

## ARTICLE

## Value Added Pepper Based Food Products from Green Pepper

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Green pepper berries are normally harvested and dried to produce black pepper berries. It can also be soaked for 10 – 12 days to ret its outer skin and then washed before dried under the sun. This is then will produce white pepper berries. However, there are still many pepper based food products which can be developed from green pepper in which the aim of this study will focus on the development of pepper based food product done intensively by Malaysian Pepper Board such as green pepper in brine, green pepper sauce, green pepper vinaigrette, green pepper sambal and dehydrated pepper berries. Developed products will be go for sensory evaluation as to determine the acceptance of the panellists toward the product apart from discussing formulations being used in the development of the products. As a conclusion, pepper based food products developed from green pepper as listed are well accepted and can be further commercialised to interested food industries.

### Introduction

Pepper (*Piper nigrum* L.) is known as the King of Spices all around the world whereby the fruits/berries are consists of black and white pepper berries. Both black and white pepper berries are derived from green pepper berries whereby black pepper berries are obtained by drying the green pepper berries under the sun and the berries will turn black and shrivelled. As for the white pepper, it is produced by soaking the mature berries in the stream or river for 14 days for the outer skin to ret. The berries are then washed to produce white skinless berries and then dried under the sun. As comparison, outer fruit layer on black pepper contains aroma-contributing terpenes including germacrene (11%), limolene (10%), pinene (10%), alpha-phellandrene (9%) and beta-carophyllene (7%) which give citrusy, woody and floral notes (Jirovetz et al 2002). These scents are mostly missing in white pepper, whereby white pepper has different odours (including musty notes) from its longer fermentation stage (Mcgee 2004). Due to that as well, black pepper is more pungent than white pepper in which food application or recipes using either black or white varies depending on aroma, flavour or appearance of the final product or recipe.

The ever changing demand of the food industry sector have triggered the pepper industry to explore in coming up with new pepper based food products from black pepper and white pepper which have contributed to several products in the market such as pepper sauce, marinades, dry and wet seasonings. Apart from that, positive success of extracting pepper oil and pepper

oleoresin from pepper is another achievement for the pepper industry as both extracts can be used as a food flavour in health food products or even non-food products. Although black pepper and white pepper have been successfully developed and commercialized into marketable pepper based food products, the potential of green pepper berries to be developed into value added pepper based products must also be looked into. Green pepper berries or green pepper corns are the immature, fresh (green) berries of the pepper vine which are plucked fresh from the vines and can be processed into various specialty products while retaining their natural green colour and flavour. Putting this into account, whereby apart from improving the economic wellbeing of pepper farmers, the value addition of green pepper berries into other products will also increase range of product from pepper which can be transferred to interested food industries or even local SMEs in Malaysia.

As per our knowledge, there is no report on the development of value added pepper based food products from green pepper berries in Malaysia which can be developed into green pepper in brine, green pepper sauce, green pepper vinaigrette, green pepper sambal and also microwave vacuum dried pepper.

In general, green pepper in brine is used in making sauces, in meat processing industries and also in food service sector. The green pepper sauce can be used as dipping sauce and in cooking whereby its taste is less pungent in comparison with black pepper sauce. As for the green pepper vinaigrette, it is used in salad dressing and suitable for all types of salads or even in mixed fruit salads. The green pepper sambal is nevertheless similar

to the chilli sambal whereby it emphasised on the usage of blended green pepper and then combined with local anchovies. The microwave vacuum dried pepper is another value added product produced from the microwave vacuum dried technology in which this technology is still new to the pepper industry. All these mentioned products shall emphasise on the usage of green pepper berries as its main ingredient and its product development process shall be further discussed in this paper.

## Materials and Methods

### Materials

Green pepper berries, filtered water, sea salt, vinegar, citric acid, salt meter, pH meter, sterilized glass jars, sugar, vinegar, modified corn starch, food gum, food colouring, sodium benzoate, Endecott viscometer, refractometer, food processor, handheld blender, anchovies, fresh red onions, fresh garlic, lime juice, cooking oil, frying pan, oven, food vessel, stainless steel pot, microwave vacuum dryer (Model: FTE [Taiwan]).

### Green pepper in brine

Harvested green pepper berries are separated from its stalk, washed and cleaned thoroughly. Pinheads or tiny berries are separated from the good quality berries and then weighed at 30 gram to be filled into sterilized glass jars. The brine solution is prepared by boiling the filtered water and then added with sea salt (20.0% - 30%), vinegar (1.3% - 2.0%) and citric acid (0.2% - 0.5%). The concentration of the brine and the acidity of the brine are then measured using the salt meter and the pH meter. The brine solution is then poured into the glass jars filled with green pepper berries and then sealed.

