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Analysis of Ozone Technology Interventions for Economic Recovery during the COVID 19 Pandemic: A Case Study of Batu Bara District through Chili Production Center

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Abstract

The Center for Plasma Research (CPR), Diponegoro University, as the institution that drafted SNI 8759:2019, continues to oversee it implementation. In this paper, we report the successful implementation of SNI 8759:2019 at the chili center in Batu Bara. This success is strongly supported by the producer cooperative "Berkah Abadi Jaya". At the end of May 2021 there will be a chili harvest throughout Indonesia. Chili prices in the Batu Bara chili farming area fell sharply. Chili is bought by a wholesaler for Rp. 7,000.00 per kilogram. The cooperative buys from the farmers as much as Rp. 10,000.00/kg and Rp. 10,500.00/kg and save as much as 835 kg. The collaboration between the research team and the "Berkah Abadi Jaya" Cooperative has synergistically succeeded in applying ozone plasma technology for large-scale chili storage during the main harvest. These saved chilies are resold to the market when prices have improved. The application of plasma ozone technology in chili centers through washing fresh chili grade 1 using ozonized water and storing it in a refrigerator at a temperature of 80 C can extend the shelf life of chilies to 2 months. This application has provided a double benefit for farmers when their crops are purchased by cooperatives. In addition, farmers who are members of the cooperative also benefit by reselling chilies that have been stored at a higher price, which is between Rp. 16,000.00 - Rp. 23,000.00. The quality of chili stored with this technology has been previously investigated by the CPR and examined for confirmation for storage in the chili center of Batu Bara Regency.

Keywords
producer cooperative; farmer exchange rate; ozone technology; chili farmer; horticultural storage

I. Introduction

According to the latest data from the Ministry of Agriculture of the Republic of Indonesia, the national chili production continues to increase, reaching production of more than 1.2 million tons and in many provinces increasing even up to 31%. This very rapid development occurred in the provinces on the island of Sumatra, including Riau, which experienced the largest development until it reached almost 2 times its development.

Compared to the island of Java, the land area on the island of Sumatra is recorded to be larger, reaching 63 thousand hectares, while in Java it is only 52 thousand hectares. The province of North Sumatra is recorded as the third largest chili producer in Indonesia with a total production of 154 thousand tons per year and an illustration of the distribution of chili production in Indonesia is shown in Figure 1. It appears that 3 provinces in Indonesia function as control holders of national chili production, namely Java. Central, West Java and North Sumatra. Simalungun Regency is the area with the largest production reaching 5000 tons, followed by Karo, Dairi, Langkat, and Batubara, but the latter area is an area with the most advanced processing technology with many cooperatives involved. Therefore, based on the situation, the Governor of North Sumatra plans to build a chili factory in Batubara district.

Chili is a national superior commodity that always leaves problems: (1) stock availability is very unstable, and (2) processing technology is not dominant. The instability of chili stocks is largely determined by weather conditions in Indonesia which in the end causes very uncertain prices, which reach a price disparity per kilogram of Rp. 18.300,-. Based on data from the Indonesian Ministry of Agriculture, the national chili production which reaches 1.2 million tons/year, most of which is used to meet the daily needs of the community and the rest is for the benefit of the HORECA market (hotels, restaurants, and catering) which is recorded at 38% from the national demand for chili, and taken from the quality of chili at the second grade level. Based on information from the private sector, the quality of this second grade chili almost reaches 78% of the total national chili production, and is very vulnerable to the rotting process. Therefore, chili processing is the key to stabilizing chili prices and maintaining national stocks. These two components are important strategies, in addition to extending the shelf life, as well as to increase the exchange rate of farmers, especially for areas that are considered to have a surplus of chili production, such as in North Sumatra, which reaches a production surplus of 100,000 tons per year.

