Proximate, Protein Digestibility and Amino Acids Composition Of Aceh Traditional Food (Keumanah)

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Abstract. Keumamah is a traditional food in aceh. The aim of the research is to determine nutrients content in keumamah and see the level of consumer acceptance of color, aroma and flavor of keumamah as side dishes. This research design was a completely randomized design (CRD) with three processing methods. They are traditional keumamah, type, I modified Keumamah and type II modified Keumamah. Parameters observed in this research were the amount of moisture, ash, fat, protein, water-soluble protein content, digestibility of protein and amino acid's composition. The result of this research showed that processing methods had significant effect (p<0.05) on the moisture, ash, fat, crude protein, water-soluble protein and protein digestibility of keumamah. The highest total amino acid was recorded in type II modified Keumamah (90.995 g/100 g crude protein), which is 63.729% of the essential amino acids and 36.271% of non essential amino acids. The processing methods had significant effect (p<0.05) on sensory properties. They are color and overall acceptance.

Key-word : traditional food, keumamah, amino acid's composition

1. Introduction

Consumption of fish is a very appropriate choice to overcome nutritional problems in Indonesia. Fish is a source of protein and micronutrient. The fish is a high perishable food because of it is high-water content (65-80%) and high microbial contain. Main purpose of fish consumption is to meet protein and other nutrient's requirement. As a source of nutrients, consideration of processed products is very important [1]. Keumamah is traditional food in Aceh used as side dishes. Keumamah always available in every home so that it can be used whenever needed. Keumamah must be processed into a dish before it is consumed. Some dishes are made from keumamah like teutumeh keumamah, peulemak keumamah, hade and others. As traditional foods keumamah also served for party and restaurant food [2].

Keumamah is usually made from skipjack tuna (Katsuwonus pelamis) and cigar (Auxis thazard). The keumamah processing is boiling fish, discarding skin and bones, then placing it on top of the fireplace (loft), occasionally dried in the sun to dry. Before storing smear the fish with furnace ashes to lengthenlife time of keumamah. Currently, it is very rare to cook using a furnace. This causes keumamah processing becomes simpler, namely boiled the fish, discarded skin and bones, then dried in the sun to make it dry and hard as wood. Before storing keumamah smear tapioca as replacement of ashes of the furnace. Tapioca is hygroscopic so it is easy to absorb water, which causes keumamah easily covered with mold.

Given the potential of keumamah consumption in the nutritional needs of the Acehnese, the effort to produce keumamah with good quality becomes very important. The purpose of this study is to obtain the best processing techniques to minimize the loss of nutrients in the keumamah and see the level of consumer acceptance of aroma, color and flavor keumamah as side dishes.

2. Material and Methods

Research design: This study examined the effect of keumamah processing method to proximate levels, water-soluble content, protein digestibility, amino acid composition and sensory properties (color, aroma,
flavor). Research design was a completely randomized design (CRD) [3] with three processing methods. They are traditional keumamah, type I modified Keumamah and type II modified Keumamah.

**Materials and instruments:** skipjack (Katsuwonus pelamis) used in this study was obtained from the fish auction place (TPI) Muara Angke, North Jakarta. Smoke source material from coir. The enzyme trypsin (Porcine pancreatic trypsin, type IX, BEAE 14190 units/mg protein, SIGMA), chymotrypsin (bovine pancreatic chymotrypsin, type II, 60 units/mg of powder, SIGMA) and peptidase (Porcine intestinal peptidase, 102 units/g of powder, SIGMA). Other chemicals for analysis of proximate using pro analysis specification. Equipment used was oven, mikrokjeldhal apparatus, Soxhlet, High-Performance Liquid Chromatography (HPLC).

**Keumamah processing methods:** skipjack tuna was dressed, boiled (90 – 100°C, 45 min), divided into 4 loin, removal of skin and bone, dried (40°C, 105 hours) with cabinet dryer (keumamah traditional). Skipjack tuna was dressed, boiled (90 – 100°C, 45 min), divided into 4 loin, removal of skin and bone, smoke curing stage I (30 – 40°C, 2 hours), filling of meat, smoke curing stage II (30 – 40°C, 90 hours), dried (40°C, 24 hours) with cabinet dryer (keumamah modification I). Skipjack tuna was dressed, steamed (80 – 85°C, 45 min), divided into 4 loin, removal of skin and bone, smoke curing stage I (30 – 40°C, 2 hours), filling of meat, smoke curing stage II (30 – 40°C, 90 hours), dried (40°C, 24 hours) with cabinet dryer (keumamah modification II).