### Green pepper Sauce

Clean green pepper berries are blended finely with a food processor and then placed in an airtight container. 35% – 40 % of modified corn starch is mixed with 60% - 65% of filtered water in a stainless steel pot. Blended green pepper (10% - 12%) is added in followed by salt (2% - 4%), 0.1% food colour (Pea Green) and sugar (20% - 25%). Mixture is blended with a hand blender at full speed until fully mixed. Transfer mixture to a stainless steel pot and heat on stove until simmer. Food gum (1% - 2%) is being mixed into the mixture bit by bit to avoid lump. Stir thoroughly and then vinegar is added. The sauce is heated until total soluble solid is measured at 30 Brix. The green pepper sauce is then poured into sterilised glass jars, capped and placed in room condition.

### Green pepper Sambal

Green pepper berries (30%) are blended coarsely by using the food processor and placed in the refrigerator. Fresh anchovies (32%) are cleaned properly and then oven baked at the temperature of 200°C for 1 hour. Then

it is to be kept in an airtight container while other raw materials are being prepared. Fresh red onions and fresh garlic (15% - 22%) are peeled and then blended coarsely by using the food processor. Two tablespoons of cooking oil is poured into the frying pan and the chopped red onions and garlic are added. The ingredients are stirred evenly and the blended fresh green pepper is added in followed by the baked anchovies. Sugar (0.5 – 2%) is added and then followed by lime juice (6.5% - 10%). Stir thoroughly and heat is switched off. It is packed and sealed in the Enterpack food vessel and kept in the chiller at the temperature of 1 - 3°C.

### Green pepper vinaigrette

Green pepper berries (23% - 25%) and fresh peeled garlic (11% - 13%) are blended finely using a food processor. Filtered water is place on stove and let to simmer. Blended green pepper and blended garlic is added in. Stir properly and add in cooking oil and vinegar. Pour into sterilised jars and capped properly.

### Microwave vacuum dried pepper

Harvested green pepper berries are separated from its stalk, washed and cleaned thoroughly. The green pepper berries are dried and strained using a plastic strainer. Spread evenly on the tray of the microwave vacuum dryer (maximum 100gm) and it is then placed inside the chamber of the microwave vacuum dryer. Vacuum is set at -75cmHg and the temperature is set at 70°C, 80°C and 90°C for a period of three (3) hours. After completion of drying, the microwave dried pepper shall be labelled separately based on different drying temperatures for analysis in terms of moisture content, volatile oil and piperine content.

## Results and Discussion

### Green pepper in brine

Based on the product development process, the green pepper in brine is bottled in sterilised glass jars and is monitored by using a salt meter every two (2) days. Based on observation for a period of 60 days, green pepper preserved in 20% of brine solution is non-mouldy in comparison with green pepper preserved in 12% - 15% of brine solution. However, it is recommended to replace the brine solution every 60 days to obtain a clearer and better brine solution as it is bottled in clear glass jars. Addition of citric acid at a level of 0.2% also reduced or prevented the blackening of berries in the brine solution in which the addition of the citric acid did not affect the final taste of the green pepper in brine. Green pepper in brine which is not added with citric acid turned black on the 25<sup>th</sup> day of brining whereby the final appearance and also the smell are not acceptable.

### Green pepper sauce

The quality of the green pepper sauce was evaluated in terms of pH, total soluble solid and viscosity whereby the measured pH is 3.5 with total soluble solid of 30 - 35°Brix. The viscosity of the sauce was measured using the Endecott Viscometer in which it was 6.5 cm per 30 seconds. The sauce produced has a better thickness in which the thickness of sauce described the viscosity and the smoothness of the sauce produced (Gould, 1974). The viscosity of the sauce is formulated based on the total amount of modified corn starch at 36% and amount of food gum at 1.5%. Observation on the sauce kept at room condition for a period of 12 months indicated that the colour of the sauce did not deteriorate at 0.1% level of colour added. In the sensory evaluation, 10 panellists were invited whereby in general, the panellists were able to accept the product in terms of taste and appearance.

### Green pepper Sambal

The green pepper sambal product was packed using the Everpack packing vessel and then kept in chilling temperature of 1° - 3°C. The product is able to be kept for a period of three (3) months in the mentioned temperature and after three (3) months the product deteriorated in terms of colour and became rancid. However, during sensory evaluation, the product was well accepted by the sensory evaluation panellists either by consuming it alone or by mixing it with fried rice.

### Green pepper vinaigrette

The green pepper vinaigrette was subjected to sensory evaluation whereby 30 panellists were invited to evaluate the product. Based on the sensory evaluation, the panellists were able to accept the product characteristics especially when they find the product is compatible with any salad recipes such as fruits or vegetables. The product basically is a combination of green pepper berries, garlic and palm oil and is bottled in a transparent jar.

