

Improving Sago Flour Production Using Semi-Dry Process Combine with Fermentation

Agus Triputranto¹, Abdul Majid¹, Henky Henanto¹, Bambang Haryanto², DwiSetyaningsih³,

¹ Researcher, Research Center for Agroindustry-BRIN

²Lecturer, Sahid University

³Lecturer, IPB University

Email : agus067@brin.go.id

ABSTRACT

The quality improvement of sago starch was analyzed by observing the fulfillment of sago starch standard. To obtain sago starch, generally use water for the extraction process, while the accumulation of sago starch waste will cause environmental pollution. This study aims to obtain the best results of semi-dry sago flour production by fermentation, including the type of starter, soaking time and water saving. Soaking time is intended to save water used in the sago flour processing. This is due to the high content of crude fiber in sago flour. Processing of semi-dry sago flour combined with fermentation will produce sago flour with crude fiber close to 1% (Standard For Industry MS468, 1976) and influences the yield and mildness. The yield of sago flour by fermentation using Bimo CF starter, resulted in the highest yield at two days incubation of 26.40% and incubation for three days of 26.50%. Starter with dry yeast produced the highest yield during incubation for a day of 24.75% and the highest yield of spontaneously fermented sago flour during incubation for two days of 24.15%.

Keywords: sago flour, semi-dry process, fermentation

INTRODUCTION.

Indonesia has the largest sago forest in the world, about 85% of the world's sago area is spread in Sumatra, Maluku, Sulawesi, and Papua (including West Papua). The total area of sago forests (including plantations) in Indonesia is around 5.5 million hectares and 5.2 million hectares, of which are in Papua (4.75 million ha) and West Papua (510,213 ha) (Bantacut et al., 2020). The potential of sago starch produced throughout Indonesia can reach 6.84 million tons/year. However, from the potential area of sago forests in Indonesia based on data from the Directorate General of Agriculture in 2019, the site in the form of sago plantations that can be utilized has only reached 0.314 million hectares or around 5.79%.

Straying trunk sago into sago starch in its extraction process takes a lot of water. With this water intermediary, sago starch can be separated by its fibres. Generally, sago processing is carried out near water sources, such as on the edge of rivers or creeks. In the sago processing industry with a large capacity, the remaining sago starch from the extraction will accumulate in the river banks. If this continues, sago starch waste will accumulate, resulting in river water pollution (Haryanto & Siswari, 2004). To anticipate the reduced availability of water in quality and quantity, it is necessary to find alternative methods of sago treatment that do not use much water, as well as improvements in the quality of sago processed products.

So far, sago production mostly produces sago starch. According to Flach (1997), starch is the result of mechanical extraction in a wet state from the pith of a tree, while flour is the result obtained from dry grinding of a material that still contains fibres and other coarse materials (Louhenapessy, 2010). In making sago flour, it is thought that it will save water compared to making sago starch. Therefore, it is necessary to engineer the production process of sago flour. Saripudin (2006) has carried out the engineering of the sago flour process, but the sago flour that is still produced contains a high fibre content of 10.10%. In addition to not meeting the maximum fibre content standard required by SNI 01-3729-1995 of 0.1% and the sago requirement for the MS468: 1976 industry of 1%. The high fibre content in sago flour will also limit the use of its flour. So to expand the use of sago flour, there needs to be efforts to develop the engineering of the sago flour production process.

Efforts to improve flour quality to reduce crude fibre levels through fermentation have been carried out using starter Bimo CF (Rachmadi, 2011). Using yeast tape, fermentation in several carbohydrate sources decreases simple fibre content (Arif and Anan, 1996). Starter Bimo CF and yeast tape are easily available in the market. In this study, a semi-dry sago flour production process will be carried out with fermentation treatment using the two starters.

RESEARCH METHODS

Research Time and Place

This research was carried out for five months, from January 2019 to May 2019. The manufacture of sago flour is carried out at the Agro-industrial Technology Laboratory, LABTIAB – PUSPIPTEK Serpong. Sago flour testing was carried out at the Testing Laboratory of the Department of Agricultural Industrial Technology IPB and the LABTIAB Test and Analysis Laboratory – PUSPIPTEK Serpong.

