Community Empowerment and Tropical Animal Industry

This publication is issued as the Proceedings of the Fifth International Seminar on Tropical Animal Production held in Yogyakarta, Indonesia October 19-22, 2010.

Published by:
Faculty of Animal Science
Universitas Gadjah Mada
Jl. Fauna 3, Bulaksumur
Yogyakarta, Indonesia 55281
www.fapet.ugm.ac.id

ISBN: 978-979-1215-21-3

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PREFACE

The Faculty of Animal Science, Universitas Gadjah Mada, is pleased to have The 5th International Seminar on Tropical Animal Production, held at our campus in Yogyakarta, on October 19-22, 2010. The previous seminar has been successes in discussing various issues at that time. Agriculture is the mainstay of the people of most tropical countries, where billion of people live. Within agriculture, a high priority is placed on animal rearing, since farm animals play important roles in the economies of the countries. The present seminar on ‘Community Empowerment and Tropical Animal Industry’ follows on in a series on tropical animal production.

The conference was aimed to gather educators, academics, researchers, industry practitioners, representatives of professional industry associations and non-government organizations in the field of animal science, to discuss issues and concerns confronting the various stakeholders in responding to the community empowerment and tropical animal industry. The conference further aimed to provide an interdisciplinary forum to facilitate the exchange of information through research and networking amongst the conference participants to foster collaborative research and academic exchanges.

The conference featured more than 200 panel, paper and poster presentations, and attendees, by animal science academics and practitioners from more than 20 countries. All the full papers and abstracts in these proceedings have been subjected to a double blind refereeing process coordinated by selected academics. The success of an international seminar with published proceedings depends on the collective team efforts of many people. We owe a significant debt of gratitude to many individuals. We wish to take this opportunity to thank these individuals who have contributed to the success of this conference. First, we would like to thank the paper and panel presenters as well as the conference session chairs for their contribution of expertise, time and efforts. We would also like to extend special thanks to the Paper Reviewers and Editors who have spared their precious time and efforts to review and edit the papers. The names of the Paper Editors are listed on the following page. The review and editing process has been a complex one given the fact that English is not the native language of many of the delegates who submitted papers for this seminar. With a number of papers it has been necessary to focus, at times, more upon intent and meaning than grammatical correctness.

We also commend the hard work done by the conference steering and organizing committees composed of the academic, administrative staff and students of the Faculty of Animal Science, Universitas Gadjah Mada.

Prof. Dr. Krishna Agung Santosa
Editor in Chief
REPORT OF ORGANIZING COMMITTEE

Good Day,
His excellency, Minister of Agriculture, Republic of Indonesia
The honourable Rector of Universitas Gadjah Mada,
Distinguish guests, participants, ladies and gentlemen,

On behalf of the organizing committee, I would like to extend our warmest welcome all supporters, presenters, and participants to the Fifth International Seminar on Tropical Animal Production 2010 in Yogyakarta, Indonesia, and indeed it is a great pleasure to see you all in our campus of Universitas Gadjah Mada.

This is a very special international event that held by Faculty of Animal Science, Universitas Gadjah Mada, Indonesia. The International Seminar on Tropical Animal Production (ISTAP) is conducted every four years. The first, second, third and fourth were conducted in 1994, 1998, 2002, and 2006, respectively. The theme of the 5th ISTAP 2010 is “Community Empowerment and Tropical Animal Industry”.

This forum is attended by more than 200 delegates representing 18 countries (Australia, Denmark, India, Iran, Japan, Kuwait, Malaysia, Pakistan, The Netherlands, The Philippines, Nepal, Sri Lanka, Nigeria, Thailand, Timor Leste, United Kingdom, USA, and Indonesia. There were over 170 abstracts submissions and 150 papers were accepted and will be presented at the forum. We are confident that the 5th ISTAP will be an excellent opportunity for all participants to share and learn from each other.

We hope that this ISTAP will be a success and that your stay in Indonesia will be a pleasant one.

I would like to express my sincere appreciation to the keynote speaker His excellency Ir. Suswono, MMA, Minister of Agriculture, Republic of Indonesia, and the invited speakers, Prof. Dr. Dale R. ZoBell, Prof. Dr. E.R. Orskov, Prof. Dr. Mogens Lund, Dr. Henning Otte Hansen, Ms. Fokje Steenstra, Mr. Vinod Ahuja, Dr. Yanin Opatpanakit, Prof Dr. Ryo Akashi, Prof. Dr. Michio Muguruma, Prof. Dr. Tohru Suzuki and Dr. Ferry Purnama.

