

## Physical Properties of Matured Pepper Berries

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### Abstract

Pepper is known as the 'King of Spices' and its botanical name is *Piper Nigrum* which is one of the most popular and oldest spices in the world. There is a problem during manual sorting and grading of pepper such as the selected pepper berries for white pepper production are less fulfilled according to standard of properties (dimension, weight and colour) requirement that had been done by man power. This study is carried out to determine the physical properties (dimension, weight, and colour) of mature pepper berries because they are vital in sorting and grading to evaluate the food quality. The physical properties of food materials is essential for processing design and optimization. The preparation of the samples is starting to collect from the plantation. The spikes with mature pepper berries were threshed manually to obtain the pepper berries. The only full mature pepper berries were selected and prepared for further analysis. The physical properties of mature pepper berries such as dimension (5.42 mm), weight (0.12 g), and colour (value of 63.05 (a\*), 47.33 (b\*), and 39.17 (L\*)) were obtained after analysed. Hence, the results are based on the maturity period and can be applicable for the food processing.

Keywords: physical properties, pepper berries, matured, sorting, applicable

### Introduction

The botanical name of pepper is *Piper Nigrum*. Pepper is known as the 'King of Spices' and one of the most popular and oldest spices in the world. Its natural habitats are in Vietnam, Malaysia, Indonesia, Sri Lanka and others. The pepper maintains the highest standards among the spices for a little more than one fourth of the total world trade in spices (Taylor et al., 2009). It has a sharp, pungent aroma and flavour, light colour (Thankamani & Giridhar, 2004). There is an increasing demand for white pepper in the markets worldwide (Thankamani & Giridhar, 2004). The amount of production of pepper is 5 kg per year for one pepper vine. The largest of the national production of pepper in Malaysia is contributed by Sarawak which is 98% (Hong, 2015). The pepper is widely grown in several areas such as Kuching, Samarahan, Sri Aman, Betong and Sarikei (Rosli et al., 2013). The area of plantation in Sarawak is about 13,000 hectares. Pepper has various types which including green, yellow or red, black and white pepper. The green pepper berries are the immature berries meanwhile the yellow or red pepper berries are the fully matured berries. These both types of pepper have the same average diameter, which is 5 mm to 6 mm. According to Malaysian Pepper Board (MPB), there are few recommended varieties of pepper such as Kuching, Semongok Emas and Semongok Aman. The Kuching pepper is most widely grown cultivar in Sarawak and Johore when compared to other varieties. In order to produce either black or white pepper, the physical properties are very vital in food processing. Some components are inedible or have variable physical characteristics contained in most raw materials. Processing techniques such as sorting and grading are necessary

to obtain the required uniformity of the raw materials for further processing. The manual techniques of sorting and grading is time consuming and inaccurate susceptible due to human judgements (Fauzi et al., 2015). Dimension, weight, and colour also known as main external criteria needed to sort agriculture products. The dimension sorting is essential to estimate the effectiveness of methods used to prevent blocking. Weight sorting is more accurate than other methods which completing measurement weight of raw materials before further processing and mostly used for more valuable foods. The matureness or ripeness of fruits and food can be specified by colour that has been widely used in agriculture application. Specification in colour range from yellowish or slight reddish to bright red which are a direct result of senescence and it is used in colour sorting of pepper (Shearer & Payne, 1990). Based on the physical properties, the lower grade pepper will be classified by sorting for any crushed, immature or undersized pepper. The aim of this study is to determine the physical properties (dimension, weight, and colour) of mature pepper berries as it is easier for sorting and grading techniques during white pepper production.

### Materials and methods

#### Preparation of sample

The fully ripe pepper berries were selected and collected from the farm in Universiti Putra Malaysia. The spikes which have one or two reddish-orange berries were collected for the analysis. The pepper berries was separated from the leaves and others by manual. The sorted pepper berries were put in a plastic bag and stored in chiller with 10°C before further analysis.

### Dimension

100 samples of pepper berries were used. A digital Vernier calliper (Series 500, Mitutoyo, Japan) with accuracy of 0.01mm was used to measure the dimensions of the pepper berries (Rosnah & Chan, 2014; Sirisomboon et al., 2007; Terdwongworakul et al., 2009). The dimensions of sample were measured as major axis (a), medium axis (b) minor axis (c) and diameter as shown in Figure 1.

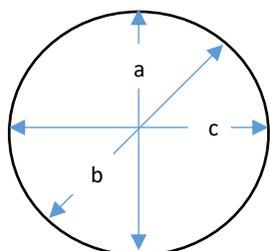


Figure 1: Dimensions of pepper berry

### Weight

The mature pepper berries were weighed by using an electronic balance (ER-120A, AND, Japan) with accuracy of 0.0001 g (Terdwongworakul et al., 2009). 100 of pepper berries were used as samples and the weight obtained was divided by 100 to get the average weight for a pepper berry.