Fermentation Process

The raw material for sago used in the study was sago in the form of a 50-60 cm log obtained from the sago processing business owned by MrRovi in Ciluar Bogor and came from Pandeglang. Before the fermentation process, sago is suffocated through scouring.

The fermentation process uses starter mocaf, *Biologically Modified Cassava Flour* (Bimo CF) obtained from PT. Multi Usaha Wisesa and yeast tape used by the KeretaKencana brand produced by Sinar Sekawan and purchased at the Lembang Ciledung market in Tangerang City, fermentation is carried out at room temperature (30 °C) for 1, 2, 3, 4, and 5 days with an ideally submerged ratio of solids to liquids. After the fermentation process, the sago material is drained.

To test fermentation's effect on sago flour's quality and impact on the fermentation process, soaking with water (natural fermentation) and a positive control test with cellulase enzymes are carried out.

The addition of sodium metabisulfite after the fermentation process is intended to help stop the fermentation process, remove black spots in the flour, increase the degree of white flour and is expected to improve the solubility properties of the resulting sago flour.

Scavenging Process

Before the process of bending, the fermented sawut material is dried. The scavenging process is intended to obtain sago flour with a fineness of 100 mesh; Sago scavenging is carried out using a *disk mill*. After the scavenging process, sifting is carried out using a 100 mesh sieve.

RESULTS AND DISCUSSION

Sago flour produced from the sago bending process is tested for a decrease in fibre content by conducting a proximate analysis and then tested the particle size distribution to determine the smoothness of sago flour using the screening method, namely passing ingredients through a series sieve (*Sieve shaker*) which has the size of the sieve hole getting smaller. Sifting is carried out using a graded sieve with the size of the sieve from top to bottom being 30 mesh, 60 mesh, 80 mesh, and 100 mesh.

Testing of proximate components and physical observations and analyzing amendments. Starch granules were observed using the *Scanning Electron Microscope* (SEM) Jeol JSM-6510LA. Observations were made to determine the impact of fermentation and matching starch types according to SNI 01-3729-1995. To determine fermentation treatment's effect on sago flour's characteristics with one-way ANOVA analysis.

Effect of Fermentation Process on Decrease in Crude Fiber Content

The content of sago flour that affects its use is its crude fiber content. Fibre content can affect the quality of sago flour and limit its use in the food industry. The noodle industry will affect the pull-off strength of the noodles, and the processed food industry will affect the crispiness. The results of crude fibre content analysis in fermented sago flour with variations in starter and soaking time are presented in figure 1. Fermented sago flour using a Bimo CF starter can reduce fibre levels by up to 1.82% and 1.41% at incubation times of 2 and 3 days. Microbes that grow during fermentation produce pectinolytic and cellulolytic enzymes that can destroy cell walls (Muyyasroh and Afriyani, 2010) and (Hawani and Yuliasri, 2012). According to Roida (2013), cellulose is the main constituent component of the plant cell wall, together with hemicellulose and pectin. The main constituent components of the cell wall of plants can reach 40-50% of the mass of tumbuhan (Milala *et al.* 2005).

Fermentation using yeast tape stater can reduce fibre levels by up to 1.36% with a soaking time of 2 days. Fungi cause the decrease in fibre levels in yeast, namely the species *Aspergillus*. *Aspergillus flavus* is relatively inactive compared to other cellulolytic fungi, but the enzymes produced by *Aspergillus orizae* and *Aspergillus flavus* can degrade *cellulose* and hydrolyze *xylon* (Widodo, 2011).