Furthermore, my great thanks go to the sponsors of the conference, i.e. Toyota Nasmoco Mlati, Bank Indonesia, Bank Negara Indonesia, Bank Rakyat Indonesia Syariah, PT. Jackson Niagatama, PT. Peksi Guna Raharja, CV. Restu Bumi, Livestockreview.com, Kedai Roti Ola, Setia Farm, and Mr. Syahrul Bosang.

I would also like to acknowledge the support in the organization of the conference, Abad Entertainment and CV. Prima Katalisindo. Similarly, I also express my sincere gratitude for the hard work and dedication displayed by our paper reviewers, editors, committee and students of Universitas Gadjah Mada.

Again, we would like to welcome you all to the Fifth ISTAP for Participants, Delegates, and Special Guests in Yogyakarta, Indonesia

Thank you.

Dr. Budi Gunotoro
Chairman
WELCOME ADDRESS
DEAN OF FACULTY OF ANIMAL SCIENCE, UNIVERSITAS GADJAH MADA

Assalamu’alaikum warahmatullahi wabarakaatuh,

Honorable the Minister of Agriculture, Republic of Indonesia.
Your excellency Rector of Universitas Gadjah Mada
Distinguish guests, ladies and gentlemen

Let us thank full God almighty, that because of his amazing grace, we are all able to meet together at this Internationnal Seminar. On behalf of the Faculty of Animal Science, Universitas Gadjah Mada, it is my great privilege and pleasure to have you in Universitas Gadjah Mada.

Faculty of Animal Science, one among of 18 faculties in UGM, has been recognized as the prime educational institution in Indonesia, providing teaching, research and extension programs in science and animal industry including animal nutrition, animal production, technology of animal products and livestock social economics.

This is the fifth International Seminar on Tropical Animal Production (5th ISTAP), and the like the first until the fourth ISTAP, is the agenda of own faculty to be conducted once after every four years. The aim of this respective will contemplate in-depth community empowerment and animal industry problem in the tropical developing countries. The big problem which are constituting a challenge in tropical developing countries, particularly in Indonesia, among other things are the economic transformation and the trend of economic globality.

Finally, on behalf of the Faculty, I extend my sincere gratitude to honorables Minister of Agriculture the Republic of Indonesia, for your kind and generosity to include this event on your busy time schedule and be with us to give keynote speech and talk policy matters. We have proud and full of honourable to have invited speakers from all around the world as well as all participants derived from many universities, research institutes, related governmental offices and industries in Indonesia. Four-day conference hopefully would yield valuable solution and discussion in livestock production with holistic management of local resources could be successfully. By this opportunity, I would like to thank all parties and members of both Steering and Organizing Committees, who have devoted their time to make this seminar success. Allow me for this event, to request Prof. Dr. Sudjarwadi to officially open this seminar. Thank you.

Wassalamu’alaikum warahmatullaahi wabarakaatuh.

Prof. Dr. Tri Yuwanta
Dean
OPENING REMARKS
RECTOR OF UNIVERSITAS GADJAH MADA

Assalaamu’alaikum warahmatullaahi wabarakaatuh

The honorable Ministry of Agriculture Republic of Indonesia
Distinguished Guests, Participants of the seminar, and Ladies and Gentlemen.

It is my pleasure to welcome all of you to the campus of Universitas Gadjah Mada to attend the 5th international Seminar on Tropical Animal Production. This seminar is more or less a response to the recommendation forwarded at the 4th International Seminar on Tropical Animal Production held in 2006.

Ladies and Gentlemen,

Universitas Gadjah Mada on behalf of Faculty of Animal Science is very delighted to host this fourth yearly seminar. First of all, I would like to thank and express my appreciation to the Dean of Faculty of Animal Science and all members of the committee of the seminar who have been working very hard to make the seminar successful.

The large numbers of representative we have here from all around the world indicate that the interest generated in animal production is real and trying to affect the resources of rich and poor nations.

Secondly, on this significant occasion I would like to express as well sincere gratitude to the Minister of Agriculture, Ir. Suswono, MMA for your special speech.

