EFFECT OF STERILITY ($F_0$) VALUE AT DIFFERENT CANNING TEMPERATURES ON THE PHYSICAL PROPERTIES OF CANNED GUDEG

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Abstracts

Gudeg is a traditional food from Yogyakarta and Central Jawa, Indonesia. The meal is made of young jackfruits (Artocarpus heterophyllus) cooked in a mixture of spices, palm sugar and coconut milk. Traditionally, gudeg is cooked for a long time and we have studied canning process for gudeg to shorten the cooking time, extend its shelflife and improve the overall convenience. This study specifically aims to evaluate the effect of sterility value (Fo) with different time-temperature combination on the physical properties (hardness and color) and the preference score of the canned gudeg. Gudeg was prepared according to the traditional recipe with modification. Prepared young jackfruit cuts were canned and retorted at predetermined sterility (F0) values of 4, 12, 20, and 28 minutes at different retort temperatures of 111, 116, and 121°C. The hardness of the resulting canned gudeg was measured with a texture analyzer, whereas its color with a Minolta Chromameter. A sensory analysis was also conducted on the canned gudeg. Our study shows that increasing the F0-values during processing causes softening of the gudeg as indicated by increased penetration depth from the penetrometer test. Increase in F0-values is also associated with increase in the redness and decrease in the yellowness as well as the brightness of the canned gudeg. Processing at different retort temperatures of 111, 116 and 121°C with the same F0-values, however, did not show any significant difference in color and texture. An F0-value of 20 minutes obtained from a processing temperature of 121°C for 57.1 minutes provides the best canned gudeg as assessed by panel preference, texture and color. At the temperature range studied (111-121°C), the physical properties of canned gudeg are determined by the F0 values; regardless of retort temperatures.

**GUDEG ?**

- **Gudeg**: a traditional food from Yogyakarta and Central Jawa, Indonesia.

- The meal is made of **young jackfruits** (Artocarpus heterophyllus).
  - Local name: Gori

- Cooked in a mixture of spices, palm sugar and coconut milk.
GUDEG?

• **Gudeg**: Need a very long cooking time → up to 12 hours

• Smooth texture of young jackfruits and unique flavor and color of cooked gudeg

• BUT ... It will not last long

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GUDEG?

• **Gudeg**: Studies of canning technology for Gudeg have been done

To obtain specific objectives:

• shorten the cooking time,
• extent its shelflife, and
• improve the overall convenience.
GUDEG?

• **Canned Gudeg**: has been introduced to market

• Supported by works of the *Technical Implementation Unit for Development of Chemical Engineering Processes, Indonesian Institute of Sciences* (UPT. BPPTK LIPI)

OBJECTIVES?

• To Study the effect of $F_0$-value on the quality (color, texture and other organoleptic properties) of Gudeg

• To study the effect of different combination of time-temperature (at the same $F_0$-value) on the quality (color, texture and other organoleptic properties) of Gudeg
MATERIALS & METHOD

Materials for Gudeg Preparation:
Young Jack fruits, meat/beef, mixed of spices, coconut milk, and salt

Material for analysis
Aquadest, HCl, K2SO4, HgO, Na2S2O3, H2SO4, H3BO3, HCl, NaOH, Etc

Equipments for Analysis
Penetrometer, analytical balance, Chromameters, glassware, etc

Equipments for Processing:
Vertical Retort, thermocouples, thermorecorder, thermometer, blender, etc
MATERIALS & METHOD?

Retort operational procedure, retort heat distribution and determination of heat penetration curve were done according to standardized protocol (Institute For Thermal Processing Specialists - IFTPS; www.iftps.org/)

**Determination of \( f \) and \( J_h \) values**

### Materials & Method

**Time (t)-Temperature (T) Combination?**

<table>
<thead>
<tr>
<th>T, (°C)</th>
<th>Target (F_0) (min)</th>
<th>Calculated* (t_b) (minutes)</th>
<th>Calculated** (t_p) (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>4</td>
<td>88.5</td>
<td>81.3</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>174.7</td>
<td>167.5</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>253.9</td>
<td>246.8</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>332.3</td>
<td>325.2</td>
</tr>
<tr>
<td>116</td>
<td>4</td>
<td>62.5</td>
<td>54.9</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>91.5</td>
<td>84.0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>117.7</td>
<td>110.1</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>144.9</td>
<td>137.4</td>
</tr>
<tr>
<td>121</td>
<td>4</td>
<td>38.0</td>
<td>30.0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>52.6</td>
<td>44.7</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>65.1</td>
<td>57.1</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>73.6</td>
<td>65.6</td>
</tr>
</tbody>
</table>

