LAMPIRAN

Lampiran 1. Sutrisno, A. (2012)

ARTIKEL

Proses Penurunan Kadar Kalsium Oksalat Menggunakan Penepung "*Stamp Mill*" untuk Pengembangan Industri Kecil Tepung Iles-Iles *(Amorphophallus muelleri* Blume*)*

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ABSTRAK

Umbi iles-iles (*Amorphophallus muelleri* Blume) mengandung glukomanan yang sangat tinggi dengan kadar mencapai 15-65 persen. Pemanfaatan iles-iles di Indonesia masih sangat terbatas karena terkendala oleh kandungan kalsium oksalat yang tinggi. Kalsium oksalat dalam iles-iles menyebabkan rasa gatal, iritasi dan gangguan kesehatan bila dikonsumsi.Penelitian ini bertujuan untuk meningkatkan kadar glukomanan dan menurunkan kandungan kalsium oksalat dalam tepung iles-iles menggunakan mesin penepung *stamp mill*. Mesin *stamp mill* digunakan karena tidak menimbulkan panas sehingga mampu mempertahankan sifat-sifat glukomanan. Penelitian dirancang secara deskriptif eksploratif untuk mempelajari pengaruh berat *chip* iles-iles dan lama penumbukan. Perlakuan berat *chip* iles-iles terdiri 1,5; 2 dan 2,5 kilogram, sedangkan faktor lama penumbukan terdiri dari 0, 3, 6, 9, 12, dan 15 jam, dengan 3 kali ulangan.Penumbukan dengan *stamp mill* selama 15 jam dan dengan berat *chip* iles-iles 1,5 kg menghasilkan tepung terbaik dengan komposisi: kadar glukomanan 81,86 persen, kalsium oksalat 0,095 persen, protein 3,585 persen, abu 4,197 persen, kadar air 9,29 persen, dan viskositas 23416 mPa.s. Penepungan dengan *stamp mill* terbukti mampu meningkatkan kadar glukomanan sekaligus menurunkan kandungan senyawa non-glukomanan khususnya kalsium oksalat pada tepung iles-iles yang selama ini menjadi kendala pemanfaatannya sebagai bahan pangan di Indonesia.

kata kunci : tepung iles-iles, *stamp mill*, glukomanan, kalsium oksalat

ABSTRACT

Iles-iles tuber (Amorphophallus muelleri Blume*) contains high glucomanan up to 15-65 percents. However, the utilization of iles-iles tuber in Indonesia as food is very limited due to its calcium oxalate content. Calcium oxalate crystal is toxic component that causes itchy, irritation and health problems when consumed.This research aims to increase the glucomannan content and reduce the calcium oxalate content of iles-iles flour using a stamp mill.Stamp mill was chosen because it did not generate heat that could damage the function of glucomannan. The effects of iles-iles chip mass and milling time are studied. Three levels of iles-iles-chip mass, namely 1.5 kg, 2 kg, and 2.5 kg, and six (6) levels of milling time, namely 0, 3, 6, 9, 12, and 15 hours are applied. The best treatment, which produces high quality flour, is found to be from the milling using stamp mill for 15 hours and iles-iles-chip mass of 1.5 kilograms. The composition of the flour are as follows: glucomannan content is 81.86 percent, calcium oxalate is 0.095*

Lampiran 2. Mawarni, R. T., Widjanarko, S. B. (2015)

Penurunan Oksalat Tepung Porang - Mawarni, dkk
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PENGGILINGAN METODE *BALL MILL* DENGAN PEMURNIAN KIMIA TERHADAP PENURUNAN OKSALAT TEPUNG PORANG

Grinding By Ball Mill With Chemical Purification on Reducing Oxalate in Porang Flour

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ABSTRAK

Kalsium oksalat dalam tepung porang dapat menimbulkan iritasi dan gatal apabila dikonsumsi. Penepungan metode *ball mill* dengan pemurnian kimia dilakukan untuk mengurangi kandungan kalsium oksalat dan meningkatkan kecerahan tepung. Tujuan penelitian ini mengetahui pengaruh lama penggilingan tepung porang dengan metode *ball mill* dengan pemurnian kimia terhadap kadar kalsium oksalat dan derajat putih. Penelitian menggunakan Rancangan Acak Lengkap (RAL) satu faktor yaitu lama penggilingan yang terdiri dari 9 level (L0 hingga L8) diulang 2 kali sehingga didapat 18 satuan percobaan. Data dianalisis metode analisis ragam dan dilakukan uji lanjut DMRT. Pemilihan perlakuan terbaik dianalisis metode *Multiple Attribute*. Hasil penelitian menunjukkan bahwa lama penggilingan terbaik metode *ball mill* dengan pemurnian kimia berpengaruh sangat nyata terhadap kadar kalsium oksalat dan derajat putih pada taraf α=0.01.Perlakuan terbaik diperoleh perlakuan L8 dengan kadar kalsium oksalat 0.89%, derajat putih 69.65, dan ukuran tepung berkisar 180.00-322.7 µm berdasarkan SEM

