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Application of Individual Quick Freezing (IQF) Technology for Freezing the Raw Materials of Sambal at UD Dede Satoe Surabaya

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Abstrak

Harga bahan baku sambal di Indonesia banyak dipengaruhi oleh beberapa faktor. Faktor-faktor tersebut di antaranya musim panen yang tidak menentu, sifat bahan yang mudah rusak, penanganan pasca panen yang kurang baik, dan juga penawaran dan permintaan cabai di pasar. Hal tersebut menjadi penyebab kerap terjadinya fluktuasi harga bahan baku sambal. Fluktuasi harga bahan baku sambal menjadi permasalahan dalam proses produksi sambal di UD Dede Satoe. Sehingga diperlukan suatu system inventory untuk menyimpan dan membekukan bahan selama harga bahan naik. System inventory tersebut berupa lemari pendingin IQF dengan media pembekuan es kering. Es kering biasanya ditambahkan ke media pendingin karena kemampuan menyerap panas suatu bahan oleh es kering lebih besar dibandingkan media es biasa. Penggunaan es kering dalam proses pembekuan bertujuan untuk penurunan suhu bahan yang lebih cepat karena kemampuan daya serap panas yang besar disebabkan oleh rendahnya titik suhu sublimasi dari es kering, yaitu sekitar -78,5^{o}C. Sehingga, bahan yang dibekukan tersebut dengan lemari pendingin IQF dapat memperpanjang umur simpan karena menahan pertumbuhan mikroba, mempertahankan kualitas nutrisi, dan sensorisnya.

Kata kunci: *Individual Quick Freezing, Sambal, Dry Ice*

Abstract

The price of chili raw materials in Indonesia is influenced by several factors. These factors include erratic harvest seasons, the nature of perishable raw materials, poor post-harvest handling, and also supply and demand at the market. This is the cause of frequent fluctuations in the price of chili raw materials. Fluctuations in the price of chili raw materials are a problem in the chili production process at UD Dede Satoe. Thus, an inventory system is needed to store and freeze ingredients during rising material prices. The inventory system is an IQF refrigerator with dry ice freezing media. Dry ice is usually added to the cooling media because the ability to absorb the heat of a material by dry ice is greater than ordinary ice media. The use of dry ice in the freezing process aims to reduce the temperature of the material more quickly due to the large heat absorption ability caused by the low sublimation temperature point of dry ice, which is around -78.5oC. Thus, the material frozen with IQF refrigerators can extend the shelf life because it restrains microbial growth, maintains its nutritional and sensory quality.

Keywords **:** *Individual Quick Freezing, Sambal, Dry Ice*

Introduction

Sambal is a ready-to-eat product that uses chili peppers and ground onions as the main raw materials. The production of sambal has occurred since time immemorial by many Indonesians and foreigners and can be used as a profitable business opportunity because of the high public consumption demand. Likewise, UD Dede Satoe Surabaya opens business opportunities by producing various types of sambals. However, there are problems that the company encounters, which is experiencing frequent fluctuations in the price of raw materials such as red chili, cayenne pepper, shallots, and garlic. These commodities often experience fluctuations due to its function as the main cooking seasoning so the demand for the commodity tends to increase, moreover, the characteristics of these commodities are perishable (Riyadh, Hendrawan, & Silalahi, 2018).

Red chili, cayenne pepper, shallots, and garlic as the raw material not only are prone to fluctuations in value, but they are also perishable because they are fresh ingredients that have not been processed in any way. Chili commodities tend to spoil faster due to several factors such as unhygienic harvesting tools, being harvested too early, and being stored at room temperature for too long (Sulistyaningrum & Darudriyo, 2018). Meanwhile, onion commodities tend to experience fluctuations affected by the harvest season and their perishable characteristics as well. If there are fluctuations in raw materials, raw materials are necessary to be purchased in the first place when prices are low or decrease in large quantities. These low-price materials then will be stored in an inventory system and used as a preparation of spare materials for the production process.

