ity, sanitation, pest control, environment and ware house are crucial. During trade stage, consumer complaints and se control are managed. At consumer stage, the specification, ergens, consumer response, complaint handling and process ies are important to ensure food safety. Integrated quality management applied in Kraft Foods considers those factors on r to guarantee that the food products are safe.

SHELF-LIFE PREDICTION OF SEASONING POWDER MADE FROM WHOLE FERMENTED FISH (PEDA) BY USING ARRHENIUS METHOD

Meta Mahendra Datta¹, Februadi Bastian¹, Kasmiati², Nur Amaliah³

¹ Food Science and Technology Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar 90245
² Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar 90245
³ Graduates of Food Science and Technology Study Program, Hasanuddin University

ABSTRACT

Ready to use seasoning powders in markets are commonly based on meat extract or spices. Such seasoning powder made from fish or fish products is rarely found, whereas the raw material has great potential. This research aimed to produce seasoning powder as flavor enhancer for foods which was made from whole fermented fish (peda). The product was stored for 8 weeks at two different temperatures, i.e. chilling (7°C) and room temperature (28°C) with aluminum foil packaging. The change of product profile was evaluated and the shelf-life of product was predicted. 'Peda' was processed by addition of clove and cinnamon. After fermentation, 'peda' was then milled into paste. After that onion and garlic were added to the paste and the mixture was then dried. Measuring parameters used for seasoning powder were histamine content, water content, total mesophilic microbe and sensory evaluation using hedonic scale for color, texture and odor. Shelf-life prediction was carried out using Arrhenius method. Research result showed that there was an increase of histamine content during eight weeks storage. The lowest and highest level of histamine was found during storage at chilling temperature, i.e. 1.311 (control) and 20.144 mg/100g (7th week) respectively, whereas at room temperature there were 5.459 (1st week) and 19.845 mg/100g (7th weeks), respectively. However, the increase was still below the unsafety level. Water content and total mesophilic microbe also increased during storage. Water content ranged between 6.3% to 9.8% (at chilling temperature) and 6.3% to 10.5% (at room temperature). Total mesophilic microbe ranged between 2.1x10⁶ to 2.1x10⁷ cfu
to 8.7x10^3 cfu (chilling temperature) and 2.86x10^4 cfu to 1.5x10^6 cfu (room temperature). Arhenius method was used to predict the shelf life of seasoning powder because temperature is the main factor which influenced the quality of foodstuff. Shelf-life prediction based on histamine content, water content and total mesophilic microbe at 224 days (32 weeks), 70 days (10 weeks) and 91 days (13 weeks) respectively. During storage, response of panelists on color, texture and odor of product was evaluated. The result showed that seasoning powder made from 'peda' was still acceptable during 8 weeks storage.

Key Words: 'peda', seasoning powder, herbs and spices, shelf-life.

INTRODUCTION

Ready to use seasoning powders in markets are commonly based on meat extract or spices. Such seasoning powder made from fish or fish products is rarely found, whereas the raw material has great potential. For example, fermented fish products that can be developed as seasoning powder for various menus. Besides that, fish products based on fermented fish are well known and processed through local and indigenous technology like 'peda' or fermented whole fish. The problem, which occurs off by such process, is the formation of histamine which can cause allergy and even poisoning.

Histamine poisoning case with symptoms such as itching in face and neck, headache, vomiting, nausea, diarrhea, usually rapidly occurred. Avoiding against poisoning is necessary by inhibition the histamine formation during processing of fishery products. Once histamine is formed, it is difficult to destroy it. Therefore, the most important thing is to avoid the decarboxylation process by inhibition of enzyme histidine decarboxylase (HDC)-activity. HDC takes important role to change free histidine into histamine (1H-imidazol-4-ethanamin) through decarboxylation.