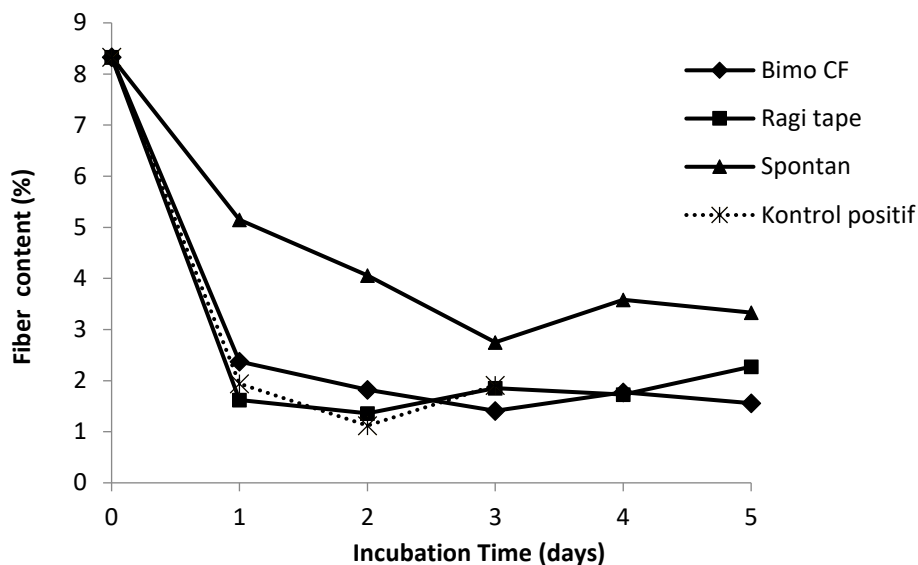


Figure 1. Percentage of crude fiber content to incubation time on various stater variations

Figure 1 shows that the results of positive control testing using the CELLULASE ENZYME ETHOL GE decreased fibre levels ranging from 1.94 % - 1.12 % for an immersion time of 1 to 3 days. It shows the positive influence of the role of cellulolytic enzymes that grow during fermentation using yeast stater tape and staterBimo CF. In contrast to spontaneous fermentation, which only lowers fibre content by 2.75% at a soaking time of 3 days. The fermentation process results showed a decrease in crude fiber content in sago flour, which was not far from 1% (Standard for the MS468 industry, 1976). However, based on fingerprint analysis using one-way ANOVA in fermentation treatment with stater variations and soaking time of sago, it had no effect ($P>0.05$) on reducing crude fibre content. This shows that variations in starter and soaking time have the same effect on decreasing fiber content.

Effect of Fermentation Process on Particle Distribution and Sago Flour modification

Fermented dried sago sawut is then scavenged with a *disk mill* and measured particle size distribution using a graded sieve of 30, 60, 80 and 100 mesh sizes. Those that pass the 100 mesh sieve are designated as sago flour products, as well as the desired standard for the success of the fermentation process and the quality of sago flour. Sago flour with a size of 80/100 mesh can still be used as food flour with limited use. Usually, flour from seeds and tubers is produced at 80/100 mesh. As a food flour, fibre content up to 5.9 is still acceptable as in soybean flour. And for flours whose size is 60/80 mesh to +30 mesh is set as pulp. Fermented sago pulp can be directly used as animal feed. Several studies show that introducing cellulolytic bacteria has increased the digestibility of crude fibre and is favoured as animal feed. The distribution of fermented sago flour particles with variations in stater and soaking time is shown in figure 2.

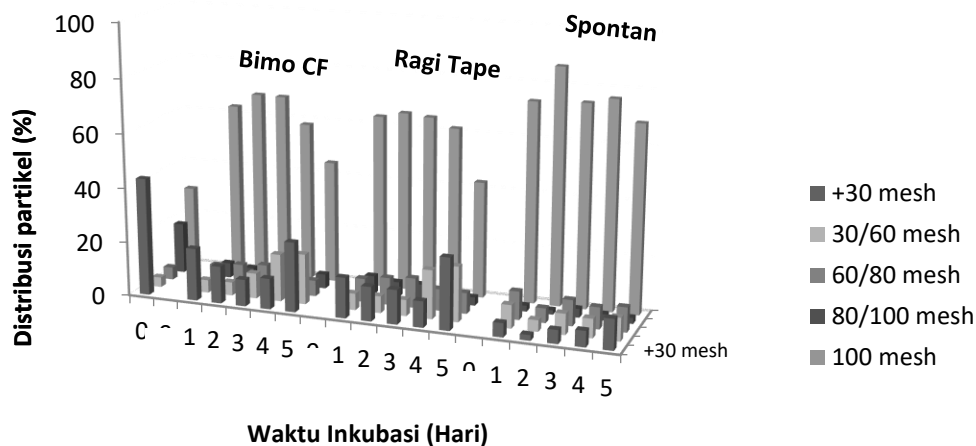


Figure 2. Sago Flour particle Distribution Percentage Graph to the Soaking Time and Various Variations of Starter