The inventory system that can be initiated to be a solution to the problems faced by UD Dede Satoe is Individual Quick Freezing (IQF) method. The IQF method material freezing process is assisted by dry ice media. Quick freezing using dry ice can keep raw materials from damage during the freezing process. Dry ice is commonly added to ice cooling media so that the ability to absorb the heat of a material is greater than ice media only. The rate of temperature reduction is faster because of the large heat absorption due to the low sublimation temperature point of dry ice, which is around -78.5^{o}C. Therefore, an optimization process is carried out for the cooling process of the main raw material for sambal using dry ice at UMKM Dede Satoe.

The purpose of this community service activity is to provide solutions to the problems faced by UD Dede Satoe, which is to avoid significant losses in purchasing raw materials during price fluctuations. This service activity is expected to innovate a new storage system for UD Dede Satoe, specifically the storage of raw materials in frozen form through the IQF method. In addition, with the implementation of this service activity, it is expected that the application of IQF freezing technology can be more widely recognized by the common people, so that it can improve the quality of existing human resources, especially workers. With the improvement of technology among small medium enterprise, it is hoped that it can improve social welfare.

Implementation Method

This service activity will be carried out at UD Dede Satoe which is located on Jl. Tenggilis Timur VI Blok DD No.1, Tenggilis Mejoyo, Kec. Tenggilis Mejoyo, Surabaya, East Java 60292, within the time span from August 2023 - December 2023.

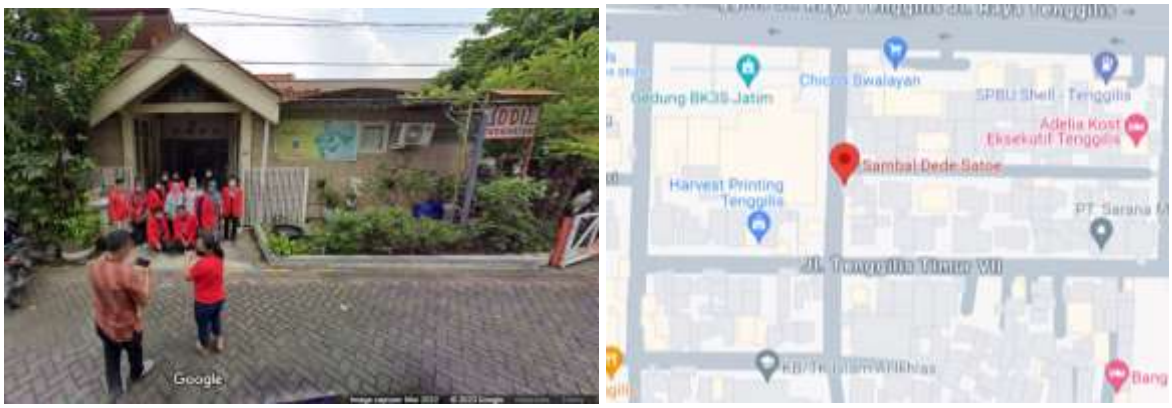

Figure 1. Location of UD Dede Satoe (Source: Google Maps, 2023)

The activities that will be carried out to enable the implementation of IQF technology at UD Dede Satoe are as follows:

1. **Construction of IQF Cabinets**
   IQF cabinets will be constructed with stainless steel material and there are several compartments in the cabinets. There are perforated compartments and tray compartments.
2. **Socialization and Experimentation of Material Freezing Process Using IQF Refrigerator**
   This step will be conducted directly at UD Dede Satoe, which begins with the introduction and socialization of cooling equipment to all employees. Furthermore, experiments will also be carried out on the freezing process with dry ice using IQF refrigerators.
3. **Evaluation of Freezing Results Using IQF Cabinets**
   The last step is the evaluation of the frozen ingredients which will be carried out by the community service team and assisted by the UD Dede Satoe team. The aspects evaluated are the appearance of the material before and after freezing, the durability of the material during storage for a long time after freezing, data analysis, and process improvement to complete the whole process.

Result and Discussion

Partner Profile

UD Dede Satoe is one of the MSMEs that produces ready-to-consume sambal in plastic jar and sachet packaging (https://sambeldedesatoe.co.id/). UD Dede Satoe was established in November 2011 and is located on Jl. Tenggilis Timur IV / DD-1, Surabaya City. Raw materials used for sambal production are obtained from the city of Surabaya and its surroundings within the scope of the East Java region. Sambal produced consists of 12 types of sambals and 5 variants of spices and 6 other products.