### Microwave vacuum dried pepper

Green pepper dried using the microwave vacuum drying at various temperatures from 70°C - 90°C was analysed in terms of moisture content (ASTA Method 2.0), volatile oil (ASTA Method 5.0) and piperine content (ISO 5564 – 1982(E)) by using the FT-NIR instrument. Result obtained as in Table 1 below.

Table 1

Type of Analysis	Temperature (°C)		
	70°C	80°C	90°C
Moisture (%)	6.84	6.15	5.95
Volatile oil (%)	2.98	2.60	2.33
Piperine (%)	6.68	6.12	5.90

Pepper has moisture content at 65% - 70% at harvest which should be brought to safer levels of 10% by adequate drying under the sun (Devasahayam et al.,

2015). High moisture content exceeding 12% will cause the berries susceptible to fungal attack in which the moisture content for the berries dried using the microwave vacuum dryer ranges between 5.95% - 6.84%. The moisture content for berries produced using the microwave vacuum dryer is lower than 10% thus inhibits the growth of fungus.

The aroma of pepper is determined by the composition of the volatile oil content whereby the higher the volatile oil content, the better the aroma (Purseglove et al., 1981). The microwave vacuum dried pepper produced at the temperature of 70°C has higher volatile oil content at 2.98% in comparison with pepper dried at higher temperatures which is 80°C and 90°C. However, based on Malaysian Food Act 1983 (Regulation 324: Black Pepper Powder), the volatile oil content of the microwave vacuum dried pepper ranges from 2.33% to 2.98% which is above the requirement stated in Regulation 324 (2)(b) (ii) shall contain not less than 1.5% v/w of volatile essential oil. However, the composition of black pepper oil can vary considerably relating to the cultivar and also ripening stage (Lawrance 1985; Richard and Jennings, 1971) in which the cultivar used in the drying trial is of Semonggok Aman variety.

The main pungent principle in pepper is piperine and in general, the piperine content of black peppercorns lies within the range of 3-8gm/100gm (Tainter and Grenis 1993). As for the microwave vacuum dried pepper, the highest piperine content is 6.68% obtained from the drying temperature of 70°C. This is followed by pepper dried in the temperature of 80°C with piperine content of 6.12% and then 5.90% for pepper dried in the temperature of 90°C. In general, the piperine content in microwave vacuum dried pepper exceeded the standard of piperine content for black pepper (Regulation 324 (b) (iii)) in Malaysian Food Act 1983 which is not less than 4.0%.

The final quality of microwave vacuum dried pepper which is analysed in terms of moisture, volatile oil and piperine content complied with the specified standards for black pepper in Malaysian Food Act 1983. Nevertheless, several factors must be looked into such as pepper variety and maturity stage in order to produce black pepper of high quality from green pepper berries.

## Conclusions

Pepper based food products developed from green pepper berries such as green pepper in brine, green pepper sauce, green pepper vinaigrette and green pepper sambal are potential products which can be commercialised by the food industry. Apart from that, the microwave vacuum drying technology can be looked into as a new alternative in improving the present drying process of green pepper to black pepper and must be considered by the pepper industry. The combination of value added pepper based food products and postharvest

technology will ensure the Malaysian pepper industry to prosper and benefit the pepper farmers in general.

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## Conflict of Interest

All the authors declare that they have no conflict of interest.

## References

- 1 Devasahayam S., John Zachariah T., Jayasmae E., Kandiannan K., Prasath D., Santhosh J Eapen, Sasikumar B., Srinivasan V and Susella Bhai R. (2015). Black Pepper, Indian Institute of Spices Research, Kozhikode. pp 1-24.
- 2 Gould W.A. (1974) Tomato production - processing and quality evaluation. Avi Publishing Company Inc. USA, 373 P.
- 3 Jirovetz L., Buchbaner G., Ngassoum M.B. and Geissler M. (2002). Aroma compound analysis of piper nigrum and piper guineense essential oil from Cameroon using solid phase microextraction – Gas Chromatograph, mass spectrophotometry and olfactometry. *Journal of Chromatography*, 976(1–2): 266 – 275.
- 4 Lawrance B.M. (1985) *Progress in essential oils - perfume flavour*. (10): 52 – 60.
- 5 Mcgee H. (2004) *Black pepper and relatives on food and cooking (Revised Edition)* Scribner, USA, pp 427 – 429.
- 6 Purseglove J.W., Brown E.G., Green C.L. and Robbins S.R.J. (1981). *Spice*. Longman, New York, Vol. 2.
- 7 Richard H.M. and Jennings W.G. (1971). Volatile composition of black pepper. *Journal Food Science* 36: 584 – 589.
- 8 Tanter D.R. and Grenis A.T. (1993). *Spices and seasonings – A food technology handbook*. Vch Publishers, New York, USA.