New rapid method for cow’s skin (jangat) processing
[Kaedah baru yang cepat bagi pemprosesan kulit lembu (jangat)]

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Abstract
This study was carried out to develop a new rapid technique of processing cow’s skin compared to the conventional process. The conventional process involves immersing in a 1.25% sodium hydroxide solution for 24 h for hair removal, followed by defatting and the overall process took two days. Proximate, physico-chemical, vitamin, mineral, texture and sensory characteristics were analysed.

The total dietary fibre sample was increased significantly (p <0.05) using the new technology compared to the conventional process. Ash, moisture, protein, fat, energy and mineral contents decreased significantly (p <0.05) using the new technology compared to the conventional process. The cholesterol content in the conventional sample (12.41 mg/100 g) and new technology sample (5.68 mg/100 g) was significantly different (p <0.05). For texture analysis, there was significant difference (p <0.05) between the conventional sample and new technology sample for hardness, rupture and rubbery. The sensory evaluation results showed that there were no significant differences between the conventional and new technology samples for all attributes. This study indicated that the new technology sample could be commercialised as a potential healthy food-based product which is low in fat, cholesterol and energy contents, high in fibre, vitamin A and acceptable by consumers.

Keywords: cow’s skin, rapid method, physico-chemical, texture analysis, sensory evaluation

Introduction
Consumers nowadays are increasingly aware of their health to improve their quality of life. Diet is not the only factor that affects well-being and health, but it is one of the most important. The aim is to have a balanced, varied diet containing even safer and healthier foods and still with a pleasant mouth-feel. Factors that have fostered this development include the tremendous current impact on public opinion of the media on the relationship between diet and health, and the growing life-expectancy of the population. Consumers have a high purchasing power and greater health problems and they are very eager to take part in any initiative to keep healthy (Jimenez-Colmenero et al. 2001).

Meat and meat products are essential components in the diets of developed countries. Their consumption is affected by various factors such as product characteristics, consumer preference and environment-related. The product characteristics are one of the important factors such as sensory and nutritional
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properties, safety, price and convenience. Consumer and environment-related also play important roles such as psychological, health, family or educational aspects, general economic situation, climate and legislation. These factors are usually closely linked to social, economic, political and geographical aspects (Jimenez-Colmenero et al. 2001).

The increasing awareness of health modification through diet has led to an upsurge in the availability of nutritious functional foods that have potential health benefits beyond the basic nutrition (Hasler 1998). Accordingly, the new technology of jangat’s process has the potential of being a source of essential nutrients for consumers. Besides the meat that is usually eaten, all cows’ organs have also been used in a variety of meals. Cow’s skin, commonly known as ‘jangat’, is also popularly used as an ingredient in the meals and is a traditional food of Jawa and Minangkabau people.

Before the skin can be eaten, hair and fats must be removed from the skin. This process takes a long time, about two weeks to two months, depending on the weather to get the best quality. For that reason, the price of processed skin costs about RM14/kg compared to unprocessed skin which is only RM4/kg. Cow’s skin also has many nutritional values as it is rich in collagen (Meyer et al. 2005).

The past decade has been characterised by rapid changes in consumer trends pertaining to meat consumption. Sensory quality is important when it comes to consumer’s acceptance (Hoffman et al. 2003). The main consumer requirement is palatability, which is generally defined by the integration of a spectrum of sensory attributes including tenderness, juiciness and flavour (Aaslyng et al. 2003).

MARDI has taken the opportunity to find a new, simple and easy method to remove hair and fat from cow’s skin and at the same time maintain its quality. Therefore, this study was carried out to compare the new technology with the conventional method of cow’s skin processing. The physico-chemical compositions and sensory properties were also evaluated.

Materials and methods

New technology of cow’s skin processing

The new rapid procedure of cow’s skin processing was adopted from Vaquero et al. (2004) with some modifications. It consisted of three consecutive stages. The first stage was to eliminate hair residuals in the cow’s skin including the hair root. The skin was cut into pieces and immersed in a vessel containing basic solution (1.25% NaOH, pH 12) for 24 h. The vessel was continuously stirred on a platform shaker. The second stage was to swell the skin and then wash with distilled water. The last stage was preparation of the cow’s skin. The skin was washed with distilled water, blanched in hot water and then defatted and cooled to room temperature. The processed skin was stored at –20 °C until further application (Figure 1).