One of many ways to avoid the formation of histamine is the application of materials which possesses antimicrobial properties. Previous research proved that the use of clove and cinnamon could inhibit the activity of HDC so automatically the Formation of histamine could be inhibited (Mahendradatta and Adiansyah, 2007; 2008). Besides that, spices and herbs are used also in menu food products as flavor enhancer.

Materials and chemicals

Materials used in this research were short-bodied red mullet (Rastrelliger neglectus), table salt, cloves, cinnamon, garlic and All materials used were bought from fish market and true market in Makassar. Chemicals used in this research were his dihydrochloride, trichloro acetic acid, n-butanol, NaOH, N. heptane, HCI, 4-nitrobenzen diazonium tetrafluoroborat. chemicals were bought from chemical distributors in Makassa.

Methods

A. Product Quality

Seasoning fish-paste powder was evaluated for its histamine content (Mahendradatta and Schwedt, 1998), total bacterial (F 1989), water content (Horwitz, 1980) during eight weeks. The sensory properties of products (color, texture and odor) were evaluated by a 10 panelists using a five-point scale (5-excellent good, 3-acceptable, 2-doubtful, 1-acceptable) (Larmont, 1977). Samples graded above point 3 were considered to be acceptable consumption.

B. Prediction of shelf life

Shelf life of seasoning powder was predicted using Arrhenius method (Syarief and Halid, 1989)

Analysis Procedure

A. Histamine content

Ten g of each sample was homogenized with 25 ml trichloro acetic acid (TCA) then centrifuged by 4000 rpm 1 minutes. The supernatant was decanted in 50 ml measured. Residue was homogenized once more with 5% of TCA gnc centrifuged. The supernatant was combined and filled with...
**Sensory properties of products (color, texture and odor) were evaluated by a 10 panelists method (Syarief and Halid, 1989). The sensory properties of products (color, texture and odor) were evaluated by a 10 panelists method (Syarief and Halid, 1989). The sensory properties of products (color, texture and odor) were evaluated by a 10 panelists method (Syarief and Halid, 1989).**

**Analysis Procedure**

**A. Histamine content**

Ten g of each sample was homogenized with 25 ml of 5% trichloro acetic acid (TCA) then centrifuged by 4000 rpm for 10 minutes. The supernatant was decanted in 50 ml measured flask. Residue was homogenized once more with 5% of TCA and then centrifuged. The supernatant was combined and filled with 5% of
TCA till mark and filtered. One ml filtrate was transferred to centrifuge tube containing 5 ml n-butanol, 0.25 ml NaOH 5mol/l and 0.75 g NaCl. The tube was shaken for 3 minutes and centrifuged for 10 minutes at 4000 rpm. All organic phase was transferred to the second tube containing 2.5 ml NaOH 0.1 mol/l saturated NaCl. After shaken and centrifuged at the same way described previously, 4 ml organic-phase are transferred to the third tube containing 2.5 ml HCl 0.1 mol/l and 7.5 ml n-heptane. The solution was shaken and centrifuged. Acidic-phase was ready for analysis. One ml 0.2% 4-nitrobenzene diazonium tetrafluoroborat was added to 1 ml of acidic-phase and 1ml 10% of Na2CO3.H2O solution will be added. After 5 minutes the absorbance was measured on 470 nm.

B. Arrhenius Method (Syarief and Halid, 1989)

Seasoning powder was divided into 2 parts and was stored under different temperature, i.e. 7°C and 28°C with room and refrigerator humidity 85.6% and 76% respectively. Observation on the change of product characteristic was conducted every week from the day before storage (control) until eighth week. Product quality measured can be seen in point A. Measurement result during storage was then tabulated, regressed and two regression equations has been drawn for two different conditions. From that Arrhenius equation, parameter score has been provided, i.e. $1/T$ ($\theta K$) and $ln K$. Furthermore, $1/T$ was plotted toward $ln K$ and Arrhenius equation as well as the change of product characteristic every week was drawn. Arrhenius equation $K = K_0 \cdot e^{E_a/RT}$, where $E_a$ is activation energy of change reaction of quality characteristic (cal/mol), $R$ = constant of ideal gas (1.986 cal/mol.K), $T$ = absolute temperature (°C + 273).