The theme of fifth International Seminar on Tropical Animal Production is “Community Empowerment and Tropical Animal Industry”. Since animal production in the tropics has been developed rapidly in order to provide high quality food, however it still very much depends on science, technology, and resources from developed countries. Overseas depending resources make agriculture development difficult to be sustainable. It is urgent to concern and take responsibility for sustainable development of agriculture which integrates three main goals: environmental health, economic profitability and social economic equity.

This seminar will be hopefully being continued as a forum of researchers, specialists in animal science and technology for tropical countries. In our constant effort to improve the food production and technology for tropical countries, we very much depend on cooperative efforts of scientists who have already improved livestock production in the region.

Finally, I do hope you enjoy very much this seminar and your stay in Yogyakarta. Thank you very much.

Wassalaamun’alaikum warahmatullaahi wabarakaatuh.

Prof. Dr. Sudiarwadi
Rector
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INSTRUCTIONS TO AUTHORS

The Annual Report on Agricultural Development in South Asia is an international forum for the presentation of original research, policy analysis, and practitioner experience related to agricultural development in South Asia. This year’s report focuses on the theme of “Innovation and Transformation in Agriculture.”

The report includes a review of the key trends and challenges facing agricultural development in South Asia, as well as case studies of successful innovations and practices. It also highlights the role of science, technology, and policy in driving agricultural progress.

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Effect of broiler age and extraction temperature on characteristic chicken feet skin gelatin

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ABSTRACT: Gelatin was prepared from chicken feet skin of Broiler. Yield, moisture, ash content, pH value, fat content, protein content, viscosity and gel strength of the chicken feet skin were evaluated. A completely randomize factorial design was used, with two levels of broiler age (30 and 40 day) and three levels of extraction temperature (45, 50 and 55°C). Results of the research showed influence of interaction of both treatments Broiler age and extraction temperature was not significant (P>0.05) upon the yield, gelatin moisture, pH value, fat content, protein content and gel strength, while it was significant (P<0.01) to viscosity. The average of gelatin characteristic made of chicken feet skin from this study were yield 15.498%, moisture 10.930%; ash content 0.249%; pH value 3.422; fat content 0.139%; protein content 93.521; viscosity 6.896 poise and gel strength 119.085 g/cm². The results indicated that chicken feet skin gelatin can be used as a substituted for commercial gelatin for food industry application.

Key words: gelatin, chicken feet skin, Broiler, age, extraction temperature

INTRODUCTION

Gelatin is a protein substance that can dissolve in water does not naturally occur in nature, but derived from the destruction of collagen through the process of secondary structures with various degrees of hydrolysis (Phillips and Williams, 2000). Collagen is a fibrous protein found in many connective tissues in the body of animals, such as bone, cartilage, skin and tendons (Pearson and Dutson, 1992).

Physical and chemical properties of gelatin was significantly affected by raw materials, animal age, type of collagen and method of manufacture (Ledward, 1986), tissue type, species (Gomes-Guillen et al., 2009), collagen characteristics and treatment process (temperature , time, and pH) (Johnson-Banks, 1990; Kolodziejska et al., 2008). Muyonga et al., (2004) suggests that collagen derived from fish skin of Nile perch (Lates niloticus) with the age difference to produce the proteins that are almost identical (20-22%), the content and amino acid composition was not significantly different, whereas the fat and mineral content of adult Nile perch fish was higher than that of young fish. Furthermore Dwi Wulandari (2006) argued that differences in the concentrations of acid and alkaline soaking process broiler feet skin with extraction temperature 45°C, showed no significant difference on yield, viscosity, fat content, ash content, pH, whereas the gel strength and protein content showed significant differences.

Gelatin is generally made from waste generated from the cutting and processing of livestock, such as skin and bone. Based on data in 2007, production of gelatin in the whole world about 326 000 tones, with details of 46.0% was derived from pig skin, cow leather 29.4%, 23.1% came from the bone and 1.5% from other sources (GME, 2008). On the basis of these data, the production of gelatin derived from pig skin is very high. This is a problem particularly in Indonesia, due to the gelatin on the market 100% of it is imported gelatin, while the majority of Indonesian people embraced Moslem which forbids a food that comes from pigs.