Pytohormone ethylene is the main component that causes damage to various types of fruit and vegetables. Moreover, with the tropical climate in Indonesia, the growth of bacteria such as Erwinia chrysanthemi and fungi such as Fusarium sp on fruits and vegetables can easily grow and rot fruits such as pineapple, snakefruit apples and also vegetable products such as chili within 3 days of storage. Various strategies to extend the shelf life of these agricultural products have been developed using citric acid, chitosan, and carrageenan but in fact have an impact on decreasing consumer preference and are also quite expensive so they are not feasible for industry. The Integrated Food Technology Laboratory research team has succeeded in developing a preservation technique using the peroxidase system but it is still relatively expensive and has not been able to reach the agricultural industry market in Indonesia because it has several limitations, including the short durability of the material.

Seeing these limitations, the Plasma Research Center (CPR) of Diponegoro University has succeeded in developing ozone technology to extend the shelf life of agricultural products in Indonesia and has succeeded in producing ozone generator commercial products with patent and brand protection, which are now produced by partner companies in the Industrial Estate with a license agreement. The method developed by the research center has resulted in Indonesia National Standard (INS), which means its use has been approved to extend the shelf life of agricultural products while reducing Post Harvest Loss Reduction (PHL) in agricultural products by up to 70%, a very large number.

The success of ozone plasma technology on fresh horticultural products is considered very good and has high application prospects because it can increase the shelf life of

horticultural products up to 4 times, as has been done with chili which can be stored for up to 12 days. without drastic changes in physical and chemical properties. Ozone plasma technology was initiated by CPR in 2013 by formulating ozone production equipment using the silent plasma technique or Dielectric Barrier Discharge Plasma (DBDP). In its development, this technique can then be used by small industries to extend the shelf life of horticultural products such as tomatoes, lettuce, and leeks.

The outbreak of this virus has an impact of a nation and Globally (Ningrum *et al*, 2020). Covid 19 pandemic caused all efforts not to be as maximal as expected (Sihombing and Nasib, 2020). The presence of Covid-19 as a pandemic certainly has an economic, social and psychological impact on society (Saleh and Mujahiddin, 2020).

According to Economic Recovery during the COVID 19 Pandemic that Indonesia has joined the G20 Troika to welcome the position of the Presidency (host) at the G20 Summit in 2022. The theme of Indonesia's G20 presidency will assume that 2022 is a critical year for safe-guarding the global economic recovery towards strong, sustainable, balanced and inclusive growth. Indonesia's G20 presidency will emphasize the role of the G20 in ensuring that all economies can recover together and invest for a stronger future. This translates into three strategic pillars as the foundation to set up the Agenda of the G20 in 2022, which are (i) Promoting Productivity, (ii) Increasing Resiliency and Stability, and (iii) Ensuring Sustainable and Inclusive Growth. Indonesia is committed to actively involved on G20' works with relevant international partners in overcoming the pandemic and accelerating the economic recovery.

II. Research Method

Plasma Ozone Technology and Ozone Dissolved Water

The technique of using ozone in this research is to apply ozone dissolved water technology. This ozone dissolved water is created using an ozone generator that has been developed by CPR (D'Ozone - Diponegoro University). Ozone gas is pumped into the water in a stainless steel bath (2,400 L, filled to two thirds level) for 30 minutes with microbuble ozone technology to ensure the dissolved ozone concentration is sufficient for the chili washing treatment.

Ozone dissolved water of 0.5 ppm was then used to soak the chilies for 15 minutes. This method was adopted from the previous research team. Plasma ozone technology equipment for horticulture has been in the chili farming area in Batubara Regency since December 2020. The use of technological devices related to SNI: 8759: 2019 is under direct supervision from CPR.

The sorted chili is then placed in a Stainless Steel crate (50 kg per crate) and immersed in ozone water for 15 minutes. Furthermore, the chili is then dried using a blower with a speed of 3700 rpm for 2 hours. Next, the chilies are put into a cooler with temperatures between 4-10 degrees C. Figure 1 shows a seven-step horticultural post-harvest management scheme that can be washed. These steps include washing "picked" vegetables/fruits using clean water to remove adhering sand and soil. Next, during washing vegetables/fruits, turn on the ozone power generator and wait 45-50 minutes until the ozone is dissolved. We use zone micro bubble technology in dissolving ozone into this water. When the ozone has been dissolved, the ozone generator will issue a sound indicator (alarm) indicating that the vegetables can be washed/soaked in a water solution that has been dissolved with ozone. Next, wash or soak the vegetables/fruits in a washing container with standard food grade Stainless Steel.

