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## POST-HARVEST HANDLING EVALUATION OF RED CHILI ALONG THE SUPPLY CHAIN IN SUKABUMI

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### ABSTRACT

*Red chili is a horticultural product commonly used by people in their daily lives. Horticulture products have a long handling process until they reach consumers. The postharvest handling generally must be carried out are collecting, sorting, grading, packaging, transporting, distributing. This study was conducted to analyze the suitability of postharvest handling from each actor in the supply chain according to the standard operational procedure (SOP) of postharvest handling in red chili. This study used purposive and snowball sampling as the methods of selecting respondents. The percentage of the suitability of postharvest toward SOP was obtained with a simple data calculation. This study found that the supply chain of red chili in the Perbawati village of Sukabumi has two types of chains. Postharvest handling of red chili had done were sorting and packaging while another postharvest handling such as collecting, grading, cleaning had not done by the farmers. For the farmers and middleman handling practices compare to the standard operational procedure of postharvest red chili, was 45.56% of post-harvest handling that suitable with the SOP.*

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## INTRODUCTION

Red chili is one of the horticultural products that people often use for daily consumption. In general, horticultural products require a lot of handling so that these products can reach consumers. Commonly, postharvest handling needed is collection, sorting, grading, packaging, transportation, and distribution, so that the product can be purchased by consumers.

Postharvest handling has a very important role for fresh horticulture products, and from good and proper postharvest handling will be able to maintain the quality and quantity of the product and either, improper postharvest handling can result in shrinking quality or quantity, it is estimated that red chili shrinks during postharvest handling of red chili peppers by 29.32% along the supply chain (Wigati et al., 2019).

This study aims to be able to analyze the practice of handling postharvest red chilies through actors involved in the supply chain, analyze the quality and quantity of damage caused, and analyze the suitability of postharvest handling to the standard operational procedures (SOP) of red chili postharvest.

## METHODS

### Research instruments

Primary data were obtained using a structured questionnaire and interviews with respondents. This approach allows the collection of qualitative and quantitative information about various aspects of respondents. The questionnaire was made systematically, by collecting information from respondents and allowing the collection of appropriate data that can be analyzed.

## Research stages

### Respondents determination

Respondents in this study were obtained from the purposive sampling method, also referred to as the purposed determination method used to select Perbawati, Sukabumi as the first respondent. The selected farmers are those who cultivate red chili and based on three categories of farmers seen from the land area, called gurem farmers, small farmers and large farmers with a total of 18 farmers. Determination of the respondents was continued using the snowball sampling method based on farmers' recommendations to be able to obtain further respondents, namely 1-person middleman because there was only 1 middleman in Perbawati, and 11 retail sellers who took red chili from the previous middleman. The last respondent was 102 consumers who bought red chili from 11 previous retail sellers.

### Data collection

The data that was taken from the initial actors were farmers, followed by the next actors were middleman, retail sellers in the wet market and consumers. Data is collected by interviewing in accordance with the questionnaire that has been prepared, in addition, it is also carried out direct observation of postharvest handling practices conducted at the location of the actor was.

### Calculation of the suitability of SOP postharvest red chili

The suitability of SOP postharvest red chili is obtained from interviews and field observations. The suitability parameter was a way of comparing postharvest handling conducted by actors and compared with SOPs that have been prepared and issued by the directorate of cultivation and postharvest of vegetables and medicinal plants, directorate general of horticulture ministry of agriculture

(Kementerian Pertanian Direktorat Jenderal Hortikultura Direktorat Budidaya dan Pacapanen Sayuran dan Tanaman Obat, 2013).

SOPs that have been issued only cover postharvest handling by farmers and middleman, so that the parameters of the suitability of postharvest handling for the retail seller in the wet market and consumer level were adjusted to the standard of handling that has been generally recommended.

The calculation of the percentage of conformity to the SOP was obtained from the number of respondents who did each parameter divided by the total respondents of each actor level, then multiplied by 100%.

$$KS = \frac{A}{B} \times 100\%$$

Where:

KS: SOP suitability

A: number of respondents who conducted postharvest handling parameters based on SOP

B: total number of respondents

For the calculation of the percentage of improvement efforts obtained from the number of respondents who did not handle based on the SOP in each parameter divided by the total number of respondents per actor level and multiplied by 100%.

$$UP = \frac{A}{B} \times 100\%$$

Where

UP: improvement needed

A: number of respondents who did not conduct postharvest handling parameters based on SOP

B: total number of respondents

Then each percentage of each parameter was added up and averaged so

that the total percentage of postharvest handling was in accordance with the SOP and the percentage of handling that was not in accordance with the SOP.