Therefore, it is necessary to find alternative sources that can replace the pig skin gelatin. One of the most abundant source is from poultry by-product, namely the shank of broiler chickens. In Indonesia, in general, broiler feet has been used as food (e.g.: soup, rambak) or created as an accessory (e.g.: wallet, belts). While in the area of South Sulawesi in particular, broiler feet are still regarded as waste, the utilization is still limited as food and feed.
Potential of broiler chicken feet as a source of gelatin can be seen from the increasing number of chicken population in Indonesia. Data from the Directorate General of Animal Husbandry (2008) total population of broiler chickens in Indonesia in 2008 is approximately 1,075,884,785 heads. In addition, qualitative skin fresh broiler chicken feet contains 22% crude protein, fat 5.50%, ash 3.5%, water 64% and 3% other substances (Sriyanto, 1986). According to Cheng et al., (2009), collagen content of broiler feet that is extracted using acetic acid ranging from 516.6 ± 28.9 mg/g. Further as stated by Vittayanont and Benjakul (2005), Lin and Liu (2006), the collagen of chicken feet, including collagen type I, contains many amino acids glutamate (Glu), aspartate (Asp), hydroxyproline (Hyp) and proline (Pro) and has stability to high temperature. Thus, collagen from chicken feet may be used as a material suitable for biomaterials. Dwi Wulandari (2006) stated that the average value of broiler chicken feet skin gelatin characteristic obtained with various concentrations of the curing material, are 12.31% yield, gel strength of 136 g/cm², 7.51 poise viscosity, protein content 83.23 %, fat content 1.09%, 0.27% ash content, water content 6.75% and pH 4.5, there are 17 amino acids detected with glycine and hidroksiprolin quite high.

Based on the above description, the potential Broiler chicken feet skin should be studied as an alternative to gelatin pig skin and bones, as well as characteristics of the resulting gelatin.

**MATERIALS AND METHODS**

Gelatin production was conducted at the Laboratory of By-product Technology and Environment, Faculty of Animal Husbandry. Measurement of the characteristics of gelatin was done in the Laboratory Technology I, Faculty of Agricultural Technology and Laboratory of By-product Technology and Environment, Gadjah Mada University, Yogyakarta.

**Material**

Research materials used are skin feet of Hubbard broiler strain aged 30 and 40 days around 1500 pieces. This material was obtained in the form of pieces of chicken feet so the skin is still embedded in the bones. Weight ratio of chicken feet and foot skin of broiler chickens aged 30 and 40 days are presented in Table 1.

<table>
<thead>
<tr>
<th>Replication</th>
<th>Feet weak of the Broilers, g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 day old</td>
</tr>
<tr>
<td>Skin Complete feet</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16.1</td>
</tr>
<tr>
<td>2</td>
<td>16.5</td>
</tr>
<tr>
<td>3</td>
<td>16.5</td>
</tr>
<tr>
<td>Total</td>
<td>49.1</td>
</tr>
<tr>
<td>Average</td>
<td>16.37</td>
</tr>
</tbody>
</table>

**Methods**

**Sample Preparation of Chicken Feet**

Broiler feet that have been separated from his body are washed and skinned by the method Purnomo (1992). Chicken feet with the scale still on it were washed clean. Cut finger nails. At the rear of the middle finger the skin was sliced from cob with a knife straight to the base of the longest finger. Weevil exfoliated skin sections up to ± 2 cm downwards and clamped with pliers. Sections of bone that has been exfoliated also clamped with pliers, and then each was held with one hand. Pulled to the opposite directions until the skin on fingertips peeling off. Meat that comes with the skin was removed with knife.
Gelatin Extraction

Making gelatin according to the method by extraction Dwi Wulandari (2006) through the curing process multilevel (alkaline, acid and acid) with slight modifications. Skin chicken feet after separated from the bone was washed, immersed in water at a temperature of 50°C for 30 minutes to remove the scales. Furthermore, washed, cut with a size of ± 1 cm². Furthermore, as many as 400 g of each sample of skin that has been cut, soaked in 0.1% NaOH solution for 40 minutes, then washed with tap water (repeated up to three times), then soaked in 0.1% sulfuric acid solution for 40 minutes , washed with tap water (repeated up to three times). Furthermore, soaked in 0.4% citric acid solution for 40 minutes, washed with tap water (repeated up to three times). Comparison of chicken feet skin was soaking solution was 1 to 5, for each treatment. Subsequently the skin was soaked in distilled water and put into water bath with temperature extraction of 45°C, 50°C and 55°C for 24 hours to extract the gelatin. The next process is filtering gelatin solution using filter paper. Solution of gelatin obtained by each of Approximately 300 ml was container of 30.5 cm x 30.5 cm, then dried in an oven temperature of 60°C for 24 hours. Gelatin obtained then was crushed using a blender and stored for further analysis.

