PRODUCTION OF EXTRUDED INSTANT RICE SUPPLEMENTED WITH AROMATIC PANDAN LEAF EXTRACT

Miss Jittimon Wongsa
Dudsadee Uttapap, Buddhi Lamsal, Chureerat Puttanlek and Vilai Rungsardthong

Department of Agro-Industrial, Food and Environmental Technology, Faculty of Applied Science, Food and Agro-Industry Research Center, King Mongkut’s University of Technology North Bangkok, Bangkok, Thailand
THE ATTRACTIVENESS OF THE INSTANT RICE

Rice is the staple food of more than half of the world's population

[www.irri.org (2016)]

Regular rice requires ~20 mins cooking

Instant rice needs less than 5 mins

Easy cooking

Light weight

Long shelf life

Top 5 rice exporters 2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>US$ billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>India</td>
<td>5.3</td>
</tr>
<tr>
<td>2</td>
<td>Thailand</td>
<td>4.4</td>
</tr>
<tr>
<td>3</td>
<td>US</td>
<td>1.9</td>
</tr>
<tr>
<td>4</td>
<td>Vietnam</td>
<td>1.4</td>
</tr>
<tr>
<td>5</td>
<td>Pakistan</td>
<td>0.9</td>
</tr>
</tbody>
</table>

[www.thairiceexporters.or.th (2017)]

Thailand is one of the leader rice exporters

Thai jasmine rice is the most popular rice

[Rice grains] [Rice Products (2014)]

254,514 tons
1,600 USD/Ton

6,720,000 tons
600 USD/Ton
THE METHODS OF PRODUCING INSTANT RICE

1. Traditional process (Soak-cook-dry methods)
   - Rice Grain
   - Soaking
   - Cooking
   - Drying
   - Instant Rice

2. Extrusion process
   - Rice flour
   - Water
   - Conditioner
   - Extruder
   - Dryer
   - Extruded Rice

Extrusion cooking is a continuous process with high production capacity and low cost per product unit.
HERBS AND PAN DAN-FLAVOR SUPPLEMENTED RICE PRODUCT

**Herbal Supplement**
Rice coated with encapsulated pandan extract by spraying and dried by using fluidization technique.

Teprungsri (2010)

**Pandan-flavor supplement**
Pandan flavor used for supplemented in rice noodle product.

Poolpun (2014)

---

**Rice Grains**

By product

**Broken Rice**

**Instant Rice**

**Herbal Instant Rice**

**Extruded Instant Rice**

**Aroma Extruded Instant Rice**

---

**Thai Jasmine Rice**

Pandan flavor

2-Acetyl-1-Pyrroline (ACPY)
To determine optimum processing conditions and use of a monoglyceride on physical properties extruded instant rice.

To produce an aromatic extruded instant rice with the addition of natural pandan leaf extract.
MATERIALS AND EQUIPMENT

Materials

- Broken Rice Grains → Rice Flour
- Tapioca starch
  Supported by Ampol Food Processing Co., Ltd. (Thailand)
- Monomuls 90-35P, the monoglyceride based on palm oil
  Purchased from Cognis Thai, Ltd. (Thailand)
- Gum arabic
  Purchased from Chemipan Corporation Co., Ltd. (Thailand)
- Pandan leaf extract
  Supported by Food and Agro-Industry Research Center, KMUTNB (Thailand)

Equipment

- Single Screw Extruder Brabender-19/20DN (Germany)
  - Die diameter 1 mm
- Physical Properties
  - Colorimeter Hunter Lab Color Quest (USA)
  - Texture profile analysis TA-XT2, Stable Micro System (UK)
- Gas Chromatography Hewlett Packard-HP6890 (USA)
Factorial experimental design was employed to investigate the effect of Monoglyceride content (0, 1 and 2% by flour weight), Feed moisture content (25 and 30% wb) and Barrel temperature: zone 3 (100 and 120°C) on physical properties of the extruded instant rice.

- Rice flour: 90%
- Cassava starch: 10%
- Monomul 90-35P: 1 and 2%
- Water (Moisture content): 25 and 30%
- Barrel temperature: 100 and 120°C

Single Screw Extruder Brabender-19/20DN (Germany)
## PHYSICAL PROPERTIES OF EXTRUDED INSTANT RICE