What does not pass the 30 mesh sieve is thought to be the material of the sago stem part of the leather pulp that cannot be smoothed anymore by re-grinding. According to (Flach, 1997), the proportion of the *cortex* or outer bark for sago trees originating from Indonesia is 32%, and the thickness is less than 2.5 cm. To peel, it must be careful because the inside still contains a lot of starch. Softening parts of the *cortex* is very beneficial in the bending process. Various variations of starter caused a decrease in the percentage of flour that did not pass 30 mesh compared to test controls without immersion.

Compared without incubation, the use of starter Bimo CF increased the fineness to 68.21 % at the soaking time of 2 days and 68.11 % at the soaking time of 3 days, while for a soaking time of more than three days, the degree of fineness decreased further. Fermentation using a yeast tape stater can increase the fineness to reach 65.76% for a soaking time of 2 days, and soaking time of more than two days, the smoothness decreases.

The smoothness of sago flour is one important physical property due to its role in operating units such as mixing, drying and extrusion. In addition, fineness is essential in evaluating the quality and properties of sago flour during processing. Figure 2 shows an increase in fineness due to the fermentation process in all starter variations and soaking time. The variety analysis results using one-way ANOVA on fermentation treatment with variations in stater and soaking time showed a natural effect ($P < 0.05$) on smoothness.

Fermentation using the Bimo CF stater produced the highest yield at a two days soaking time of 26.40% and a three days soaking time of 26.50%, and this amendment was the highest of the other stater variations. The highest yield for yeast stater tape was 24.75 % at a soaking time of one day. Spontaneous fermentation produces the best conditions at a soaking time of two days with an amendment of 24.15%. If using a dry base, sago flour amendment with fermentation treatment using Bimo CF starters produces the highest yield at an incubation time of two days of 50.99%. Using tape stater yeast, resulted in incubation with the highest yield at one day incubation time of 45.20% and spontaneous fermentation with the highest addition of sago flour at two days incubation time of 53.50%. The analysis of diversity using one-way ANOVA which has been carried out on the fermentation treatment of sago materials with variations in stater and soaking time shows a natural effect ($P < 0.05$) on the increase in yield.

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sago flour amendment at a two days incubation time of 53.50%. The diversity analysis using one-way ANOVA that has been carried out on the fermentation treatment of sago materials with variations in stater and soaking time shows a natural effect ($P < 0.05$) on the increase in yield.

Degree of Whiteness

The degree of whiteness of sago flour as a result of fermentation treatment using Bimo CF starter and tape yeast was not as white as starch. Both the starch produced by the industry is 91.96, and the starch produced by SMEs is 51.14. The degree of whiteness does not enter as a condition of standardization. In SNI 01-3729-1995 the required colours are standard. The ash content influences sago flour's low degree of whiteness from fermentation treatment. The increase in ash content of fermented sago flour compared to raw materials is caused by a dredging device whose surface is also shed when making sago sawut. As for the high ash content affecting the mineral content (Erliana, 2004), it was revealed that the high ash content in flour materials is less preferred because it tends to give a darker colour to the product. The results of measuring the degree of whiteness in sago flour from fermentation treatment using Bimo CF starters and yeast tape can be seen in figure 5.