Prediction of shelf-life of seasoning powder was carried out by using semi empirical approach with order zero reaction. Determination of reaction order was based on constant correlation score of equation. The shelf-life prediction was measured using formula:

$$T = (A_e - A_0) / k$$

Note:

$A_e$ = standard quality of product characteristic
$A_0$ = product characteristic at initial condition
$k$ = rate of the change of product quality

Data Processing
For histamine content, the absorbance measured was drawn for point A standard curve. The histamine content is calculated by the value with correction factor from sample preparation, sample clean up step and standard solution [Mahendrad] Analysis was carried out in triplicate. Other data were presented quantitatively descriptive.

RESULT AND DISCUSSION

Product Quality

Result showed that there was an increase of histamine content and total bacteria for 8 weeks storage. C. fish with white flesh, the higher level of histamine is found with dark flesh. It is related to the high level of free histidine. The increase of histamine content (Fig. 1) agreed increase of total bacteria (Fig.2) during storage.

![Figure 1. Histamine content during 8 weeks storage](image-url)
The tube was shaken for 10 minutes and centrifuged at the speed at 4000 rpm. All organic phase was transferred to the third tube containing 2.5 ml HCl/1. Acidic-phase was ready for analysis. One ml 0.2% 4-izene diazonium tetrafluoroborat was added to 1 ml of acidic-and 1 ml 10% of Na2CO3.H2O solution will be added. After 5 minutes the absorbance was measured at 470nm.

**rhensius Method (Syarief and Halid, 1989)**

Seasoning powder was divided into 2 parts and was stored different temperature, i.e. 7°C and 28°C with room and itor humidity 85.6% and 76% respectively. Observation on ge of product characteristic was conducted every week from before storage (control) until eighth week. Product quality d can be seen in point A. Measurement result during storage tabulated, regressed and two regression equations has been or two different conditions. From that Arrhenius equation, er score has been provided, i.e. 1/T (°K) and ln K. here, 1/T was plotted toward ln K and Arrhenius equation as ge change of product characteristic every week was drawn.

**equation**

\[ K = K_0 \cdot e^{ER} \]

- **K** = constant pre exponential or absolute rate (undependable rate)
- **Ea** = activation energy of change reaction of quality ristic (cal/mol)
- **K0** = constant of ideal gas (1.986 cal/mol°K)
- **R** = absolute temperature (°C + 273)

The shelf-life of seasoning powder was carried out by using prical approach with order zero reaction. Determination of order was based on constant correlation score of equation. *t*life prediction was measured using formula:

\[ \eta = (A_c - A_0) / K \]

**RESULT AND DISCUSSION**

**Product Quality**

Result showed that there was an increase of histamine content, water content and total bacteria for 8 weeks storage. Compared to fish with white flesh, the higher level of histamine is found in fish with dark flesh. It is related to the high level of free histidine in dark flesh. The increase of histamine content (Fig. 1) agreed with the increase of total bacteria (Fig.2) during storage.

![Figure 1. Histamine content during 8 weeks storage](image-url)
Based on histamine content analysis, it showed that histamine content at 8th week under room temperature and chilling temperature was 16.0877 mg/100g and 19.168 mg/100g, respectively. The increase was still under safety limit of histamine content, i.e. 50mg/100g.

Processing of whole fermented fish powder involved bacteria. Some bacteria can support the formation of histamine through decarboxylation process from free histidine into histamine. Although there was an increase of water content, but it did not exceed critical limit.

Figure 2. Total bacteria during 8 weeks storage

Raw material used to produce seasoning powder was 'peda' or whole fermented fish. 'Peda' was made by fermentation process which involved some bacteria. Bacteria which are important in histamine formation included Morganella morganii, Klebsiella pneumoniae and some Alvei. These bacteria could grow well in fermented fish and could produce histamine (Ward and Cameron, 1991).