CPR is in charge of ensuring that the ozone generator and all supporting equipment such as cooling rooms, washing and draining racks, water tanks with dissolved ozone can be used properly and according to needs. CPR provides training to cooperative members and research representatives from USU. Seven steps to get treatment results on horticultural products were tried at the chili center, Batu Bara Regency.

Figure 1. *Schematic of post-harvest treatment process*

III. Results and Discussion

In the results and discussion section of this paper, we will first discuss the development capacity building program is focused on post-harvest management of chili. The discussion was followed by the implementation of SNI 8759: 2019 in the chili center of Batu Bara Regency.

The planting and maintenance of chilies in chili plantations in the chili center of Lubuk Cuik Village, Lima Puluh Pesisir Subdistrict, Batu Bara Regency takes place from February 2021 to May 2021. The third week of May farmers start harvesting chilies. Nationally, chili prices fell sharply. In the Lubuk Cuik area, agents can only buy at a price of Rp. 10.000,00/kg. Even in the first week of June 2021 the price of chili in the area fell again so that it reached a price of Rp. 7,000.00 - Rp. 8,000.00 per kg. At this price, farmers do not benefit at all. Some of them even lost.

Figure 2. *An ozone generator device, an ozone dissolution tank with micro bubble technology and a cold storage filled with ozone are used at the Chili Farming Center, Lubuk Cuik Village, Lima Puluh Subdistrict, Batu Bara Regency, North Sumatra.*

Cooperative Enterprise “Berkah Abadi Jaya” took this opportunity to buy chilies from cooperative members on the condition that they use the chili picking stages according to the standards they have received from the Plasma Center Research Team, which is step by step as a Standard Operating Procedure as shown in Figure 1.

Farmers are asked to pick chilies with good treatment, put them in baskets that have been prepared by the cooperative. The chilies are brought in baskets to the maintenance area in the warehouse where the Ozone Plasma Generator (D,Ozone) device has been installed, the sink, drain rack and cooling room have been equipped with an ozone flow installation (see Figure 10). Figure 11 shows the implementation of stages 1 to 4 of the 7 stages that CPR has developed in handling premium spicy chili products. The seven stages are related to the use of standard treatment according to SNI 8759:2019.

Table 1. Total weight of chili and the purchase price of chili from cooperative members

No	Purchase of Chili	total (kg)	purchase price per kg	purchase price total
1	Purchase of Chili I (9-10 June)	626	Rp10.000	Rp 6.260.000
2	Purchase of Chili II (June 20)	209	Rp10.500	Rp 2.194.500
	Total Chili	835		Rp 8.454.500

Chili that has been purchased from farmers is treated with ozone treatment. After washing with ozone water for 15 minutes, the chilies were drained to get wind-dried chilies. On the surface of the pork there are no more water droplets attached.

A B

Figure 3. *Chilies that have been soaked in ozone water for 15 minutes, drained dry (A), put in a basket basket and stored in a cooling room with ozone (B)*

The next step is to put the chilies in a basket basket and put them in a storage (refrigerated room) ozone. Until June 20, 2021, the cooperative still buys chilies and does not resell them at all. In the sense that chilies are stored in storage while ozone is sent to storage every day as much as 15 g/cubic meter (SNI SNI 8759: 2019). On that occasion the cooperative bought from members for Rp. 10,000.00 per kg on the first purchase and costs Rp. 10,500.00 per kg on the second purchase. These prices are above the cost of

production (CoP) and above the price of fresh chili on the market at that time. Steps taken like this are expected to increase the farmer's exchange rate (FER). Table 4 shows the quantity and price of chili purchased from cooperative members on the condition that the chili is treated according to the steps according to the SOP.