Proximate analysis

Moisture content of samples was determined in triplicate using the method of AOAC (1990). The samples were ground using a laboratory Waring blender. The homogenised sample of 5 g was placed in a 105 °C hot air convection oven (Mermet ULM 800) for moisture content analysis after the sample reached constant weight.

Protein, fat and ash contents were determined according to the method of AOAC (1984). Protein content was determined by weighing 0.2 g of homogenised sample into a Kjeldahl digestion flask of capacity 30 – 35 ml. Potassium sulphate (1.2 g), mercuric solution (1 ml) and concentrated sulphuric acid (2.5 ml) were added. The mixture was then heated on a top pan heater in a fume cupboard. After heating, 10 ml of alkali mixture was added, and the
steam was passed through the apparatus until the volume of liquid was 50 – 100 ml. Finally, the liquid was titrated with 0.02 N HCl.

Fat content was determined by the method described by Tee et al. (1986), by directly extracting 10 – 40 g of dried ground sample with 150 ml petroleum ether in a Soxhlet extraction apparatus. The residue in the extraction flask after solvent removal represented the fat content of the sample.

The ash content was determined by drying the homogenised sample in a dish in an oven at 130 °C for 24 h. The dried sample was charred until it ceased smoking. The dish was placed in a cold muffle oven until the temperature reached 550 °C. Total ash content was obtained after the weight of the sample was constant. Total dietary fibre was analysed using AOAC method 985.29 (AOAC 2000).

The carbohydrate content was calculated by difference [100 – (moisture + protein + fat + ash)]. The energy was calculated as shown below:

Energy (kcal/100 g) = [Fat x 9] + [Protein x 4] + [Carbohydrate x 4]

**Physico-chemical, vitamin and mineral analyses**

The pH value was measured by using a pH meter (HANNA Instrument-model pH 211). The cholesterol was determined using the high performance liquid chromatography (HPLC) method which included micro-scale saponification and extraction with n-hexane. The detection is operated using two channels of a diode-array spectrophotometer (Lopez-Carventas et al. 2006).

Ascorbic acid (Vitamin C) was determined by extracting the homogenised sample with an aqueous solution of metaphosphoric acid and acetic acid mixture (15 g metaphosphoric acid + 40 ml acetic acid + 200 ml water) and titrated with 2,6 dichlorophenol indophenol dye. The end point of titration was detected when the dye gave a rose pink colour in acid solution (Tee et al. 1986). Vitamin A was analysed by HPLC (Waters LC Module1 Plus) according to Khatijah (2001). Vitamin B<sub>1</sub> and B<sub>2</sub> were extracted simultaneously with riboflavin through acid hydrolysis followed by enzyme digestion (Kumar and Aalbersberg 2006)

Minerals content such as Na, Ca, Fe, P and Mg were determined by pretreating the samples by dry ashing at 550 °C and dissolving them in nitric acid before injection into an inductive coupled plasma emission spectrophotometer (ICP) (Khatijah 2001).
Texture analysis
Texture analyser (TA-XT2, Stable Micro System Ltd.) was used to determine the texture characteristics of cooked cow’s skin. The Warner-Bratzler Blade was used to cut the sample. The accessory used was the Knife Edge with Slotted Insert (HDP/BS) (Warner Bratzler) using 25 kg load cell Heavy Duty Platform (HDP/90). Three characteristics were determined, cutting strength (hardness/firmness), distance of failure (rupture) and work of shear (rubbery/toughness). The pre-test speed and test speed were measured at 2.0 mm/s. Data acquisition rate was 200 pps.

Sensory evaluation
Thirty panelists consisting of research staff from Food Science Technology Research Centre, MARDI, Serdang, were invited to do the sensory analysis of cooked sample. The sensory responses of the samples using a 9-point hedonic scale (1 = Dislike extremely, 2 = Dislike very much, 3 = Dislike moderately, 4 = Dislike slightly, 5 = Neither like nor dislike, 6 = Like slightly, 7 = Like moderately, 8 = Like very much, 9 = Like extremely) (Larmond 1970). The attributes evaluated were appearance, aroma, tenderness, taste and overall acceptability. The samples were presented randomly. The mean score for each attribute was reported.