### Colour

Colour of pepper berries were measured and the colour values of  $L^*$ ,  $a^*$  and  $b^*$  were determined by using a colour meter (CR-10, Konica Minolta, Japan). They were recorded and used to determine the chroma and hue angle by using equation below (Mohsenin, 1986). The Commission Internationale de L'Eclairage (CIE) 'Lab' colour space coordinates indicates  $L$  represents the degree of lightness (the light to dark spectrum),  $a$  represents the green to red spectrum, and  $b$  represents the blue to yellow spectrum (Rosnah & Chan, 2014).

$$\text{Chroma, } c^* = [(a^*)^2 + (b^*)^2]^{1/2}$$

$$\text{Hue angle, } h^* = \tan^{-1} (b^*/a^*)$$

## Results and discussion

### Dimension

The properties of dimensions include diameter, major axis, medium axis, and minor axis of mature pepper berries are shown in Table 1. The values of dimensions are determined by using 100 mature pepper berries. According to Table 1, the average diameter of the mature pepper berries is 5.42 mm with standard deviation of 0.449. The mature pepper berries have the values of 5.22 mm, 5.50 mm, and 5.55 mm for the average major axis (a), medium axis (b), and minor axis (c). The average value of minor axis is larger among the others and then followed by the average value of medium and major axis. Based on the results in Table 1, it indicates the average diameter of mature pepper berries is higher value when compared to previous works on green pepper

berries (Rosnah & Chan, 2014) and dried black pepper seeds (Murthy & Bhattacharya, 1998) which are 5.21 mm and 5.12 mm respectively. Thus, the mature pepper berries have the highest value of average diameter when compared previously published works.

### Weight

The average weight of 100 pepper berries measured is 11.52 g. After dividing the 100, the weight of a pepper berry is 0.12 g. Meanwhile, the previous work according to Rosnah & Chan (2014) indicates the weight of one green pepper berry is 0.11 g. This difference shows the mature pepper berry has the larger value of weight. One of the major parameters such as weight is important to determine density, quality and texture of pepper berries.

### Colour

The colour measurements are used as quality parameters and indicator of some inner components of the material (Jha, 2010). An analysis of colour shows the determination of the  $a^*$ ,  $b^*$  and  $L^*$  values for fresh mature pepper berries. The colour values of mature pepper berries are shown in Table 2. The colour values are referred to the Commission Internationale de L'Eclairage (CIE) 'Lab' colour space coordinates. The value of  $a^*$  is representing as the green to red spectrum,  $b^*$  represents the blue to yellow spectrum, and  $L^*$  represents the degree of lightness which is the light to dark spectrum. Table 2 indicates a red colour of mature pepper berries with an average value of 63.05 ( $a^*$ ), 47.33 ( $b^*$ ), and 39.17 ( $L^*$ ) with standard deviation. These values are in the range of red colour according to CIE 'Lab' colour space. The average  $c^*$  and  $h^*$  values of mature pepper berries are 48.64 and 36.90. These results are obtained and calculated by substituting the values of  $a^*$  and  $b^*$  into the equations. Meanwhile, the average value of -36.69 ( $a^*$ ), 40.77 ( $b^*$ ), 42.05 ( $L^*$ ), 54.88 ( $c^*$ ), and -47.89 ( $h^*$ ) based on previous work of green pepper berries colour at soaking day 1, which are in colour range from mint green to turquoise green (Rosnah & Chan, 2014). The different values of colour among these results are caused by different maturity period of each fresh pepper berries on a spike. The different maturity that caused the red colour of pepper berries is due to the natural pigment such as carotenoids.

Table 1: Dimension of mature pepper berry

Properties	Average	Standard Deviation
Diameter (mm)	5.42	0.449
Major axis, a (mm)	5.22	0.429
Medium axis, b (mm)	5.50	0.497
Minor axis, c (mm)	5.55	0.511

Table 2: Colour values of mature pepper berries

Properties	Mean	Standard Deviation
<b>a*</b>	63.05	0.153
<b>b*</b>	47.33	0.361
<b>L* - luminosity</b>	39.17	0.231
<b>c* - chroma</b>	48.64	0.354
<b>h* - hue angle</b>	36.90	0.151

The mature pepper berries should be sorted by the properties, which were significantly different between immature pepper berries and mature pepper berries based on the Table 1 and 2.

### Conclusions

In this study, all of the properties of mature pepper berries that have been analysed such as dimension, weight, and colour provide useful information for new design of food processing and application in future. The analysis of physical properties of mature pepper berries was conducted and results show that the diameter, major axis, medium axis, minor axis, weight,  $a^*$ ,  $b^*$  and  $L^*$  are 5.42 mm 5.22 mm, 5.50 mm, 5.55 mm, 0.12 g, 63.05, 47.33, and 39.17 respectively. It can also be concluded that the physical properties of mature or red pepper berries are determined. According to these results, the diameter of mature pepper berries is different when compared to previous work on green pepper berries. This difference is due to the maturity period.

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