On July 3, 2021, about three weeks of chili being stored in storage, the price of chili in the region has increased to Rp. 16,000.00. The cooperative removes the chili that has been stored for more than 20 days in a basket from the cold storage area. The condition of the chili is still very good, the chili stalk is still green and the color of the chili is still very bright. The spiciness tried by farmers who are very used to testing it says it is still like freshly picked. At the time of first dismantling, the cooperative sold 53 kg. Farmers are waiting for better prices. In the second sale, the farmers sold 285 kg at a price of Rp. 17,000.00. Before being weighed, the chilies that have just been removed from the storage are aerated for thermal stability and to reduce the condensation process from water vapor. The condensation process causes the chili to become wet. The resale of chili that has been stored gets the highest price of Rp. 23,000.00/kg (see table 2).

Figure 4. *Chilies stored in a cold room for more than one month are air-dried and then put into carton boxes*

This research on storing fresh chilies in large quantities in a cold room and having undergone treatment according to SNI 8759: 2019 was the first to be conducted in a chili center, and was carried out by a Chili Producers Cooperative. These results provide confirmation and validation of laboratory experiments which eventually resulted in the concept of the national standard. In this study, farmers can reduce crop damage due to good treatment of crop yields.

In the study it was found that farmers can maintain the quality of chili harvests in a fresh state longer (see Figure 4). Farmers who are members of the cooperative feel calmer because the chilies they harvest are not in a hurry to be damaged. From this storage experience, it is possible to reduce the chili price gap between farmers and consumers. In other words, the profits are not too large in the marketing chain, which consists of agents, middlemen, wholesalers in destination cities and small traders, as well as retail traders. Figure 4 shows the times when chilies are removed from storage and air-dried to obtain thermal equilibrium (Figure 4A). After arriving at room temperature the chili was put in a box (Figure 4B) which at that time had not yet obtained a steamed box prepared for this. At this time the cooperative has prepared a special box for transportation.

The use of plasma ozone technology for chili in centers that have followed SNI SNI 8759: 2019 it is able to increase the farmer's exchange rate (NTP) because their chili products can be sold when the price has exceeded the authorized price for chili (see table 2). Farmers who are members of the Cooperative can still record profits by calculating the amount of operational expenses during storage. The number of farmers involved in the treatment and storage operations is 11 people. Based on the table, it can be concluded that the use of plasma ozone technology in chili centers can open up new employment opportunities. In addition to the things that have been discussed previously, social engineering takes place, namely increasing the sense of mutual cooperation and cooperation between farmers.

Table 2. Total chili weight and selling price from members

No	Chili sales activities between July 3 -15 July 2021	Chili Weight (kg)	Price per kg	Harga total
1	Chili sales I	53	Rp 16.000	Rp 848.000
2	Chili sales II	285	Rp 17.000	Rp 4.845.000
3	Chili sales III	315	Rp 23.000	Rp 7.245.000
4	Chili sales IV	17	Rp 20.000	Rp 340.000
5	Chili sales V	60	Rp 18.000	Rp 1.080.000
	Total chili weight and total sales prices	730		Rp 14.358.000

Utilization of ozone plasma technology in chili centers can be carried out well because of the good cooperation of the technology initiators and drafters of SNI 8759: 2019 with the producer cooperative "Abadi Berkah Jaya" and PT. Bara Commerce Technology. Procurement of plasma ozone technology in Batu Bara Regency is also fully funded by the Batu Bara Regency Government with an economic recovery scheme during the pandemic. The existence of ozone plasma technology storage equipment provides farmers with an understanding of the importance of chili postharvest technology and is able to operate it according to existing standards. In addition, farmers are starting to understand and be interested in knowledge about the agricultural business, so that farmers have choices in selling their products.

IV. Conclusion

Cooperative has synergistically succeeded in applying ozone plasma technology for large-scale chili storage during the main harvest. These saved chilies are resold to the market when prices have improved. The application of plasma ozone technology in chili centers through washing fresh chili grade 1 using ozonized water and storing it in a refrigerator at a temperature of 8^0 C can extend the shelf life of chilies to 2 months. This application has provided a double benefit for farmers when their crops are purchased by cooperatives. In addition, farmers who are members of the cooperative also benefit by reselling chilies that have been stored at a higher price, which is between Rp. 16,000.00 - Rp. 23,000.00. The quality of chili stored with this technology has been previously investigated by the CPR and examined for confirmation for storage in the chili center of Batu Bara Regency.

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