Experimental design and statistical analysis
The new processing technology of cow’s skin was carried out in three replicates. All determinations were statistically analysed by the analysis of variance (ANOVA). The Duncan Multiple Range Test was used to detect the differences between samples (Gomez and Gomez 1984).

Results and discussion
Comparison between new technology and conventional processing of cow’s skin
The procedures of cow’s skin processing using new technology and conventional method are presented in Figures 1 and 2 respectively. For the conventional process, the skin was sun dried to eliminate the fat. It took a long time, approximately two weeks to two months, depending on the weather. After that, the skin was cut into pieces and burnt to remove the hair from the skin. Meanwhile, for the new technology process, the skin was immersed in a 1.25% sodium hydroxide solution for 24 h. The aim of this process was to eliminate hair residuals in the skin including the hair roots. The concentration of sodium hydroxide was within the limits of sodium specified in sub-regulation 390(3) (Food Act 1983 [Act 281] and Regulations 2010). The processes of eliminating fat and hair involved in the conventional process were very tedious and took a long time compared to the new technology which only took 24 h.

![Cow’s skin processing diagram](image-url)

Figure 2. Procedure of cow’s skin processing using conventional method
In the conventional process, the skin was blanched about 1 – 2 h before it was cut into pieces. The skin was then immersed overnight and stored for further applications. In the new technology process, the skin was blanched for only about 25 min to eliminate the fat. The skin was then cooled and cut into small pieces and stored for further applications. The conventional process took about two days while the new technology process only took half a day to complete these steps.

A new technology which is easier, faster, cleaner and safer compared to the conventional process has been successfully developed. The new technology only takes two days while the conventional process takes approximately two months.

Proximate analysis
In order to determine the quality of the new technology compared to the conventional method of cow’s skin processing, some analyses were done such as proximate, chemical, vitamin, mineral, texture and sensory. Proximate composition values in conventional and new technology samples are presented in Table 1.

There was a significant decrease \((p <0.05)\) between conventional and new technology samples for ash content, 0.93 g/100 g and 0.06 g/100 g respectively. Similar findings of low ash content have also been reported in meat products (Putra et al. 2011).

<table>
<thead>
<tr>
<th>Composition (g/100 g)</th>
<th>Conventional sample</th>
<th>New technology sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>83.14 ± 0.62(^a)</td>
<td>70.21 ± 0.55(^b)</td>
</tr>
<tr>
<td>Protein</td>
<td>36.23 ± 0.42(^a)</td>
<td>23.05 ± 0.47(^b)</td>
</tr>
<tr>
<td>Ash</td>
<td>0.93 ± 0.02(^a)</td>
<td>0.06 ± 0.01(^b)</td>
</tr>
<tr>
<td>Fat</td>
<td>9.30 ± 0.06(^a)</td>
<td>7.94 ± 0.04(^b)</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>0.00(^a)</td>
<td>0.00(^a)</td>
</tr>
<tr>
<td>Total dietary fibre</td>
<td>0.13 ± 0.01(^a)</td>
<td>0.44 ± 0.01(^b)</td>
</tr>
<tr>
<td>Energy (kcal/100 g)</td>
<td>228.62 ± 0.58(^a)</td>
<td>163.66 ± 0.89(^b)</td>
</tr>
</tbody>
</table>

Means with the same letters in the same row are not significantly different \((p <0.05)\).
Some authors noted that a number of aspects such as fat content and fatty acid profiles influenced the continuity of lipid oxidation and finally it will minimise the shelf-life of meat and meat products (Smet et al. 2008).

**Physico-chemical, vitamin and mineral analyses**

The chemical, vitamin and mineral analyses in conventional and new technology samples are presented in Table 2. There was a significant difference \((p < 0.05)\) between conventional \((8.49)\) and new technology samples \((9.45)\) for pH values. Difference in pH values are related to the varying amounts of the total glycogen of each muscle and animal (Qiao et al. 2002). The lower pH was probably due to the higher glycogen content (Huda et al. 2011).

The cholesterol content in the conventional sample \((12.41 \text{ mg/100 g})\) and new technology sample \((5.68 \text{ mg/100 g})\) showed significant difference \((p < 0.05)\). The amount of cholesterol in meat and meat products depends on numerous factors, but in general it is less than \(75 \text{ mg/100 g}\) (Romans et al. 1994; Chizzolini et al. 1999). From meat consumption and cholesterol content data, it has been estimated that from one-third to one-half of the daily recommended cholesterol intake (less than \(300 \text{ mg}\)) is provided by meat (Chizzolini et al. 1999). From the data reported by Chizzolini et al. (1999) and Romans et al. (1994), it showed that the cow’s skin had lower cholesterol level.