The market for Dede Satoe sambal is the domestic and foreign markets, including USA, Canada, New Zealand, Australia, Japan, Netherlands. Sambal Dede Satoe is currently sold offline in stores, modern retailers, outlets, and online at Tokopedia, Shopee, Lazada, Blibli, and Bukalapak. Offline sales including at Airport: Keris Galery, Distributors: Sorong, Timika, Jayapura: Gelael Group; Ranch Market Surabaya & Jakarta; Farmers, Loka, Market City, AEON; Alfamidi (East Java); Indomaret (Surabaya), and several gift shops. UD Dede Satoe's production capacity is the production of 700 jar/day or a total of 2,992 kg/month of sambal, 9,450 sachets/day, and 700 jar/day of seasoning with an average turnover of Rp. 50,000,000/month

Construction of IQF Cabinets

Cooling the raw materials for sambal requires a refrigerator. The refrigerator that is made is a refrigerator with the principle of Individual Quick Freezing (IQF). The materials used are SS-304 stainless steel for the walls of the outer and inner frame of the cabinet and SS-316 type stainless steel for the tray compartment. The compartment tray of this cabinet also consists of two types, which are a perforated tray for placing dry ice and a regular tray for placing ingredients and dry ice flakes. addition, this cabinet is equipped with a thermometer that can detect temperatures up to -70ºC.

Figure 2. Design of Individual Quick Freezing Chamber

Socialization and Experimentation of Material Freezing Process Using IQF Refrigerator

Before using this IQF refrigerator, the community service team is required to socialize how to use the system. The principle of the IQF method is the individual quick-frozen (IQF) method is used to produce high-quality frozen food by freezing one part of the food separately from the remaining food. Compared to slower block freezing, the individually quick-frozen (IQF) method, using cryogenic gas, reduces the temperature of fruits and vegetables to freezing point quickly and maintains cell integrity while barely changing their nutritional quality and sensory characteristics (Li, Lee, Luo, Kim, & Moon, 2018)**.** Therefore, the selection of the IQF method is expected to overcome the problems faced by UD Dede Satoe.

The process of using the IQF refrigerator starts with preparing the ingredients that will be frozen and those that will freeze. The material to be frozen is then placed in the tray compartment, while the freezing material or dry ice is placed in the perforated compartment. In the tray used to place the ingredients, dry ice flakes are added to further accelerate the freezing process by utilizing the conduction process. Conduction is the process of heat transfer when there is a flow of heat from a high temperature to a place with a lower temperature without the transfer of heat-conducting media (Puspawan, Mirza, Pangestu, Suandi, & Sofwan, 2020). Then the material that has been placed in each compartment will be frozen for a certain period depending on the amount of dry ice. If there is more dry ice, the freezing time will be faster. After the materials are qualitatively frozen, they are removed from the refrigerator, packed, and transferred into the chest freezer. These frozen materials can be stored for a long period.

Figure 3. Raw Material Freezing using IQF Chamber

Evaluation of Freezing Results Using IQF Cabinets

The frozen ingredients will be evaluated further with the community service team and the team from UD Dede Satoe. Those to be evaluated include the appearance of the ingredients before and after freezing, the durability of the ingredients during storage for a long time after freezing, data analysis, and process improvements to complete the whole process. The community service team evaluate the frozen ingredients in the laboratory to check for colour changes, weight changes, hardness levels, and vitamin C levels after the ingredients have been stored for a long period, approximately 1 month. From the evaluation results, data will be obtained which can be analysed to improve the use of IQF cabinets in the future.

Conclusion

The application of IQF technology in the refrigerator provided to UD Dede Satoe is expected to provide a solution to the problem of fluctuating prices of raw materials used for chili production. The application of the IQF method can also prevent microbial growth in the ingredients, maintain the nutritional value, and sensory quality of the frozen ingredients, making it suitable to be applied in this issue. The freezing process with IQF refrigerators requires further optimization to determine the optimal composition of ingredients with dry ice so that it can produce frozen ingredients with good quality.

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