Total mesophillic bacteria have been determined in this research, however, the optimum temperature for growth is 37°C and according to Hadiwiyoto (1993), the optimum temperature where the enzyme and microbe have the great activity is 30 - 70°C. Beutlinger (1996) said that the maximum activity of HDC enzy temperature 55°C. Although there is an increase of histamine during storage, its level is still below the safety limit, 50mg/100g.

The addition of spices into seasoning powder gave inhibiting the histamine formation. It was due to the compound of spices which have antimicrobial activity (H Takemasa, 1998). According to Wendakoon and Sakaguchi, clove and cinnamon were able to inhibit the growth of bacteria formation of amine compound at level 1%. Mahendra said that spices combination of clove and cinnamon applied to cook fish had the best sensory score of panelist, to other combinations consist of ginger and tamarind.

Essential oil of spices possessed antibacterial property. Making of seasoning powder from 'peda' was carried out by onion and garlic which have function as flavour and anti-

Figure 3. Change of water content during 8 weeks storage

Water content increased during eight weeks storage. The increase was due to the hygroscopic properties of pro-

hygroscopic product, temperature and humidity are very factors (Syarief et al., 1989). The increase of humidity
used Approaches: Food Safety Management

sed on histamine content analysis, it showed that histamine at 8th week under room temperature and chilling ture was 16.0877 mg/100g and 19.168 mg/100g, rely. The increase was still under safety limit of histamine i.e. 50 mg/100g. 

cessing of whole fermented fish powder involved bacteria. 
nteria can support the formation of histamine through ylation process from free histidine into histamine. Although is an increase of water content, but it did not exceed critical 6.

Figure 2. Total bacteria during 8 weeks storage

material used to produce seasoning powder was 'peda' or mented fish. 'Peda' was made by fermentation process volved some bacteria. Bacteria which are important in formation included Morganella morgani, Klebsiella age and some Alvei. These bacteria could grow well in i fish and could produce histamine [Ward and Cameron, 1996] said that the maximum activity of HDC enzyme is at temperature 55°C. Although there is an increase of histamine content during storage, its level is still below the safety limit, less than 50 mg/100g.

The addition of spices into seasoning powder gave effect on inhibiting the histamine formation. It was due to the bioactive compound of spices which have antimicrobial activity [Hirasa and Takemasa, 1998]. According to Wendakoon and Sakaguchi (1995), clove and cinnamon were able to inhibit the growth of bacteria and formation of amine compound at level 1%. Mahendradatta (2005) reported that spices combination of clove and cinnamon that was applied to cook fish had the best sensory score of panelist compared to other combinations consist of ginger and tamarind.

Essential oil of spices possessed antibacterial properties. Making of seasoning powder from 'peda' was carried out by adding onion and garlic which have function as flavour and antimicrobial agents.

Figure 3. Change of water content during 8 weeks storage

Water content increased during eight weeks storage (Fig. 3). The increase was due to the hygroscopic properties of product. For hygroscopic product, temperature and humidity are very important factors [Syarief et al., 1989]. The increase of humidity will be
followed by the increase of water content and it will affect the quality of product.

Sensory evaluation of seasoning powder based on color, texture and odor can be seen at Figure 4. Sensory score ranged between 3.1 to 3.5 for color; 3.1 to 3.7 for texture; and 2.75 to 3.5 for odor. It means that until eight week storage, seasoning powder made from 'peda' was still accepted by the panels, except the odor, because it scored below 3.

![Figure 4. Change of sensory acceptance during 8 weeks storage](image)

Preference level of panels towards color decreased at room temperature then increased at sixth week and the decay until the end of storage time. Whereas at chilling temperature the preference level of panels decreased and then increased at eighth week. The preference score ranged between unacceptable and acceptable. Seasoning powder colored brown and possessed odor from spices added.