## RESULTS AND DISCUSSION

### Postharvest handling of red chili

#### Farmers

Harvesting was done by picking chilies that have a bright red color evenly using hands-on gloves.

Then the red chili was put into a bucket that was carried by each farmer and then put them in a sack. Farmers in Perbawati very rarely to collect their harvests in a place, so farmers directly put the harvest into sacks. The collection was sometimes done only if the weather was raining then the harvest was collected in flat land covered with plastic sheeting.

Sorting and grading were not done by Perbawati farmers but this was circumvented by not including damaged red chilies or disease pests found during harvesting processes in sacks so that bad red chili was immediately disposed of in the field. But some other farmers collect bad red chili and then dump it into a landfill far from their land thinking that the diseased red chili can spread to healthy red chili. Some farmers do not throw away the bad red chili, but take it home and process it into food.

Packaging using a sack weighing 25 kg/sack (Figure 1) This package can make red chili easier has mechanical damage, physiological damage, and postharvest disease when compared to using cardboard or plastic crates (Somantri and Syahri, 2016). The packaging done was not in accordance with the implementation of SOP postharvest red chili

The use of sacks for chili packaging is still very common also in Benin and in Ghana even though the use of these sacks the level of protection for the products in it

is still very low (Hailu and Derbew, 2015). Because the harvest is directly put into the sack, the condition in the sack is very volatile with hot weather in the surrounding environment.



Figure 1 Red chili packaging for transportation

The use of sacks is unrecommended by (Sinha and Petersen, 2011) because it will increase the possibility of shrinkage during the next stage of transportation. The use of sacks will ease the mechanical damage of the red chili as it is easier cracked and broken and the red chili rot quickly (Hamid et al., 2012; Olayemi et al., 2011). In addition, if the red chili is in direct contact with water or sunlight it will cause tissue damage and cause microorganisms to quickly come and cause postharvest disease.

High temperatures in the environment while harvesting and without precooling, when the red chili was put into a sack would be able to accelerate the rate of respiration, were very susceptible to microbes and increase water content loss. Therefore, it is necessary to remove heat in advance by cold storage which aims to reduce the rate of respiration, reduce susceptibility to microbes and reduce water content loss. Cooling methods that can be used is the method with water (hydro-cooling), cooling using refrigeration or evaporative cooling (Awole et al., 2011; Rodoni et al., 2016). At this stage of the

farmer according to Wigati et al. (2019) postharvest losses may reach 2.33% due to improper handling.

### **Middleman**

After farmers harvest the red chili, the middleman collects all the harvest in the morning or before the middle day. Sack bags for packaging was sometimes provided by the middleman. After the red chili was packaged and then transferred by the farmer by weighing the red chili, then the sack roped with a raffia and transported it to the vehicles belonging to the middleman. The vehicles used were trucks without cover, so that the red chili with sacks packaging can be exposed directly to air, dust, and sunlight. This was unsuitable with the implementation of SOP postharvest red chili.

### **Retailer**

Red chili sellers at wet markets bought from middleman with an average of 10-15 kg in once purchase. There were two kinds of purchasing systems, the first seller comes directly to the middleman or the second middleman ship the red chili to sellers and they were using cardboard or plastic bag as the packaging.

After the red chili arrived at their stand then the red chili would be stored in the original packaging, after the stand began to operate the red chili was transferred to an oval tray. Every day seller would be sorting out the good and bad red chilies caused by wilting, breaking, bruising. Bad red chili would be separated, if at that time the price of red chili is high, the bad red chili would be sold at a cheap price. While if the red chili at that time had low prices, the bad red chili was discarded or brought to their home to be processed into food.

After the stand closes, the red chili would be repacked in cardboard or plastic bag and placed in the stand if the trader has a permanent stand, if the seller does not have a stand, then the red chili was packed

and placed in the porch of the other merchant's stand, or sometimes only cover it with tarpaulin. plastic sheets and reopens when the stand starts operating the next day. The condition of the traditional stand that is hot during the day and does not have a cooler would make the red chili unfresh.

### **Consumers**

Before the red chili was stored, consumers would do simple handling beforehand which was intended to make the red chili more durable when stored. Consumers took care of a case of cleaning or washing red chili using water then stored it.

After consumers purchase, consumers would store red chili in the refrigerator as much as 90.27% of respondents, and 9.72% of respondents choose to store red chili at room temperature.

During storage, red chili stored using plastic bags, containers or wrap with paper. The use of paper wrap and plastic packaging would affect the reduction in vitamin C content and can accelerate the chili weight loss by 26.32% on paper wrap and 23.13% on plastic bags for 9 days storage (Wulandari et al., 2012).