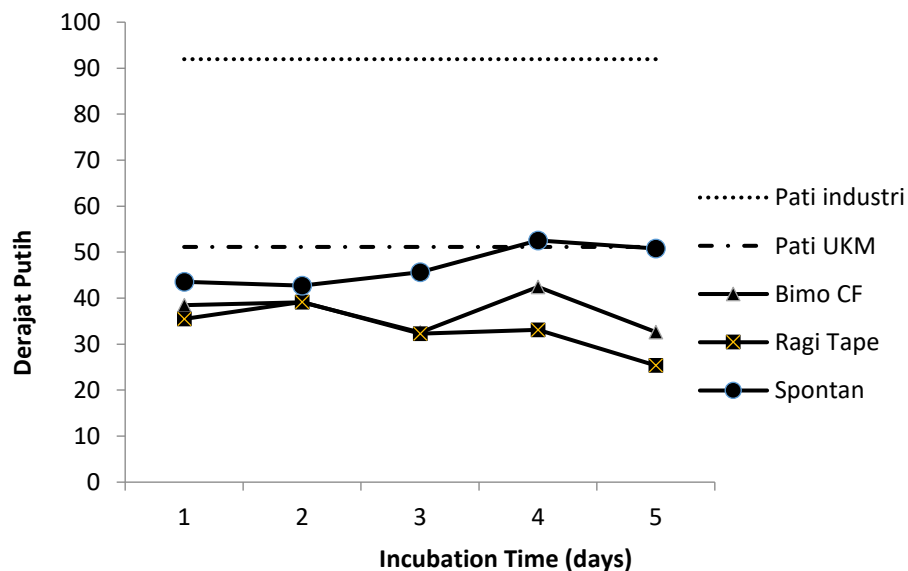


Figure 5 . Graph of the result of measuring the degree of whiteness against soaking time and on various starters

CONCLUSION AND SUGGESTION

Conclusion

The production process of semi-dry sago flour combined with fermentation using Bimo CF starter and 'tape yeast' can be used as an alternative to sago processing. The resulting sago flour has a fibre content that is not far from 1% as a requirement for sago industry (MS468, 1976); starch granules, according to SNI standards 01-3729-1995, have a pH that meets the standard for food SIRIM MS 470: 1992 of 4.5 – 6.5 and the highest yield at a two days soaking time of 26.40% and a three days soaking time of 26.50% on the use of Bimo CF starters and the highest amendment for the use of yeast tape stater by 24.75 % at soaking time of one day.

Suggestion

Further research is needed on the functional properties of fermented sago flour using Bimo CF staters and 'tape yeast' to clarify which one is the most functionally superior and for further development.

References

- Abdul Basir, 2012, Pengaruh Dimensi Mata Pamarut Terhadap Pengolahan Empelur Batang Sagu Menjadi Bahan Dasar Tepung, Jurnal Polimedia Vol 15 No 1 (2012).
- Agustin Zulaidah, 2012, Peningkatan Nilai Guna Pati Alami Melalui Proses Modifikasi Pati, ejurnal unpand Vol 10 No 22 (2012), Universitas Pandanaran.
- Andri Taruna Rachmadi, 2011, Pemanfaatan Fermentasi Rebung Untuk Bahan Suplemen Pangan dan Tepung Serat, Jurnal Riset Industri Hasil Hutan Vol 3 No 1: Juni 2011 Hal 37-41.
- Al Arif, M. Anan, 1996, Daya Cerna Bahan Kering dan Protein dari Beberapa Sumber Karbohidrat dan Difermentasi Dalam Upaya Menekan Biaya Produksi, Lembaga Penelitian Universitas Airlangga (ID).
- [BSN] Badan Standar Nasional, 1995, Standar Nasional Indonesia : SNI 01-3729-1995, Tepung Sagu, Jakarta (ID).
- Bantacut, T., Bintoro, M. H., Zuhud, E. A. M., Damayanthi, E., Arifin, H. S., Widanarni, & Ismayana, A. (2020). *policy brief Pembangunan Sagu Terpadu danBerkelanjutan 2020* (D. G. B. IPB (ed.); cetakan 1). Percetakan IPB.
- Enny Hawani Loebis & Yuliasri Ramadhani Meutia, 2012, Pembuatan Starter Mocaf Terimobilisasi dari Isolat Bakteri Asam Laktat dan Aplikasinya Pada Proses Produksi Mocaf, Hasil Penelitian Industri, Volume 25, N0 1 April 2012.
- Erliana Ginting, Suprpto, 2004, Pemanfaatan Pati Ubi Jalar Sebagai Substitusi Terigu Pada Pembuatan Roti Manis, Balai Penelitian Tanaman Kacang-Kacangan dan Umbi-Umbian.(ID).
- Erning Indrastuti, Harijono, Bambang Susilo, 2012, Karakteristik Tepung Uwi Ungu (*Dioscorea alata* L.) Yang Direndam dan Dikeringkan Sebagai Bahan Edible Paper. Jurnal Teknologi Pertanian Vol.13 No.3 Desember 2012 h.169-176.
- Flach, M. (1997). Sago palm : *Metroxylon sagu* Rottb. *Diversity*, 76. <http://sciencelinks.jp/j-east/article/200204/000020020401A1077090.php>
- Haryanto, B., & Siswari, E. (2004). Pengaruh Pengolahan Usaha Sagu Skala Kecil Terhadap