**Prediction of Shelf Life**

The food industry has a great need to obtain, in a short time, the necessary information for determining the quality of its products. It has a very important impact on how products' storage, distribution and shelf-life dating (Mizra et al., 2013).

Based on measurement of histamine content, water total mesophillic microbe resulted from every observation, an equation of linear relationship slope \( k \) (constant of histamine increase) was drawn. An regression of \( \ln k \) and each storage temperature (in °C) drawn.

\[
\ln k = -8.8272 + 276.91/T
\]

\( T \) is temperature (°K), and plotted the curve slope temperature related with \( \ln k \) and plot of temperature and formed 1

\[
\ln K = -8.8\,\ln(T) + 0.03357
\]

\( R = 0.752505 \)  
\( r = 0.918 \)

Temperature (°K) and plot of temperature and formed 1

\[
\ln K = -8.8\,\ln(T) + 0.03357
\]

\( R = 0.752505 \)

\( r = 0.918 \)

The cut of
Sufety of (AP) mesophillic presentation

Food. To/E storagd OK... wrnul... 10 (71°C) i... (28°C) the... industry...nternational...temperatur.e

by the increase of water content and it will affect the quality of the food product.

Sensory evaluation of seasoning powder based on color, texture, and odor can be seen at Figure 4. Sensory score ranged between 3.1 for color, 3.1 to 3.7 for texture; and 2.75 to 3.5 for odor. It was noted that the panels, except the odor, still accepted the seasoning powder until eight week storage, seasoning powder made from spices was still accepted by the panels, except the odor, because it low 3.

Preference level of panels towards color decreased at room temperature then increased at sixth week and the decreased again until the end of storage time. Whereas at chilling temperature, preference level of panels decreased and then increase at seventh and eighth week. The preference score ranged between good until acceptable. Seasoning powder colored brown and possessed special odor from spices added.

Prediction of Shelf Life

The food industry has a great need to obtain, in a relatively short time, the necessary information for determining the shelf-life of its products. It has a very important impact on handling of the products’ storage, distribution and shelf-life dating (Mizrahi, 2000).

Based on measurement of histamine content, water content and total mesophillic microbe resulted from every observation week at each temperature, an equation of linear relationship with curve of ln k (constant of histamine increase) was drawn. Another linear regression of ln k and each storage temperature (in °K) was then drawn.

The increase of histamine at each temperature based on the curve of linear relationship as follows,

Chilling temperature (7°C)

\[ y = 8.889 \times 10^{-6} x + 2.525005 \times 10^{-3} \]

\( r = 0.8548; K_1 = 2.525005 \)

Room temperature (28°C)

\[ y = 7.133257 + 1.266188x \]

\( r = 0.772; K_1 = 1.266188 \)

Curve slope from each temperature (ln k) was related with storage (1/T) and plotted into curve of temperature and ln k and formed linear equation

\[ y = -8.39272 + 2760 (1/T) \]

The cut of curve at y-
Figure 5. Linear equation on the changes of (a) histamine content, (b) water content and (c) total mesophillic microbe

From this equation, the rate of histamine increase was calculated as follows: chilling temperature: 2.5244 mg/100g sample weekly and room temperature: 1.2662 mg/100g sample weekly. By using Arrhenius equation order zero, the prediction of product shelf-life could be determine through equation T = (K1 - K2) / K, so that shelf-life of seasoning powder made from 'peda' was 32 weeks or 224 days at room temperature and 19 weeks or 133 days at chilling temperature.