Study Design

Research using Completely Randomized Design (CRD) with factorial pattern, as the first fact of broiler chicken age (30 and 40 days) and second factor was is extraction temperature (45, 50 and 55°C), making six combination treatment and each treatment was replicated five (5) times.

Yield

The yield was calculated as dry weight gelatin/wet weight scaled skinsx100.

Proximate Composition

The moisture, crude protein, crude lipid and ash contents of the extracted gelatin derived from the fermented skate skin were determined in triplicate (AOAC, 1995). Crude protein of the gelatin was expressed as 5.4 x nitrogen content (Johnston-Banks, 1990). All values were calculated on a percent wet weight basis.

Viscosity

Gelatin solutions (10% (w/v)) were made by dissolving the dry powder in distilled water and heating at 60°C. Viscosity as a function of temperature was determined using a computerized Brookfield digital viscometer (Model DV-II, Brookfield Engineering, USA) equipped with a No. 1 spindle (Model RVT) at 60 rpm starting at 40±1°C (Kim, Byun, & Lee, 1994).

Gel Strength

Gel strength was determined according to the method described by Johnston-Banks (1990) on a gelatin gel of 6.67% concentration, formed by dissolving dried broiler feet skin gelatin in 50 ml distilled water. The solution was cooled at 10±1°C for 16 – 18 h. Measurements were conducted at 8±1°C using a Texture Analyzer (TA.XT2, Stable Microsystems LTD, UK) for a 4 mm depression at a rate of 0.5 mm/s using a probe 2 cm in diameter. The gelling and the melting point of gelatin solution was determined visually observing changes in appearance (fluidity) and sinking loaded using a magnetic stirrer bar (1 g) on the top surface of the gelatin sample, respectively.

Statistical Analysis

One-way analysis of variance (ANOVA) was conducted using SAS (SAS Institute Inc., Cary, NC, USA). Data were analyzed using the Tukey test to determine significant differences between means.

RESULTS AND DISCUSSION

Characteristics of feet skin gelatin with different treatment combination of broiler age and extraction temperatures are shown in Table 2.
Yield

The yield is a measure of the percentage of weight gained from the conversion of collagen in the skin. The higher yield being produced, the more efficiently and effectively the performed method. Table 2 showed that the average yield was produced by A2T3, followed by A1T3, A2T2, A1T2, A2T1 and A1T1. From the presented data, it can be seen the trend of increasing extraction temperature, the amount generated yield will be bigger. According Ockerman and Hansen (2000), high extraction temperature would increase yield.

Based on ANOVA, it showed that extraction temperature has a very significant effect on the percentage of gelatin being produced (P < 0.01). Kim et al (2008) stated that the yield of gelatin was continuously increased with increasing temperature and time of extraction. Furthermore, Williams (1997) stated that high temperatures help to break the hydrogen bonds and the gel are hydrolyzed. Number of hydrogen bonds broken and the gel will facilitate the dissolution of collagen in hot water, so as to maximize the acquisition of gelatin.

The results from using the HSD test showed that there was no significant difference (P > 0.01) between treatments. This was probably due to the temperature range being used in this study differed only 5°C, so although there was an increasing yield for each treatment temperature, but the increment was very small. ANOVA results shows the treatment of broiler age and interaction between broiler age and extraction temperature had no significant effect (P > 0.05) on yield of broiler feet skin gelatin. The absence of age effect on yield resulting was probably due to the feet skin of broiler that used a very short life span, the only difference in 10 days. This is in contrast to the results obtained by Cole and McGill (1988) using calf skin with a treatment difference in age, the resulting yield increase with the age of cattle. This difference was probably caused by cow age range used was very wide, namely the age of 6, 18 and 60 months. In addition, the absence of age effect probably caused by that the resulting yield was almost equal to the yield of gelatin from skins of young broiler chickens foot. Swatland (1984) suggested that the protein content of collagen in the skin of animals was affected by age, increasing age of the animal would cause protein and fiber collagen growing stronger. Schriever and Gareis (2007) stated that the collagen derived from younger animals was more easily soluble in hot water, these properties would be decreased with the increasing age.