The vitamin C content decreased significantly \((p < 0.05)\) in the new technology sample \((6.96 \text{ mg/100 g})\) compared to the conventional sample \((7.53 \text{ mg/100 g})\). For meat products, processing will destroy vitamins as reported by Prochaska et al. (2000). Surprisingly, the vitamin A content increased significantly \((p < 0.05)\) in the new technology sample \((1.25 \mu\text{g/100 g})\) compared to the conventional sample \((0.66 \mu\text{g/100 g})\). From the results obtained, we can conclude that the new technology processing of cow’s skin will reduce the loss of vitamin A content in the product.

There were significant differences \((p < 0.05)\) between conventional and new technology samples for all minerals. All these minerals showed higher values in the conventional sample than in the new technology sample. The heat used in the processing caused irreversible destruction of vitamins and nutrients in food (Prochaska et al. 2000).

<table>
<thead>
<tr>
<th>Composition</th>
<th>Conventional sample</th>
<th>New technology sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>8.49 ± 0.02(^a)</td>
<td>9.45 ± 0.06(^b)</td>
</tr>
<tr>
<td>Cholesterol (mg/100 g)</td>
<td>12.41 ± 0.10(^a)</td>
<td>5.68 ± 0.12(^b)</td>
</tr>
<tr>
<td>Vitamin C (mg/100 g)</td>
<td>7.53 ± 0.09(^a)</td>
<td>6.96 ± 0.12(^b)</td>
</tr>
<tr>
<td>Vitamin A (as β-carotene) (µg/100 g)</td>
<td>0.66 ± 0.01(^a)</td>
<td>1.25 ± 0.05(^b)</td>
</tr>
<tr>
<td>Vitamin B(_1) (mg/100 g)</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Vitamin B(_2) (mg/100 g)</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Natrium (mg/100 g)</td>
<td>327.99 ± 0.89(^a)</td>
<td>49.49 ± 0.77(^b)</td>
</tr>
<tr>
<td>Calcium (mg/100 g)</td>
<td>11.66 ± 0.11(^a)</td>
<td>9.55 ± 0.15(^b)</td>
</tr>
<tr>
<td>Ferum (mg/100 g)</td>
<td>0.74 ± 0.01(^a)</td>
<td>0.26 ± 0.02(^b)</td>
</tr>
<tr>
<td>Potassium (mg/100 g)</td>
<td>7.82 ± 0.01(^a)</td>
<td>3.47 ± 0.01(^b)</td>
</tr>
<tr>
<td>Magnesium (mg/100 g)</td>
<td>3.35 ± 0.20(^a)</td>
<td>1.09 ± 0.01(^b)</td>
</tr>
</tbody>
</table>

Means with the same letters in the same row are not significantly different \((p < 0.05)\)

\(\text{nd} = \text{not determined}\)
Texture analysis

Texture analysis characteristics in conventional and new technology samples are presented in Table 3. The conventional sample was significantly different (p <0.05) from the new technology sample for the cutting strength. For the distance of failure, the conventional sample was significantly different (p <0.05) and gave higher rupture than the new technology sample. This result indicated that when force is applied, the conventional sample ruptured at a greater distance (distance of failure) and required much more total work, implicating a greater resistance to cutting. The conventional sample was also significantly different (p <0.05) from the new technology samples for the work of shear. The work of shear indicated that the larger the distance to fail, the more elastic (rubbery) was the sample. This would indicate that when placed on the front teeth, the conventional samples would require a stronger ‘bite’ from the consumer. Results obtained showed that the conventional sample was more rubbery than the new technology sample.

Once the trigger force had been attained, the blade proceeds to shear through the sample. The maximum force denoted the point at which the sample completely fills the triangular cavity of the blade and cuts through the sample surface. After this point, shearing had continued throughout the whole sample until the blade had passed through the base blade slot. Factors that affect the shear test are the uniformity of sample size, direction of muscle fibres, presence of connective tissue and fat deposits, sample temperature and speed of shearing (Stable Micro System 2000).

