºC/min), k_T NS (3,63±0,05×10^{-2} ºC/min), and in the crystallization process k_T GC (27,33±1,15×10^{-3} ºC/min), k_T NS (9,03±1,42×10^{-3} ºC/min). The value of the kinetic constant of changes in the quality parameters of granulated sugar during the evaporation process k_B GC (4,10±0,10×10^{-4} %/min), k_B NS (0,09±0,01×10^{-4} %/min); k_ρ GC (2,73±1,63×10^{-4} kg/m^3.min), k_ρ NS (0,08 ±0,06×10^{-4} kg/m^3.min); and in the crystallization process k_B GC (5,60±3,75×10^{-3} %/min), k_B NS (2,70±1,66×10^{-3} %/min); k_ρ GC (9,00±1,50×10^{-3} kg/m^3.min), k_ρ NS (9,00±1,50×10^{-3} kg/m^3.min), and the value of k_{Gr} GC (33,67 ±0,58×10^{-4} %/min), k_{Gr} NS (0,01 ±0,00×10^{-4} %/min); k_{Gt} GC (40,00 ±1,00×10^{-4}%/min), k_{Gt} NS (0,01 ±0,00×10^{-4} %/min) during the palm sugar processing. The quality of palm sugar with GC ingredients is better than NS ingredients (brown-yellow color, higher total sugar, lower reducing sugar, and smaller particle size). Values of G NS (0.31±0.16 mm/hour), G GC (0.60±0.11 mm/hour), as well as Bº NS (44.74±58.91 number of crystals/hr), Bº GC (9.14±3.45 number of crystals/hr).

Keywords: *palm sugar, modeling, palm sugar quality*