Table 2. Effect of broiler age and temperature of extraction on characteristic chicken feet skin gelatin.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>A1T1</th>
<th>A1T2</th>
<th>A1T3</th>
<th>A2T1</th>
<th>A2T2</th>
<th>A2T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash content, %</td>
<td>0.253</td>
<td>0.207</td>
<td>0.191</td>
<td>0.393</td>
<td>0.304</td>
<td>0.330</td>
</tr>
<tr>
<td>Fat content, %</td>
<td>0.179</td>
<td>0.098</td>
<td>0.095</td>
<td>0.198</td>
<td>0.125</td>
<td>0.196</td>
</tr>
<tr>
<td>Protein content, %</td>
<td>92.616</td>
<td>93.691</td>
<td>93.871</td>
<td>93.562</td>
<td>93.508</td>
<td>93.876</td>
</tr>
<tr>
<td>Viscosity, poise</td>
<td>6.904&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>7.089&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.293&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.723&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.51&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>6.85&lt;sup&gt;bc&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gel strength, g/cm²</td>
<td>119.849</td>
<td>112.874</td>
<td>127.794</td>
<td>112.938</td>
<td>125.562</td>
<td>115.494</td>
</tr>
</tbody>
</table>

- interaction between the two treatments for all parameters showed no effect (P > 0.05), except for the viscosity parameter
- Different superscripts on the same line showed differences (P < 0.01)
- A1T1 (30 days of broiler age with extraction temperature of 45°C); A1T2 (30 days of broiler age with extraction temperature of 50°C); A1T3 (30 days of broiler age with extraction temperature of 55°C); A2T1 (40 days of broiler age with extraction temperature of 45°C), A2T2 (40 days of broiler age with extraction temperature of 50°C); A2T3 (40 days of broiler age with extraction temperature of 55°C)
**Moisture**

Result based on ANOVA, showing that the treatment combinations of Broiler age and extraction temperature and the interaction between the two treatments did not influence the moisture of gelatin ($P > 0.05$). The lack of effect of treatments on the moisture content of gelatin, due to similar temperature and time being used. Gelatin moisture values obtained (Table 2) which was between 10.655% - 11.155%, this value still meet quality standards set gelatin SNI (1995), maximally 16%.

**Ash Content**

Table 2 shows that the percentage of ash content of broiler chicken feet skin gelatin ranged between 0.191% - 0.393%. These values were in accordance with the standards required by SNI, maximally 3.25%. Table 2 also shows that the older the age of chickens, the percentage of ash generated was higher.

Based on ANOVA, it was shown that both treatments of broiler age and extra temperature hed significant ($P < 0.05$) on the percentage of ash content of broiler feet skin gelatin. The effect of age on the ash content of gelatin is probably due to the occurrence of mineralization processes in cattle older. The statement by Muyonga et al (2004) also indicated that the ash content was also considerably higher for skins of Nile perch adult was probably because of increase mineralization on older age.

**Value (pH)**

Average pH value of gelatin obtained from all treatments ranging from 3.296 to 3.508 (Table 2). This pH value lower than the pH value of research results by Dwi Wulandari (2006) using the same immersion solution, ranging from 4.38 to 4.66. The existence of this difference is likely due to the soaking solution which was still trapped during the process of swelling, was not lost during the laundering and influence the final pH value of the product.

Results of ANOVA indicated that treatment of broiler age and the extraction temperature and the interaction between the treatment showed no significant effect ($P > 0.05$) on the pH value of gelatin. This was caused by the same soaking process, i.e. using alkaline solution (NaOH), and acid solution (H2SO4 and citric acid). With the soaking solution of acid 2 (two) times, possibly had caused the pH of the final products had low values.

**Fat Content**

Average fat content of gelatin obtained ranged from 0.095% - 0.198% (Table 2). The range is very good value, because it does not exceed 5% which is a maximum value required for the quality of gelatin according to SNI (1995). The low percentage of fat content in the resulting gelatin was probably due to the age of broiler that were still very young, so that the fat under the skin has not been formed (as stated by Muyonga et al., 2004), and extraction temperature used was also very low, so that the fat contained in the skin was not degraded. Mulyati and Sudaryati (2003) suggested that saturated fatty acids would be oxidized by the heat and break down into shorter carbon chain, making them easier dissolution. Winarno (1995) also state that fat molecules containing unsaturated fatty acid radicals would be oxidized during the heating and to farm shorter carbon chain.