**Chemical and physical analysis of keumamah (proximate analysis):** keumamah moistures were determined by AOAC (2005). The ash content was determined using dry ashing AOAC (2005). The crude protein was determined using Micro-Kjeldahl method, (N x 6.25) (AOAC, 2005). Fat was determined using the Soxhlet extraction method (AOAC 2005) [4].

**Analysis of protein digestibility (in vitro):** protein digestibility was measured by the method of multienzyme [5]. Sample of 80 meshes was dissolved in distilled water (concentration of 6.25 mg protein/ml). 50 ml suspension in beaker glass (100 ml) set up pH to 8.0 by adding HCl or NaOH 0.1 N. Furthermore, heated in a water bath at 37°C and stirred for 5 minutes. Add 5 ml multienzyme (when the addition was recorded as zero time) while still stirring in a water-bath at 37°C. Then the sample suspension pH measured at 10th minute. The digestibility of protein was calculated with the formula:

\[
Y = 210.464 - 18.103X
\]

Key:

- \(Y\) : digestibility of protein (%)
- \(X\) : sample suspension pH measured at 10th minute

**Multienzyme solution:** mix 1.6 mg of trypsin (Porcine pancreatic trypsin, type IX, BEAE 14190 units/mg protein, SIGMA); 3.1 mg of chymotrypsin (bovine pancreatic chymotrypsin, type II, 60 units/mg of powder, SIGMA); and 1.3 mg peptidase (Porcine intestinal peptidase, 102 units/g powder, SIGMA) per ml of distilled water. Multienzyme solution is placed in the ice bath and set up pH is 8.0 by adding NaOH and HCl 0.1 N.

**Amino acid analysis by HPLC [5]:** 0.2 g of sample was added with 10 ml of HCl 6 N, and then hydrolyzed in the oven 100°C for 24 hours. Hydrolyzate was cooled, then filtered to obtain supernatant. 10 mL of the supernatant was added to 25 mL of a solution of dryer and then dried in vacuum rotator. The treatment was repeated three times. The dried supernatant was added 30 mL of derivatization solution and left for 20 minutes, then diluted by the addition of Na-acetate pH 5.75 until 200 mL of volume. Samples preparing injected into the HPLC.

Solution of dryer made by mix of methanol, acetic acid pH 5.75 and triethanol amine (TEA) with a ratio 2 : 2 : 1. Derivatization solution was prepared by mix of 300 mL phenyl Isothiocyanates (PITC), 300 mL of methanol and 40 mL of TEA.
The amino acids (%) was calculated with the formula:

\[
\% \text{ Amino Acid} = \left( \frac{\text{AUC Sample}}{\text{AUC Standard}} \right) \times DF \times \frac{\text{MW} \times \text{SD}}{100}
\]

**Key:**
- DF = Dilution Factor
- MW = Molecular Weight of amino acids
- SD = Standard Density
- AUC = Area Under Curve

**Organoleptic evaluation** [6]: The organoleptic evaluation of the *keumamah* was carried out by a panel of 25 judges using a 6-point hedonic scale where 4 represented ‘liked very much’ and 1 represented ‘disliked very much’. Colour, aroma, flavor and overall acceptability of the *keumamah* as side dishes were evaluated.

**Statistical analysis** [6,7]: The data were analyzed using analysis of variance with SPSS 16, with a confidence level of 0.05. Furthermore, to determine the difference, Duncan Multiple Range Test was used.

3. Results and discussion

3.1. Proximate composition

<table>
<thead>
<tr>
<th>Processing Methods</th>
<th>Moisture (%)</th>
<th>Ash (%)</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional <em>Keumamah</em></td>
<td>23.17 ± 0.269</td>
<td>2.50 ± 0.009</td>
<td>55.19 ± 3.502</td>
<td>1.06 ± 0.042</td>
</tr>
<tr>
<td>Type I Modified <em>Keumamah</em></td>
<td>19.63 ± 3.274</td>
<td>2.50 ± 0.001</td>
<td>45.74 ± 7.118</td>
<td>2.12 ± 0.115</td>
</tr>
<tr>
<td>Type II Modified <em>Keumamah</em></td>
<td>22.43 ± 0.870</td>
<td>2.44 ± 0.066</td>
<td>50.31 ± 1.002</td>
<td>3.61 ± 0.487</td>
</tr>
</tbody>
</table>

p-value 0.000

Mean ± SD of 3 determinations.