During storage, consumers could store red chili for up to 7 days. Storage of chili is recommended at a temperature of 7-10°C with 95% relative humidity at least for 3-5 weeks, if under these temperatures the chili will easily be attacked by chilling injury, shrinking and loss of water (Ashilenje, 2013; Samira et al., 2013).

### **Suitability of implementation SOP postharvest red chili**

#### **Farmers**

The implementation of SOP postharvest red chili showed in Table 1 the first was the determination of harvest time when the physical growth of red chili was appropriate and then manually harvested by picking red chili with its stems, this

assessment parameter has been done 100% by all of the farmers. After harvesting, red chili was collected in a place that was protected from the sun and rain. Collecting after harvest when rainy days were not done by 88.89% farmers. The parameter of cooling process to release the heat from environment temperature not carried out by the farmers at all. If the collection and cooling stages were not carried out and the red chili would immediately be packed then the environment heat was still trapped in the packaging and might increasing respiration rate.

The next SOP parameter was sorting on a table not done, farmers in Perbawati did the sorting at the same time as the harvesting process, by separating the healthy chili from diseased and incomplete fruit. Red chili grading was not done because all the harvest would be taken by middleman and there was without a specific market that might require the grade of red chili. For packaging that conforms to SOP was packaging that can protect and maintain the quality of red chili from external influences and physical damage. One of the recommended packages in the SOP was the use of plastic bags with label information about product type, origin, weight, and quality, while the packaging used by farmers was 100% plastic bag but without labeling information. The SOP also recommends that the contents of the package not overweight and not too solid to reducing heat. But in its application, farmers still pack solid red chili, the sack capacity was 25 kg, but red chili was packaged up to 30 kg

SOPs in maintaining shelf life and quality of red chili was not carried by farmers. Handling could be done by controlling the rate of respiration, preventing disease attacks, maintaining the freshness of red chili, setting the storage temperature and humidity 100% was not done. This was because farmers did not

store their harvest and all the harvest would be bought by middleman.

### Middleman

At the middleman level, the SOP parameter was the vehicles and the tools used must be clean, easy to clean and to protect the product from physical or physiological damage that has been carried by the middleman. In addition, the vehicles must also have adequate ventilation and take into account the height of the pile, and the pile of products not

used as a backrest or seat. The next parameter was the product transported must avoid direct sunlight during transportation. This was not fulfilled during the transportation application because they were used an open truck

without a permanent cover or tarpaulin. Neither temperature nor humidity inside the vehicle was maintained during the transportation process.

The last SOP parameter was the recording of the products transported, the type of vegetables, the quantity and destination of the delivery must be properly recorded by the middleman.

The suitability of the application of SOP postharvest red chili at the stage of farmers and middleman was 46.39% so it needs to be improved by 53.61% as shown in Table 1.

Table 1 Implementation of standard operational procedures (SOP) for postharvest red chili

Parameters	Actors	Suitability of SOP	Needs to be improved
1	Farmer	100%	0%
2	Farmer	100%	0%
3	Farmer	11.11%	88.89%
4	Farmer	0%	100%
5	Farmer	0%	100%
6	Farmer	16.67%	83.33%
7	Farmer	0%	100%
8	Farmer	100%	0%
9	Farmer	100%	0%
10	Farmer	0%	100%
11	Farmer	0%	100%
12	Farmer	0%	100%
13	Farmer	0%	100%
14	Middleman	100%	0%
15	Middleman	100%	0%
16	Middleman	100%	0%
17	Middleman	100%	0%
18	Middleman	0%	100%
19	Middleman	0%	100%
20	Middleman	100%	0%
Suitability of SOP implementation of red chili		46.39%	53.61%



### Retailer

After the red chili reaches the wet market, the retailer did special sorting to separate the red chili that has mechanical damage, disease or incomplete. If the diseased, damaged chili was not separated, it can affect the healthy red chili and easily infected. Special sorting on a regular basis is highly recommended for retailers in the market to be able to maintain the quality of red chili and prevents waste and economic losses.

### Consumers

The storage method used by consumers was storing red chili using plastic bag packaging and put it in the refrigerator or stored at room temperature. The use of plastic bags can increase the loss of water content in red chili and cause quantity losses. Advises for consumers are to use special packaging that could close tightly for example plastic containers.

### CONCLUSION

The suitability of postharvest handling of red chili to SOP by farmers was 46.39%. This shows the compatibility between the SOP and the implementation in the field at the level of farmers, middleman, and retailer, the heat of environmental conditions made the product exposed to direct sunlight and poorly maintained hygiene makes the quality of the product easy to decline. At the level of retailer bought too much from the middleman that was one of the caused if the product does not sell well the retailer discards it. At the consumer level, commonly, bought too much red chili and not used it immediately as foods, causing longer storage and improper packaging that were the main reason for red chili became waste.

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