The same calculation was applied to the measurement result of water content and total mesophillic microbial. The increase of water content at each temperature based on the curve of linear relationship was as follows:
- Chilling temperature (7°C): y = 6.44.22 + 0.47x (t = 0.9007; K1 = 0.47)
- Room temperature (28°C): y = 6.4576 + 0.5467x (t = 0.9702; K2 = 0.5467)

Curve slope from each temperature (ln K) was related with storage (1/T) in eK and plotted into curve of temperature and In K and formed linear equation linear

In K = 1.41556 - 608(1/T) (Figure SB). The cut of curve at y-coordinates (1.41556) was In K from Arrhenius equation. So K was 4.119 and Arrhenius equation for the rate of histamine increase was K = 4.119 x e-608(1/T). From this equation, the rate of histamine increase was calculated as follows: chilling temperature: 0.470% sample weekly and room temperature: 0.547% sample weekly.

By using Arrhenius equation order zero, the product shelf-life could be determined through equation K, so that shelf-life of seasoning powder made from 'peda' was 22 weeks or 70 days at room temperature and 12 weeks or 70 days at chilling temperature.

The change of total mesophillic microbial at each t based on the curve of linear relationship was as follows:
- Chilling temperature (7°C): y = -1.53452.44 + 129365.331
- Room temperature (28°C): y = -182257.33 + 209482.67

Curve slope from each temperature (ln K) was related with (1/T) in eK and plotted into curve of temperature and formed linear equation linear

In K = 18.65296 - 1928(1/T) (Figure 5c). The cut of coordinates (18.65296) was ln K from Arrhenius equation: 126147195.3 and Arrhenius equation for the rate of histamine increase was K = 126147195.3 x e-1928(1/T). From this equation, the rate of histamine increase was calculated as follows:

Temperature: 1290114.15 colony/ml sample weekly temperature: 209399.67 colony/ml sample weekly.

By using Arrhenius equation order zero, the product shelf-life could be determined through equation K so that shelf-life of seasoning powder made from 'peda' was 22 weeks or 70 days at room temperature and 12 weeks or 70 days at chilling temperature.

Table 1 showed the all tabulated data from calculated histamine content, water content and total mesophillic microbial at chilling and room temperature. Based on calculated data, time was taken, so that seasoning powder made from 'peda' was stored until 10 weeks or 70 days.
coordinates (8.9272) was ln \( K_0 \) from Arrhenius equation. So \( K_0 \) was 1.327x10^4 and Arrhenius equation for the rate of histamine increase was
\[
K = 1.3273.10^{-4} \times e^{77K(1/T)}
\]

6. Linear equation on the changes of (a) histamine content, (b) water content and (c) total mesophilic microbe

From this equation, the rate of histamine increase was as follows: chilling temperature 2.5244 mg/100g sample and room temperature: 1.2662 mg/100g sample weekly. By Arrhenius equation order zero, the prediction of product shelf-life could be determined through equation \( T = (Ae^{-d}) / K \), so that shelf-life of seasoning powder made from 'peda' was 10 weeks or 70 days at room temperature and 12 weeks or 84 days at chilling temperature.

The change of total mesophilic microbial at each temperature based on the curve of linear relationship was as follows:
- Chilling temperature (7°C): \( y = -153542.24 + 129365.33x \) \( r = 0.794; K_1 = 129365.33 \)
- Room temperature (28°C): \( y = -182257.33 + 299482.67x \) \( r = 0.989; K_2 = 209482.67 \)

The curve slope from each temperature (ln K) was related with storage (1/T) in K and plotted into curve of temperature and in K and formed linear equation linear
\[
\ln K = 18.65296 - 1928(1/T) \] (Figure 5c). The cut of curve at y-coordinates (18.65296) was ln \( K_0 \) from Arrhenius equation. So \( K_0 \) was 126147195.3 and Arrhenius equation for the rate of histamine increase was \( K = 126147195.3 \times e^{37241/1/T} \). From this equation, the rate of histamine increase was calculated as follows: chilling temperature: 1290114.15 colony/ml sample weekly and room temperature: 209399.67 colony/ml sample weekly.

By using Arrhenius equation order zero, the prediction of product shelf-life could be determined through equation \( T = (Ae^{-d}) / K \), so that shelf-life of seasoning powder made from 'peda' was 13 weeks or 91 days at room temperature and 21 weeks or 147 days at chilling temperature.