Sensory evaluation

Sensory evaluation results in conventional and new technology samples are presented in Figure 3. The results showed that there were no significant differences between conventional and new technology samples at all attributes (appearances, aroma, tenderness, taste and overall acceptability). From the results, it showed that the new technology sample was acceptable. We can conclude that the new technology method of cow’s skin processing could maintain the quality as the conventional method.

The texture of meat, in particular tenderness, is of great importance when it comes to consumer acceptance of meat. The ultimate assessment of tenderness of cooked meat is a conjoint series of sensory properties involving the initial ease of penetration of the meat by the teeth, the ease of dividing the meat into particles during mastication, and the amount of remnants present in the mouth after chewing (Lawrie 1991). In addition, human perception of tenderness may be influenced by factors such as juiciness and mouth feeling (Warries 2000).

Table 3. Texture analysis in conventional and new technology samples (n = 3)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Conventional sample</th>
<th>New technology sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting strength (g)</td>
<td>1067.47 ± 269.66a</td>
<td>244.31 ± 126.32b</td>
</tr>
<tr>
<td>Distance of failure (mm)</td>
<td>7.92 ± 2.23a</td>
<td>3.81 ± 0.42b</td>
</tr>
<tr>
<td>Work of shear (g.s)</td>
<td>3628.56 ± 1022.45a</td>
<td>1147.60 ± 667.95b</td>
</tr>
</tbody>
</table>

Means with the same letters in the same row are not significantly different (p <0.05)
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**Conclusion**

This study showed that a new technology of cow’s skin processing had been successfully developed which is easier, faster and safer compared to the conventional process. This study indicated that the new technology sample could be commercialised as a potential healthy food based on low fat, cholesterol and energy contents, high fibre and vitamin A, and acceptable by consumers.

**References**


**Figure 3. Sensory attributes in conventional and new technology samples (n = 30). Means with the same letters in same attributes are not significantly different (p <0.05)**

<table>
<thead>
<tr>
<th>Overall acceptability</th>
<th>Conventional sample</th>
<th>New technology sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.08^a</td>
<td>6.48^a</td>
<td>6.44^a</td>
</tr>
<tr>
<td>Aroma</td>
<td>6.92^a</td>
<td>6.84^a</td>
</tr>
<tr>
<td>Tenderness</td>
<td>6.28^a</td>
<td>6.28^a</td>
</tr>
<tr>
<td>Taste</td>
<td>7.08^a</td>
<td>6.44^a</td>
</tr>
<tr>
<td>Taste</td>
<td>7.08^a</td>
<td>6.44^a</td>
</tr>
<tr>
<td>Appearance</td>
<td>6.96^a</td>
<td>6.8^a</td>
</tr>
</tbody>
</table>


Abstrak

Kajian telah dijalankan bagi membangunkan satu teknik yang lebih baik dalam pemprosesan kulit lembu berbanding dengan kaedah konvensional. Proses menggunakan teknologi baru melibatkan perendaman kulit di dalam 1.25% sodium hidroksida selama 24 jam bertujuan pembuangan bulu, diikuti oleh proses pembuangan lemak; dan ini mengambil masa keseluruhan hanya selama dua hari. Analisis proksimat, fiziko-kimia, vitamin, mineral, tekstur dan penilaian sensori telah dianalisis. Kandungan jumlah serat meningkat secara signifikan ($p < 0.05$) di dalam sampel teknologi baru berbanding dengan sampel konvensional. Kandungan abu, kelembapan, protein, lemak, tenaga dan mineral menurun secara signifikan ($p < 0.05$) dalam sampel teknologi baru. Kandungan kolesterol dalam sampel konvensional (12.41 mg/100 g) dan teknologi baru (5.68 mg/100 g) menunjukkan penurunan yang signifikan ($p < 0.05$). Berdasarkan analisis tekstur, sampel teknologi baru adalah lebih lembut dan ia berbeza secara signifikan ($p < 0.05$) bagi ciri-ciri kekerasan, kerapuhan dan kekenyalan. Bagi penilaian sensori, kedua-dua sampel tidak menunjukkan perbezaan yang signifikan antara semua atribut. Teknologi baru pemprosesan kulit lembu dapat dikomersialkan sebagai makanan berkhasiat berdasarkan kandungan lemak, kolesterol dan tenaga yang rendah, kandungan serat dan vitamin A yang tinggi serta diterima pengguna.