* Ball processing time; determined by Ball’s formula (Lopez, A. 1981. A Complete Course of Canning, 11th editions, Book 1-Basic Information on Canning)

** Operator processing time, \((T_b – 0.6 \text{ CUT})\)

### Results & Discussions

**Preparation of Canned Gudeg**

- Preparation:
  - Jackfruits, meat, spices

- Can filling

- Exhausting \(85^\circ\text{C}, 10\) min

- Can closing

- Sterilization \((T, t)\)

- Cooling

- Canned Gudeg
**RESULTS & DISCUSSIONS**

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**Preparation of Canned Gudeg**

- Preparation:
  - Jackfruits, meat, spices

  - We have established canning process for gudeg to produced canned gudeg **similar/comparable** to that of traditionally prepared/cooked gudeg

  - \( \text{pH}=5.68 \) and \( a_w = 0.934 \)

  - *potentially hazardous food (PHF).*

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**RESULTS & DISCUSSIONS**

<table>
<thead>
<tr>
<th>Organoleptic Properties</th>
<th>GUDEG</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traditionally Prepared/Cooked</td>
<td>Canned</td>
</tr>
<tr>
<td>Taste/flavor</td>
<td>• Sweet, having characteristic unique of gudeg taste</td>
<td>• Sweet, having characteristic unique of gudeg taste</td>
</tr>
<tr>
<td>Color</td>
<td>• Dark brown</td>
<td>• Lighter dark brown</td>
</tr>
<tr>
<td>Texture</td>
<td>• Mussy, tender, easy to cut</td>
<td>• Solid, tender, easy to cut</td>
</tr>
</tbody>
</table>
RESULTS & DISCUSSIONS?

<table>
<thead>
<tr>
<th>Appearance</th>
<th>GUDEG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traditionally Prepared/Cooked</td>
</tr>
</tbody>
</table>

- **F₀-value** = 4 min
- **F₀-value** = 12 min
- **F₀-value** = 20 min
- **F₀-value** = 28 min
RESULTS & DISCUSSIONS?

COLOR - redness

![Graph showing the change in redness over Fo (min) at different temperatures (111°C, 116°C, 121°C).]

COLOR - lightness

![Graph showing the change in lightness over Fo (min) at different temperatures (111°C, 116°C, 121°C).]
RESULTS & DISCUSSIONS?

COLOR - Yellowness

![Graph showing the relationship between Fo (min) and Yellowness at different temperatures (111°C, 116°C, 121°C).]

TEXTURE

![Graph showing the relationship between Fo (min) and Depth of Penetration (mm/5 s) at different temperatures (111°C, 116°C, 121°C).]

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RESULTS & DISCUSSIONS?

- A sensory analysis was also conducted on the canned *gudeg*, processed at 121°C, with $F_0$-value of 4, 12, 20, 28 minutes
- Conducted by 75 intrained panelists
RESULTS & DISCUSSIONS?

**Duncan Test**

<table>
<thead>
<tr>
<th>Quality attributes</th>
<th>$F_0=4$</th>
<th>$F_0=12$</th>
<th>$F_0=20$</th>
<th>$F_0=28$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Flavor</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Texture</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Taste</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Overall</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>“Selected products”</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

**CONCLUSIONS?**

1. We have established canning procedure for gudeg.

2. At the temperature range studied ($111-121^\circ C$), the physical properties of canned gudeg are determined by the $F_0$ values; regardless of retort temperatures.

3. A canned gudeg with $F_0$-value of 20 minutes (obtained from a processing temperature of $121^\circ C$ for 57.1 minutes) provides the best canned gudeg as assessed by panel preference, texture and color.
4. Nutritional composition of the selected Canned Gudeg (per 100 g)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (g)</td>
<td>75.40 ± 0.27</td>
</tr>
<tr>
<td>Ash (g)</td>
<td>1.55 ± 0.01</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>5.68 ± 0.00</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>0.83 ± 0.01</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>16.54 ± 0.28</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>1.97 ± 0.01</td>
</tr>
</tbody>
</table>

THANK YOU

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