Mean scores on the same column with different superscripts are significantly different (p<0.05) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers.

Proximate composition of the different *keumamah* showed on Table 1. The moisture content of *keumamah* varied from 19.63 – 23.17%. The traditional *keumamah* had the highest moisture content (23.17%). The ash content about from 2.44 – 2.50%, while the highest ash are traditional *keumamah* and Type I modified *Keumamah* (2.50%). The fat content ranged between 1.06 – 3.61% and The type II modified *Keumamah* had the highest fat content (3.61%). The crude protein content varied from 45.74 – 55.19%. Results of Anova showed a significant difference (α<0.05) in *keumamah* processing methods for moisture, ash, crude protein and fat content of *keumamah*. However, there was not significant difference between traditional *keumamah* crude protein content with Type II modified *Keumamah*.

3.2. Water soluble content and protein digestibility (*in vitro*)

<table>
<thead>
<tr>
<th>Processing Methods</th>
<th>Water-soluble Protein (%)</th>
<th>Protein Digestibility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional <em>Keumamah</em></td>
<td>7.27 ± 1.005</td>
<td>87.36 ± 0.000</td>
</tr>
<tr>
<td>Type I Modified <em>Keumamah</em></td>
<td>5.95 ± 0.806</td>
<td>84.65 ± 1.280</td>
</tr>
<tr>
<td>Type II Modified <em>Keumamah</em></td>
<td>8.04 ± 0.658</td>
<td>86.46 ± 1.280</td>
</tr>
</tbody>
</table>

p-value 0.000

Mean ± SD of 3 determinations.

Mean scores on the same column with different superscripts are significantly different (p<0.05) while those with the same superscripts are statistically the same or similar even though there may be variations in the numbers.
Water-soluble protein content and protein digestibility of the different keumamah are presented on Table 2. The water-soluble protein content ranged from 5.95 – 8.04% and The keumamah modification II had the highest content. The type II modified Keumamah treated of steaming (80 – 85°C), whereas traditional keumamah and type II modified Keumamah treated of boiling (90 – 100°C). The boiling temperature of 95 – 100°C cause water-soluble proteins, a few of peptides and free amino acids missing in boiling water [8].

Protein digestibility of keumamah is about from 84.65 – 87.36%. Protein of food is good if it has a protein digestibility equal to 80% [9]. All types keumamah have good protein digestibility, ie above 80% (84.65 – 87.36%). Protein digestibility of type I and type II modified keumamah are lower if compared to traditional keumamah. This is because of the process of smoking the food. The reaction between polyphenol compounds, reducing sugar, fat and the oxidation proceeds with protein and amino acids in fish resulted in non enzymatic browning so that it is form crosslinked which can degrade the quality of the protein [10]. Results of Anova showed a significant difference (α<0.05) keumamah processing techniques to water-soluble protein content and protein digestibility (in vitro) of keumamah.

3.3. Amino acids composition

<table>
<thead>
<tr>
<th>Amino Acids</th>
<th>Keumamah traditional</th>
<th>Keumamah modifikasi I</th>
<th>Keumamah modifikasi II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspartic (Asp)</td>
<td>1.809</td>
<td>4.741</td>
<td>4.010</td>
</tr>
<tr>
<td>Glutamic (Glu)</td>
<td>1.113</td>
<td>2.985</td>
<td>6.015</td>
</tr>
<tr>
<td>Serine (Ser)</td>
<td>1.809</td>
<td>0.527</td>
<td>2.776</td>
</tr>
<tr>
<td>Glycin (Gly)</td>
<td>0</td>
<td>nd</td>
<td>2.776</td>
</tr>
<tr>
<td>Histidine (His)*</td>
<td>2.227</td>
<td>10.008</td>
<td>11.104</td>
</tr>
<tr>
<td>Arginin (Arg)*</td>
<td>9.464</td>
<td>17.558</td>
<td>8.328</td>
</tr>
<tr>
<td>Treonin (Thr)*</td>
<td>1.392</td>
<td>1.405</td>
<td>1.234</td>
</tr>
<tr>
<td>Alanin (Ala)</td>
<td>1.809</td>
<td>17.031</td>
<td>4.318</td>
</tr>
<tr>
<td>Prolin (Pro)</td>
<td>2.923</td>
<td>1.756</td>
<td>5.552</td>
</tr>
<tr>
<td>Tyrosin (Tyr)</td>
<td>nd</td>
<td>0.351</td>
<td>8.328</td>
</tr>
<tr>
<td>Valin (Val)*</td>
<td>0.139</td>
<td>0.527</td>
<td>nd</td>
</tr>
<tr>
<td>Methionine (Met)*</td>
<td>5.010</td>
<td>4.741</td>
<td>8.483</td>
</tr>
<tr>
<td>Cysteine (Cys)</td>
<td>4.036</td>
<td>2.985</td>
<td>7.557</td>
</tr>
<tr>
<td>Isoleucine (Ile)*</td>
<td>23.241</td>
<td>7.901</td>
<td>11.104</td>
</tr>
<tr>
<td>Leucine (Leu)*</td>
<td>0.139</td>
<td>7.901</td>
<td>3.547</td>
</tr>
<tr>
<td>Phenilalanine (Phe)*</td>
<td>0.139</td>
<td>6.145</td>
<td>4.318</td>
</tr>
<tr>
<td>Lysine (Lys)*</td>
<td>nd</td>
<td>nd</td>
<td>1.542</td>
</tr>
</tbody>
</table>