<table>
<thead>
<tr>
<th>Moisture content (%)</th>
<th>Barrel temperature (°C)</th>
<th>Monomul 90-35P (%)</th>
<th>Volume expansion</th>
<th>Density (g/cm³)</th>
<th>Whiteness index</th>
<th>Hardness (g)</th>
<th>Stickiness (g•s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>100</td>
<td>0</td>
<td>1.54&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,108&lt;sup&gt;a&lt;/sup&gt;</td>
<td>142.25&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1.52&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.56&lt;sup&gt;b&lt;/sup&gt;</td>
<td>72.89&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,484&lt;sup&gt;b&lt;/sup&gt;</td>
<td>87.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1.46&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.61&lt;sup&gt;b&lt;/sup&gt;</td>
<td>73.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,705&lt;sup&gt;c&lt;/sup&gt;</td>
<td>63.20&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>120</td>
<td>0</td>
<td>1.70&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,935&lt;sup&gt;a&lt;/sup&gt;</td>
<td>120.94&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.62&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72.93&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,183&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.58&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.56&lt;sup&gt;b&lt;/sup&gt;</td>
<td>74.96&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2,502&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>100</td>
<td>0</td>
<td>1.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.57&lt;sup&gt;b&lt;/sup&gt;</td>
<td>71.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,495&lt;sup&gt;b&lt;/sup&gt;</td>
<td>148.03&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.59&lt;sup&gt;b&lt;/sup&gt;</td>
<td>72.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,832&lt;sup&gt;c&lt;/sup&gt;</td>
<td>91.86&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.63&lt;sup&gt;c&lt;/sup&gt;</td>
<td>73.72&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,981&lt;sup&gt;c&lt;/sup&gt;</td>
<td>68.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>0</td>
<td>1.46&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,215&lt;sup&gt;a&lt;/sup&gt;</td>
<td>128.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72.64&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,684&lt;sup&gt;b&lt;/sup&gt;</td>
<td>75.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.60&lt;sup&gt;b&lt;/sup&gt;</td>
<td>73.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,911&lt;sup&gt;c&lt;/sup&gt;</td>
<td>63.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

At higher moisture content: Volume expansion ↓  Density and Hardness ↑

At higher temperature: Volume expansion ↑  Density, Hardness and Stickiness ↓

At higher M90-35P: Volume expansion and Stickiness ↓  Density, Whiteness, Hardness ↑
The ability of monoglyceride to form water-insoluble complexes with amylose, prevent leaching of amylose during gelatinization, inhibits swelling of starch granules heated in water, and reduces the water-binding capacity of starch, is thought to result in reduced stickiness.

The use of Monomuls 90-35P at 1% showed smooth surface and did not stuck into a clump when rehydrated.
Rice flour and tapioca starch (90/10 w/w) blended with monoglyceride 1 % and *gum arabic 2 % w/w* in a mixer

**Moisture content 30 %**

Flour blend was supplemented with *pandan leaf extract* at 6, 12, 18 and 24 g/100 g flour blend with adjusted **pH = 4**

**80°C**  
**90 °C**  
**120°C**

**Wang et. al., (2011)**

**Aroma retention**  
(Apintanapong and Noomhorm (2003))

The extruded instant rice was dried by hot air dryer at **45°C** for 4 h and kept in polyethylene bags until further analysis
2-ACETYL-1-PYRROLINE (ACPY OR 2AP) ANALYSES

1. Gas Chromatography
The experiment and calculation were following the method from Poolpun, (2014)

\[
2AP \text{ (mg/l)} = \frac{\Delta 2AP}{\Delta \text{Collidine}} \times \frac{[\text{Collidine}]}{1000} \times \frac{1000}{100} \times 1.3
\]

<table>
<thead>
<tr>
<th>Amount of Flour</th>
<th>0 day ppm</th>
<th>90 days ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>6g/100g flour</td>
<td>150</td>
<td>52</td>
</tr>
<tr>
<td>12g/100g flour</td>
<td>300</td>
<td>65</td>
</tr>
<tr>
<td>18g/100g flour</td>
<td>450</td>
<td>102</td>
</tr>
<tr>
<td>24g/100g flour</td>
<td>600</td>
<td>151</td>
</tr>
</tbody>
</table>

ACPY Retention time = 5.33 min

2. Aroma Sensory Measurement

<table>
<thead>
<tr>
<th>Pandan (%)</th>
<th>0 day</th>
<th>45 days</th>
<th>90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10</td>
<td>10²</td>
</tr>
<tr>
<td>6</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>24</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
THE ACPY LOSS DURING STORAGE OF EXTRUDED INSTANT RICE

After the extrusion, more than 50% of ACPY compound was lost in all samples.

Instant rice supplemented with pandan extract at 18 and 24% can retain the aroma until 3 months.
APPEARANCE OF PANDAN LEAF EXTRACT SUPPLEMENTED INSTANT RICE

(a) extruded instant rice
(b) extruded instant rice supplemented with 24% pandan leaf extract
CONCLUSIONS

- Extrusion process condition, feed moisture content of 30%, screw speed of 70 rpm and a barrel temperature of 80:90:120°C produced the highest quality instant rice.
- The suitable mixed flour, rice flour blend with tapioca starch (90:10), was added with monoglyceride 1% and gum arabic 2%.
- Extruded instant rice supplemented with pandan leaf extract at 18 and 24% can retention the aroma until 3 months.

Recommendations and further study

- Study on packaging and storage conditions
This research was supported by

Thailand Research Fund
Ampol Food Processing Co., Ltd.
Research and Researchers for Industries
( Student ID R Ri - PHD5610061)
King Mongkut’s University of Technology North Bangkok

Thank You for Your Attention