LAMPIRAN

Lampiran 1. Nugroho J., WK., Astutisari Y., Setyowati P. (2012)

PENGERINGAN UMBI KIMPUL (*Xanthosoma sagittifolium Schott*) SAWUT DENGAN PNEUMATIC DRYER

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ABSTRAK

Kimpul (*Xanthosoma sagittifoliumSchott*) merupakan tanaman umbi-umbian yang mempunyai kandungan energi tinggi yaitu 145 kal per 100 gram. Tetapi pemanfaatan kimpul ini masih terbatas dengan untuk produk olahan sederhana. Pembuatan tepung kimpul dilakukan dengan tujuan menambah umur simpan bahan dan untuk mengurangi impor gandum untuk pemanfaatan tepung terigu. Salah satu tahap dalam pembuatan tepung adalah pengeringan. Dan untuk pengeringan kimpul pada penelitian ini digunakan *pneumatic dryer* yang mempunyai *duct* dengan tinggi 2 m. Pada *pneumatic dryer* ini mempunyai 3 heater, masing-masing heaternya mempunyai daya 1,5kW. Selain itu juga dilengkapi dengan *screw conyevor* untuk memasukkan bahan ke *duct* dan dilengkapi dengan *cyclone separator*. Secara umum tujuan dari penelitian ini adalah mengkaji proses pengeringan umbi kimpul dengan menggunakan *pneumatic dryer*.Umbi kimpul disawut terlebih dahulu sehingga mempunyai ukuran 41,2 mm x 4,53 mm x 1,27 mm. Setelah sawutan direndam dan dicuci, kemudian bahan ditiriskan. Pada penelitian ini digunakan 3 variasi bukaan udara pada *blower* yaitu kecepatan udara 4,4 m/s); 5,3 m/s, dan 6,12 m/s. Selain itu juga juga dilakukan variasi pada jumlah heater yang digunakan yaitu 1 heater, 2 heater, dan 3 heater. Pengeringan dilakukan beberapa kali untuk mendapatkan kadar air sekitar 10%. Kadar air bahan, suhu dan kelembaban udara pengering dan lingkungan diamati selama percobaan. Dari hasil penelitian ini didapatkan bahwa nilai sebesar 0,0121 - 0,0283 %/s, derajat kejenuhan 67,90 - 126,34(m^3/kg bahan). Pengujian statistik dilakukan pada warna L a b, dan menunjukkan adanya variasi bukaan blower (kecepatan udara dan jumlah heater yang digunakan akan mempengaruhi warna tepungnya. Berdasarkan hasil perhitungan dan hasil pengujian warna maka dapat disimpulkan bahwa variasi yang baik digunakan adalah bukaan udara 4/8 dengan jumlah heater 3.

Kata kunci : *kimpul, sawut, tepung, pneumatic dryer*

PENDAHULUAN

Kimpul (*Xanthosoma sagittifolium Schott*) merupakan tanaman sumber karbohidrat dari suku talas-talasan. Kimpul ini dikenal dengan nama "enthik" dalam Bahasa Jawa. Tumbuhan yang hidup menahun ini mempunyai batang palsu yang sebenarnya adalah tangkai daun. Dalam sekali panen, hasilnya dapat mencapai 20 kg/rumpun. Kimpul ini biasa disebut talas Belitung atau tannia, malanga, yautia, *blue taro* dalam bahasa Inggris.

Kimpul ini mengandung karbohidrat yang cukup tinggi. Masyarakat sudah banyak yang mengetahui tentang umbi-umbian ini, namun pemanfaatannya belum sepopuler ubi jalar dan singkong. Umbi kimpul ini mempunyai bentuk dan ukuran yang lebih kecil dibandingkan dengan singkong. Pemanfaatan kimpul ini masih sebatas direbus, digoreng, dan dibuat

Lampiran 2. Hawa L. C., Dewi S. R., Izza N., Wigati L. P. (2016)

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ANALISA KARAKTERISTIK FISIK *CHIPS* UMBI TALAS (*Colocasia esculenta L.)* BERBASIS *MACHINE VISION* (STUDI PENGERINGAN DENGAN *TRAY DRYER*)

(Analisys of The Physical Properties on Taro Chip (Colocasia esculenta L.) Based on Machine Vision Method during Drying)