Total Amino Acid (TAA) 55.251 86.562 90.995
Total Essential Amino Acid (TEAA) 41.751 56.538 57.990
% TEAA 75.566 65.315 63.729
Total Non Essential Amino Acid (TNEAA) 13.500 30.025 33.005
% TNEAA 24.434 34.685 36.271

*) Essential amino acid

The amino acids composition of keumamah are shown in Table 3. Total amino acid per 100 grams of the highest protein found in type II modified keumamah (90.995 g/100 g of crude protein), while the total essential amino acids (TEAA) 57.99 g/100 g of crude protein (63.729 % total amino acids). The major abundant amino acids were histidine, isoleucine and methionine with values of 11.104, 11.104 and 8.483 g/100g crude protein respectively. Isoleucine (23.241 g/100 g crude protein) was the most concentrated essential amino acid in traditional keumamah. Arginin (17.558 g/100 g crude protein) was the most
concentrated essential amino acid in type I modified keumamah, whereas histidine and isoleucine (11.104 g/100 g crude protein) were the most concentrated essential amino acids in type II modified keumamah.

The active component that determines flavor of keumamah are glutamate, histidine and lysine [11]. Glutamate, histidine and lysine content on the type II modified keumamah is higher compared to traditional keumamah and type I modified keumamah. Overall, there is a tendency that the content of each amino acid in type II modified keumamah is higher compared to amino acids in other keumamah. The type II modified keumamah treated by steaming (80 – 85°C), whereas traditional keumamah and type I modified keumamah treated by boiling (90 – 100°C). The boiling temperature of 95 – 100°C cause water-soluble proteins, a few of peptides and free amino acids missing in boiling water [8]. The reaction between the components of the smoke with a great influence on the process of protein denaturation, m&hellip;ard reaction and decrease some types of amino acids [12].

Lysine and methionine are a limiting amino acid in most food. However, the type II modified keumamah on both of these amino acids have a high enough value, namely methionine 8.483 g/100 g of crude protein in traditional keumamah 5.010 and 4.741 g/100 g of crude protein in type I modified keumamah. Meanwhile, lysine 1.542 g/100 g of crude protein, while on the other keumamah the lysine content is not detected. This indicates modification processing methods can improve the nutritional value of protein of keumamah.

3.4. Sensory evaluation

The sensory evaluation showed that the colour of traditional keumamah (3.8) was significantly (p<0.05) different from type I modified keumamah (2.65) and type I modified keumamah from type II modified keumamah (3.4). Processed methods of keumamah were not significantly (p>0.05) to The aroma and flavor of keumamah. The overall acceptability of keumamah traditional (3.75) was significantly (p<0.05) different from keumamah modification I (3.1) and keumamah modification I from keumamah modification II (3.6). Flavour is a response from the interaction between the senses of smell and taste highly influenced by culture and eating habits of a person [13].

4. Conclusion

Processing methods of keumamah has significant effect on the moisture, ash, fat, crude protein, water-soluble protein and protein digestibility of keumamah. The highest total amino acids was recorded in Keumamah modification II (90,995 g/100 g crude protein), which is 63.729% of the essential amino acids and 36.271% of non essential amino acids. The processing methods had significant effect (p<0.05) on sensory properties they are color and overall acceptance.
References