- Baku Mutu Air Anak Sungai. *Jurnal Teknik Lingkungan*, 5(3), 221–226.
- Haryanto B, 2008, Kajian Aplikasi Tepung Sagu, *Jurnal Standarisasi* Vol 10 No 1 Tahun 2008 : Halaman 27-30.
- Indah Yuliasih, Tun Tedja Irawadi, Illah Sailah, Hardaning Pranamuda, Krisnani Setyowati, Titi Candra Sunarti, 2007, Pengaruh Proses Fraksinasi Pati Sagu Terhadap Karakteristik Fraksi Amilosa, *Jurnal Teknologi Industri Pertanian* Vol.17 (1) : 29-36, (ID) Bogor.
- J.E. Louhenapessy dkk, 2010, Sagu Harapan dan Tantangan, Bumi Aksara, Jakarta
- Louhenapessy, J. E. (2010). *SAGU: Harapan dan Tantangan* (1 st, Issue 2005). Bumi Aksara.
- Loreto Alan B, Quevedo Marcelo A, Mariscal Algerico M, Okazaki Masanori, Toyota Koki, 2006, *Improvement of the Traditional Sago Starch Processing the Philippines Through Mechanization*, *Sago Palm* Vol 14 No 1 P. 4-9 : Tokyo (JPN).
- Michiel Flach, 1997, *Sago Palm Metroxylon sagu Rottb*, International Plant Genetic Resources Institute, Rome, Italy.
- M. Yusuf Samad, 2002, Meningkatkan Produksi Industri Kecil Sagu Melalui Penerapan Teknologi Ekstraksi Semi Mekanis, *Jurnal Sains dan Teknologi* Vol 4 No 5: Agustus 2002 Hal 11-17, BPPT, (ID) Jakarta.
- M. Zain Kanro, Aser Rouw, A. Widjono, Syamsuddin, Amisnaipa, Atekan, 2003, Tanaman Sagu dan Pemanfaatannya di Propinsi Papua, *Jurnal Litbang Pertanian*, 22(3) : 116-124 (ID).
- Murdani, 2012, Analisis Berbagai Macam Starter pada Fermentasi MOCAF, [Internet] : 2012 Desember 06, [diunduh 1 Nopember 2013] tersedia pada <http://bbppketindan.bppsdp.deptan.go.id/arsip/artikel/artikel-pertanian/120-analisis-berbagai-macam-starter-pada-fermentasi-mocaf>
- Muyassaroh Al Rijah & Afriyani Dewi Anggita, 2010, Pembuatan Tepung Ketela Yang Dimodifikasi dengan Proses Fermentasi Sebagai Substitusi Tepung Terigu, [Skripsi], Universitas Sebelas Maret, Surakarta (ID).
- Nur Aini, Purwiyatno Hariyadi, Tien R. Muchtadi dan Nuri Andarwulan, 2010, Hubungan Antara Waktu Fermentasi Grits Jagung Dengan Sifat Gelatinisasi Tepung Jagung Putih Yang Dipengaruhi Ukuran Partikel, *Jurnal Teknologi dan Industri Pangan*, Vol XXI No.1 Th. 2010.
- Saripudin, U. (2006). *REKAYASA PROSES TEPUNG SAGU (Metroxylon Sp .) Dan BEBERAPA KARAKTERNYA* [IPB UNIVERSITY].
<http://repository.ipb.ac.id/handle/123456789/3823>