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ABSTRAK

Untuk menghasilkan produk tepung talas yang berkualitas maka uji sifat fisik dan kimia diperlukan. Namun, karakterisasi *chip* talas dan tepung talas secara konvensional memerlukan pekerjaan laboratorium yang cukup memakan waktu. Evaluasi kualitas *chip* dapat dilakukan dengan cepat dengan menggunakan bantuan teknik *Machine Vision*. Tujuan penelitian ini adalah melakukan karakterisasi kadar air dan tekstur *chip* talas dan melakukan pengembangan sistem monitoring *online* karakter *chip* talas pada proses pengeringan. Penelitian ini menggunakan metode eksperimental deskriptif dua faktor, yaitu waktu pengeringan (50 ± 3°C, 60 ± 3°C, 70 ± 3°C) dan suhu pengeringan (5, 6 dan 7 jam). Parameter *chip* talas yang diamati adalah kadar air dan tekstur. Perubahan susut berat didapatkan dari pengamatan terkendali oleh neraca digital dan *webcam* yang mengambil citra pada *chip* talas dalam *tray dryer* yang telah dimodifikasi. Hasil penelitian menunjukkan, kadar air irisan talas segar adalah 72.75-78.80%. Kadar air terendah adalah pada suhu pengeringan 70°C selama 7 jam sebesar 2.03%. Kekerasan awal *chip* talas segar berkisar antara 8.2 -12.3%. Nilai tekstur *chip* talas terendah pada suhu pengeringan 60°C pengeringan selama 6 jam sebesar 0.7%. *Image analysis* yang dilakukan selama proses pengeringan berhasil menunjukkan adanya korelasi yang besar antara kadar air dan tekstur dengan parameter dalam *image analysis*, yaitu *Normalized Energy TFs*, *Normalized Entropy TFs* dan *Normalized Homogenity TFs*.

Kata kunci *: chip, kualitas fisik, machine vision, pengeringan, talas.*

ABSTRACT

The analysis of physical and chemical properties are required to ensure the quality product of taro flour. However, conventionally characterization of taro chips by laboratory analysis is quite time consuming. The quality analysis method using Machine Vision method was employed for determination of taro chip quality. The purpose of this study was to develop online monitoring system of taro chip during drying based on moisture content and texture data.This research were carried out using tray dryer with three levels of temperature (50 ± 3, 60 ± 3, and 70 ± 3°C) and three levels of drying time (5, 6 and 7 hours). Effects of both variables on moisture content and texture of taro chip were investigated. The real-time measurement of weight loss and texture were controlled by a digital balance and webcam from inside the dryer. The results showed that the lowest moisture content was by the 70°C for 7 hours, i.e. 2.03% and the lowest texture was by 60°C for 6 hours, i.e. 0.7%. Image analysis during the drying process successfully demonstrated the correlation between moisture content and texture with the parameters in image analysis, namely Normalized Energy TFs, Normalized Entropy TFs and Normalized homogenity TFs.

***Keyword :** chip, physical properties, machine vision, drying, taro*

Lampiran 3. Wibisono Y,. Ubaidillah U., Hawa L.C. (2019)

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Microstructure changes of taro (*Colocasia esculenta* L. Schott) chips and grains during drying

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Abstract. Microstructure changes of taro (*Colocasia esculenta* L. Schott) chips behaviour during drying at elevated temperature of 50°C, 60°C and 70°C were studied. Scanning electron microscope (SEM) images of taro chips samples taken at the end of each drying step. Series of SEM images shows a fresh section of raw taro chips which honeycomb form cells are clearly observed and distinguishably filled with starch grains. The cells are tightly connected to each other, with approximately has 50-80 μm size. The compound of starch grain, i.e. amyloplasts, has similar size of approximately 5-15 μm, yet the cohesion between amyloplast are differs. When subjected to drying temperature of 50°C, corm cells opened. Compound and individual starch grains are clearly visible. By increasing the time, the membrane cells were quietly disappeared, meanwhile the grains shrunk. However, there is no significant size decrease of the grains along the increasing of drying time up to 7 hours. This phenomenon is in line with the moisture content measurement, because since 160 minutes, the low moisture content observed and it's constant for the rest of drying process. As for samples of 60°C, the membrane cells opened further, and the starch grains were mostly appeared in individual granular. The grain size is comparable regardless the drying time. By increasing the temperature to 70°C, the impact to grains sizes is quite significant. The polyhedral shape is still observed but is in smaller grains. Therefore, microstructure of taro chips most likely related to their drying behavior at certain subjected drying temperature.