Table 2, showed that the treatment of broiler age and extraction temperature treatment influenced significantly ($P < 0.05$) on the fat content of gelatin, but not their interaction ($P > 0.01$). This was in accordance with the statement by Muyonga et al., (2004), that the fat content of Nile perch adult was higher than the young, due to the accumulation of fat under the skin occurs with increasing age of the animal. Further added by Mulyati and Sudaryati (2003), that the fat content of gelatin was determined by the temperature and time of extraction, the longer the heating time the smaller the fat content, but the higher the temperature the higher the levels of fat extraction.
**Protein Content**

Gelatin as one type of protein that is produced through a process of conversion of hydrolysis of collagen, have very high protein content in them. Poppe (1992) stated that the standard protein content of commercial gelatin was about 85-90%.

Skin gelatin protein content of chicken feet in this study were between 92.661% - 93.876% (Table 2). The high content of protein in gelatin being produced, probably due to the raw materials used comes from chicken that are still young, so that the collagen was extracted perfectly.

ANOVA results indicated that treatment of broiler age and temperature of extraction and their interaction did not significantly influence (P> 0.05) the protein content of gelatin. The lack of effect of treatment is probably due to the treatment solution and time used the same marinade. According to Pearson and Dutson(1992) immersion had caused some cross-peptide bond been hydrolyzed. Imeson (1992) stated that a long immersion time had many more peptide bonds broken, there was a change in protein formation, more and more and more proteins are extracted.

**Viscosity**

Viscosity is the physical property of gelatin which is also very important. Leiner (2000) stated that the viscosity of gelatin had effect on gel properties, especially on the point of gel formation and melting points. High viscosity yield high rate of melting point and the formation of the gel was higher than the low viscosity of gelatin.

Viscosity values obtained from broiler chicken feet skin gelatin, was between 6.293 to 7.723 poise (Table 2). This was almost the same value obtained by Dwi Wulandari (2006), which was between 7.06 to 7.77 poise and is higher than the results of research Imeson (1992), which was between 1.5 to 7.5 poise. The high value of viscosity which was obtained by Stainsby (1977) correlated with the average molecular weight of gelatin, which was associated with long-chain amino acids. Schrieber and Gareis (2007) stated that the high viscosity of gelatin was related with the many components of high molecular weight.

Results ANOVA indicated that the treatment of broiler age had no significant effect (P> 0.05) on the value of viscosity of gelatin. While temperature of extraction treatment and the interaction between the treatment of broiler age and temperature of extraction caused significant effect (P <0.01). Godmunson (2002) stated that the extraction temperature and time affected the viscosity, the higher the temperature, the lower the viscosity value. This was according to Imeson (1992), due to the high temperature water molecules had a greater energy to move, so that its viscosity was lower (more dilute solution).

**Gel Strength**

Average gel strength values obtained from chicken feet skin gelatin ranging from 112.874 to 127.794 Bloom. This value was still in accordance with the standards required by the gel strength GMIA (2006) which was ranging from 50-300 Bloom.

Results of ANOVA showed that the age treatment and the interaction between age and temperature of extraction had no significant effect (P > 0.05) on the strength of skin gelatin gel from broiler feet. This is likely related to the molecular weight distribution of gelatin which is almost the same. Gilsenan and Ross-Murphy (2000), stated that the molecular weight distribution associated with the large number of α chains. Furthermore, Sims et al (1997) stated that the conditions forming a stable gel was the ability of free chains to form a lot of cross linking

**CONCLUSIONS**

Based on the results and discussion, we can conclude as follows: 1). Chicken feet skin gelatin can be used as a substituted for commercial gelatin in food industry application. 2). Treatment of broiler chicken age does not influence the characteristics of gelatin, especially the characteristics of yield, moisture content, pH value, protein content, viscosity, and gel strength, but shows the effect on the
characteristics of ash and fat content. 3). Treatment of extraction temperature has effect on the characteristic extraction yield, ash content, fat content, and viscosity, but did not influence the characteristics of the water content, pH value, protein content and gel strength of skin gelatin foot broiler.

**LITERATURE CITED**