Table 1 showed the all tabulated data from calculation based on histamine content, water content and total mesophilic microbial at chilling and room temperature. Based on calculated data, the shortest time was taken, so that seasoning powder made from 'peda' could be stored until 10 weeks or 70 days.
Table 1. Calculated data for shelf-life prediction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>F (MPa)</th>
<th>K (MPa)</th>
<th>R (MPa)</th>
<th>T (MPa)</th>
<th>E (10^9)</th>
<th>E (10^9)</th>
<th>E (10^9)</th>
<th>E (10^9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td>1.077</td>
<td>0.614</td>
<td>1.063</td>
<td>1.067</td>
<td>1.064</td>
<td>1.064</td>
<td>1.064</td>
<td>1.064</td>
</tr>
<tr>
<td>Total free-glutamic acid content</td>
<td>5679.105</td>
<td>1247.222</td>
<td>1185.6</td>
<td>1201.508</td>
<td>1201.508</td>
<td>1201.508</td>
<td>1201.508</td>
<td>1201.508</td>
</tr>
</tbody>
</table>

CONCLUSION

1. Histamine content, total microbe and water content increased during eight weeks storage of seasoning powder made from 'peda'.
2. Seasoning powder made from 'peda' can be stored in aluminium foil until 10 weeks at room temperature.
3. Based on sensory evaluation, this product was still accepted until 8 weeks storage (during research schedule), except its odor.

Acknowledgement

This work was a part of research project funded by Directorate General for Higher Education (DGHE) through "Hibah Bersaing Perguruan Tinggi 2009". I wish to thank for the financial aids.

References


Larmond, E., 1977. Laboratory Methods for Sensory Evaluations of Food. Research Institute, Canada Department of Agri.


Table 1. Calculated data for shelf-life prediction

<table>
<thead>
<tr>
<th>E</th>
<th>R%</th>
<th>F</th>
<th>T</th>
<th>R%</th>
<th>R% (F) - (E)</th>
<th>T (weeks)</th>
<th>T (months)</th>
<th>R% (F) - (E)</th>
<th>T (weeks)</th>
<th>T (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>


CHEMOREACTION DRYING AND ITS EFFECT ON BLACK PEPPER QUALITY

Nur Wulandari1,2, Soewarno T. Soekarto1, and Purwiy Hariyadi1,2
1 Department of Food Science and Technology, Faculty of Agr Engineering
2 Southeast Asian Food and Agriculture Science & Techno (SEAFAST) Center, Bogor Agricultural University, Indonesia
wulandari_safardan@yahoo.com

ABSTRACT

By using quicklime (Calcium oxide, CaO) as active reagent, chemoreaction drying, drying process of black pepper can be done at temperature to minimize the loss of its volatile compounds and to optimize quality. The objectives of this research were to study the drying in chemoreaction drying of black pepper, and to analyze the effect process to the volatile oil content of black pepper. The drying process were conducted with 5 different weight ratios of CaO to fresh pepper: 1, 2, 5, and 20. The temperatures were relatively constant (approx. 38°C), but the higher the ratio of CaO to fresh pepper, the lower it was at the drying process. Use of CaO:fresh pepper in the ratios of 2:1 resulted in dried pepper with water content less than 12% (wet basis) in 5 days. This drying time was shorter than that obtained by sun drying for 8 days. Chemoreaction drying had no effect on the volatile oil content in black pepper produced compared to the fresh pepper. The processes resulted black pepper with volatile oil content between 2.70% (dry basis). The color of the oil was clear greenish yellow with flavor quality.

Keywords: black pepper, drying, quicklime, volatile oil.

INTRODUCTION

Black pepper has been known as the largest and most important spice commodity in Indonesia. Black pepper processing simply by drying the fresh fruit pepper to targeted moisture