1. Introduction

Taro (*Colocasia esculenta* L. Schott) is a rich-starch corm widely grown in Indonesia, with Malang as one of its major producers. According to Arici et al. [1], taro is also grown in 43 countries in the world, with around 32% of total production is in Asia. Some previous researches were reported that taro has high nutritional benefit, e.g. medium glicemic index and potential antioxidant [2]; highly digestible [3]; and include fiber, protein, vitamins, phosphorous, and calcium [4]. Due to its nutritional benefit, the commodity has attracted attention of researchers in recent years. The corm is consumed as several forms, i.e. flour, paste and canned product, cereal bars, beverage powders, and chips. In Indonesia, taro still consumed in limited ways, i.e. taro flour as raw material for sweet-sticky cake (locally known as 'dodol') and taro-stick snack [5]. The recent derivative of taro-based product that recently draws attention from researchers, especially in Indonesia, is taro flour. Taro flour is prospective to be developed due to various end-products that have economic value on food and

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Lampiran 4. Pratama M. Z., Agustina R., Munawar A. A. (2020)

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KAJIAN PENGERINGAN PORANG (Amorphophallus oncophyllus) BERDASARKAN VARIASI KETEBALAN LAPISAN MENGGUNAKAN TRAY DRYER

(Study of Drying Porang (Amorphophallus oncophyllus) Based on the Variation of Layer Thickness Using a Tray Dryer)

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Abstrak. Indonesia mempunyai berbagai jenis serealia dan umbi-umbian yang kaya akan karbohidrat. Salah satu umbi-umbian yang cukup potensial dikembangkan di Indonesia adalah porang. Tanaman porang mulai dibudidayakan secara komersial dan dimanfaatkan baik untuk industri pangan maupun non pangan. Penelitian ini bertujuan untuk mengetahui mutu tepung porang berdasarkan perlakuan variasi ketebalan irisan porang pada proses pengeringan dengan menggunakan Tray Dryer. Penelitian ini menggunakan Porang varietas *Amorphophallus oncophyllus* dengan pengeringan menggunakan suhu 50°C. Hasil penelitian ini menunjukkan bahwa Semakin tebal irisan porang maka durasi pengeringan akan semakin lama. Rata-rata lama pengeringan pada ketebalan irisan 1 mm adalah 260 menit, ketebalan irisan 2 mm selama 290 menit dan ketebalan irisan 3 mm selama 330 menit. Rerata kelembaban relatif ruang pengering saat proses pengeringan irisan porang 1 mm adalah 57,12%, irisan porang 2 mm sebesar 57,78%, dan irisan porang 3 mm sebesar 58,10%. Kadar air tepung porang yang dikeringkan dengan ketebalan irisan 2 mm lebih tinggi yaitu 10,39% dari pada kadar air tepung porang yang dikeringkan ketebalan irisan 1 mm dan 3 mm. Rendemen tepung porang tertinggi terdapat pada ketebalan irisan 2 mm sebesar 8,83% dan rendemen tepung porang pada ketebalan irisan 1 mm dan ketebalan irisan 3 mm bernilai sama yaitu sebesar 8,67%. Tingkat kecerahan tepung porang tertinggi terdapat pada variasi ketebalan irisan 1 mm, tingkat nilai L yang diperoleh sebesar 79,67. Berdasarkan uji organoleptic hedonik terhadap warna dan aroma tepung porang, penilaian rata-rata aroma tepung porang dari ketiga perlakuan menunjukkan nilai 3 (netral) diakibatkan karena masyarakat (panelis) masih belum terlalu mengenal tepung porang, sedangkan untuk penilaian skala warna tepung porang, panelis memberikan skor 4 (suka) untuk tepung porang pada ketebalan irisan 1 mm karena warna tepung lebih cerah (putih kekuningan).

Kata kunci : Pengeringan Porang, Tepung Porang, Tray Dryer.