Kata kunci: *Ball Mill*, Oksalat, Tepung Porang

ABSTRACT

Calcium oxalates in porang flour which causes itching and skin irritation if consumed. Flouring process by ball mill with chemical purification that can reduce the calcium oxalate levels and increase whiteness of porang flour. The purpose of the research was find out the effect of grinding time porang flour by ball mill with chemical purification on calcium oxalates levels and whiteness. Completely Randomized Design was used which was the duration, grinding time. The variable consisted of nine level grinding time(L0 until L8) and each treatment was replicated twice. Finally there were 18 treatments. The result of this research showed that the grinding time using ball mill with chemical purification give significant effects on calcium oxalates levels and whiteness (α=0.01). The best treatment was produced by L8 with 0.89% calcium oxalate levels, whiteness of porang flours 69.65, and partikel size of the flour between 180.00-322.7 µm with SEM analysis

Keywords: Ball Mill, Oxalates, Porang Flours

PENDAHULUAN

Porang (Amorphophallus muelleri Blume) adalah tanaman hutan yang mulai dikembangkan di Indonesia pada tahun 2003. Pengolahan umbi porang menjadi tepung porang merupakan salah satu alternatif untuk memudahkan pengolahan umbi porang menjadi aneka produk di bidang industri pangan [1]. Kelemahan pada tepung porang tersebut apabila dikonsumsi dapat menimbulkan iritasi dan gatal yang disebabkan oleh

Lampiran 3. Witoyo, J. E., Widjanarko, S. B., Argo, B. D. (2019)

The Effect of Feed Rate and Inlet Air Velocity to Reduce Calcium Oxalate on Porang Chips Using Micro Mill Assisted Cyclone Separator

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Abstract. Porang is the native plant and sources of glucomannan in Indonesia, but the utilization is limited. The presence of calcium oxalate in the porang tuber can cause to the health problem. The milling and air clarifying are the need to eliminate the impurities, i.e. calcium oxalate for producing pure porang flour. The aims of this present research were to know the effect of feed rate and inlet air velocity to reduce calcium oxalate on porang chips using micro mill assisted cyclone separator. This research divided to be 2 stages, the first stage was the determined the condition of feed rate and the inlet air velocity of the cyclone separator, and the second stage was to trial milling with the condition that obtained in the first stage. The result showed the range of feed rate of 45 – 55 kg/h and the inlet air velocity of 3 – 7 m/s. The feed rate and the inlet air velocity had a significant effect ($p < 0.05$) on the yield, the degree of whiteness, and calcium oxalate of porang flour. Overall, the best treatment was obtained at the feed rate of 50 kg/h and 7 m/s in the inlet air velocity of the cyclone separator.

INTRODUCTION

Amorphophallus muelleri Blume (locally known as porang) is one of East and Southeast Asia endemic plants [1], and also found in the Indonesia forest with an average annual production of 8251 tons [2], which contains high glucomannan [3]. However, it also contains relatively high calcium oxalate, which can cause itching and irritation during consumption, and another health problem [4-5], so that more processing is carried out to separate calcium oxalate. Several studies have developed milling (batch methods) followed by air clarifying for separation glucomannan and calcium oxalate, such as hammer mill [6], stamp mill [7-9], and ball mill [10-12], but still have many constraints and disadvantages of various methods were developed.

The micro mill is a modified from a hammer mill which is equipped with a water cooling system to prevent the heating process during the milling process. It has the advantages of producing various particle sizes, capable of grinding brittle or fibrous material [13-15], and requires very little energy consumption during the grinding process [16]. The milling research using a micro mill or hammer mill has been carried out by various researchers with different milling factor for non- food [17] and food product milling [18-19]. In the other hand, cyclone separator is a method to separate or fractionation various particles based on particle size or density [20-21]. However, limited research work had been found to evaluate effect feed rate and inlet air velocity to reduce calcium oxalate on porang chips by continuous milling methods. The aims of presents research, we observed the effect of feed rate on the micro

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