Abstract. Indonesia has various types of cereals and tubers which are rich in carbohydrates. One of them is potential to be developed in Indonesia is porang. It began to be cultivated commercially and utilized both for food and non-food industries. This study aims to determine the quality of *porang* flour based on the variation of thickness treatment of porang slices in the drying process by using Tray Dryer. This research uses Porang *Amorphophallus oncophyllus* varieties by drying using a temperature of 50°C. The results indicated that the thicker the slices of porang, the drying duration will be longer. The average drying time at 1 mm slice thickness is 260 minutes, 2 mm for 290 minutes and 3 mm slice for 330 minutes respectively. The average relative humidity of the drying chamber during the drying process of 1 mm slices is 57.12%, 2 mm by 57.78%, and 3 mm by 58.10%. The water content of dried porang flour with a slice thickness of 2 mm is higher at 10.39% than the water content of dried porang flour which has sliced thickness of 1 mm and 3 mm. The highest yield of porang flour is at a thickness of 2 mm slices of 8.83% and the yield of porang flour at a slice thickness of 1 mm and the thickness of a slice of 3 mm has the same value of 8.67%. The highest brightness level of porang flour is found in the variation of slice thickness of 1 mm, the level of L value obtained was 79.67. Based on organoleptic hedonic tests on the color and aroma of porang flour, the average assessment of the aroma of porang flour from the three treatments showed a value of 3 (neutral) due to the community (panelists) were not yet familiar with porang flour, whereas for the assessment of the porang flour color scale, panelists gave score 4 (likes) for flour at a slice thickness of 1 mm because the color of the flour is brighter (yellowish white).

Keywords: Drying, Porang, Flour, Tray Dryer.

Lampiran 5. Nipa J. F., Mondal H. T. (2021)

Thin layer drying kinetics of taro root (*Colocasia esculenta* L.)

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Abstract: Appropriate drying model is an important attribute for describing the drying kinetics of food products. Thin layer drying of taro roots were performed in a laboratory scale hot air dryer operated at 50°C, 60°C and 70°C temperature with air velocity of 0.5 ms^{-1}. Analysis of the result exhibits that drying of taro roots took place in falling rate period. Thin layer model such as Henderson-Pabis, Page and Lewis equation were studied to fit with the experimental data using nonlinear regression analysis. The suitable drying model was selected based on chi square (χ^2), root mean square error and relative percent error. Study of goodness of fit indicated that among the proposed models, Page equation gave better fit than all drying conditions used. Effective moisture diffusivity was determined through simplified Fick's second law of diffusion. Activation energy for moisture removal was described by Arrhenius equation and found as 18.01kjmol^{-1}.

Keywords: drying kinetics, taro roots, thin layer drying, effective moisture diffusivity, activation energy

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1 Introduction

Drying, the oldest method for the processing and preservation of freshly harvested agricultural produce has long been practiced by the human and quality of the finished product greatly depends on it. The purpose of drying is to reduce the moisture content in a certain level to prevent the microbial deterioration and most of the chemical reactions within the food components (Mondal et al., 2019). The storage and packaging of dried products takes lower spaces as it losses volume and weight through the drying process as well as makes the transportation system easier (Mujumdar, 1995). Traditionally, natural sun drying is widely practiced for the drying of agricultural produce throughout the world which contaminates dust, foreign particle and insects with the dried products. Therefore, drying of these product should be accomplished in a controlled environment which retains the product quality.

Taro is an important root crop of superior food value which is comprehensively cultivated in the many countries of the sub-tropical and tropical region of the world (Jane et al., 1992). The consumption of taro and its product as a root and tuber crop with the incorporation of another food is increasing day by day (Wang, 1983). Demand of taro and taro-based products are swelling at present age and commonly found in the most of the super market as first food. In addition to this, it offers great nutritional values like carbohydrate, mucilage and 70-80% minute starch granule which is readily digested by human (Kaushal et al., 2012). It is also an excellent source of minerals (calcium, phosphorous, and iron), high in fiber, vitamin C and vitamin B complex like thiamine, riboflavin and niacin which has a significant effect on human diet (Kaushal and Sharma, 2013). Apart from these uses, taro is also used as a biodegradable material in the plastic industry (Darkwa and Darkwa, 2013).

Freshly harvested tuber crops are highly perishable as it possesses high moisture content up-to 83% on wet basis

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