**INTRODUCTION**

Extrinsic factors can cause skin aging in the form of sun exposure (photoaging). As a result of exposure to the sun, the manifestations of aging will appear faster than the age they should be. Indonesia, as a country located in the equatorial area, has sun exposure throughout the year so it is prone to photoaging. The sun is the main source of ultraviolet (UV) light. UV rays have several spectrums; between these spectrums, UVA and UVB are UV rays that play a role in photoaging. Clinically, skin that is photoaged will look wrinkled, thick, stiff, and have rough folds.

UV rays affect the skin by increasing free radicals (reactive oxygen species) in the skin. Increased ROS will affect various signal transductions such as nuclear factor-kappa beta (NF-κB), mitogen-activated protein kinase (MAPK). These changes will result in an increase in matrix metalloproteinase. Matrix metalloproteinases (MMP) are enzymes that play a role in collagen degradation. One of the MMP subtypes responsible for degrading collagen in the photoaging process is MMP-1. Photaging manifestations arise through changes in collagen that occur in the skin during the photoaging process.

To overcome the increase in ROS that occurs, compounds that can neutralize them are needed, such as antioxidants. Antioxidants can be derived from foodstuffs containing secondary metabolites in the form of stilbene, phenolic acids, and flavonoids. One of the natural ingredients that have antioxidant properties is coffee. Indonesia is one of the largest coffee producers in Indonesia and the contribution of coffee production comes mostly from Aceh Province, especially the Gayo highlands.

Coffee processing will produce large amounts of waste. Morphologically, coffee consists of exocarp, mesocarp, endocarp, and endosperm. The utilization of coffee waste is still not optimal. The most waste produced is coffee pulp. The content contained in the coffee waste can still be used in the health sector. Through previous research, coffee compounds have pharmacological activities such as antioxidants, antimicrobials, anti-inflammatory, anticancer, and neuroprotective. The use of pulp waste that is popular today is the use of dried pulp waste (cascara pulp) as tea drinks. Cascara pulp is eight times better at inhibiting free radicals than blueberries.

This research aims to investigate the efficacy of topical cascara pulp Gayo arabica coffee extract cream to collagen fiber thickness and density of wistar rat (Rattus norvegicus) as treatment for photoaging.
METHODS

Material
The cascara pulp of Gayo Arabica coffee obtained from the Arabica coffee plant that grows in Gayo Lues, Aceh. Extracts were made using 96% ethanol as solvent. The extract was made into cream with a concentration of 5%; 7.5%; and 10%. Histological examination was carried out using the Mason trichome stain to assess the density and thickness of collagen fibers.

Animal study model
Experimental animal research was conducted at UPT Hewan Coba, Faculty of Veterinary Medicine, Universitas Syiah Kuala. The subjects used in this study were Wistar rats (Rattus norvegicus) which were calculated using the Federer formula so that the number of subjects used was 30. The Wistar rats used were male rats with the age of 2-3 months and body weight of 150-200 grams. Experimental animals were divided into 5 groups with 6 repetitions. The negative group (PN) was given basic cream, the positive group (PP) was given vitamin C cream, the treatment group (PP1) was given Gayo Arabica coffee cascara pulp extract cream with a concentration of 5%, the treatment group (PP2) was given Gayo Arabica coffee pulp cascara extract cream with a concentration of 7.5%, and the treatment group (PP3) was given cascara pulp extract cream of Gayo Arabica coffee with a concentration of 10%. The cream was given to each group by shaving the back of the rats first. The cream was given as much as 0.05 mg/cm² with a frequency of 2 times a day, 20 minutes before irradiation and 4 hours after irradiation. Cream application is still done on days without irradiation. This research has been approved by ethics committee for animal use Faculty of Veterinary Universitas Syiah Kuala. The subjects used in this study were Wistar rats (Rattus norvegicus) as experimental animals was conducted at UPT Hewan Coba, Faculty of Veterinary Medicine, Universitas Syiah Kuala. The subjects used in this study were Wistar rats (Rattus norvegicus) which were calculated using the Federer formula so that the number of subjects used was 30. The Wistar rats used were male rats with the age of 2-3 months and body weight of 150-200 grams. Experimental animals were divided into 5 groups with 6 repetitions. 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UVB Light Sources
UV-B rays originate from the narrowband UVB kernel Kn-403. Each group was exposed to UV-B rays with the same dose between groups with frequency 3 times a week for 4 weeks. In the first week, exposure to UVB rays is 50mJ/cm². In the second week, exposure to UVB rays was 70 mJ/cm² and in the third and fourth weeks, UVB exposure was 80 mJ/cm². The one-way ANOVA analysis of collagen fiber density was carried out using the cervical dislocation method. After the euthanasia procedure, the skin of the mice will be biopsied with an area of 1x1 cm² to the depth of the muscle. The skin sample will be subjected to histological examination to assess the thickness and density of skin collagen fibers. Collagen thickness and density were assessed using top view and imageJ applications.

Collagen fiber thickness
The one-way ANOVA test of collagen fiber thickness is presented in Table 1. The table shows that the P2 group has the highest average value of collagen thickness compared to other groups. The PP group had the lowest collagen thickness compared to other groups. Through this analysis, the value of p<0.001 was obtained. This value means significant differences exist in the five groups (p<0.05).

Collagen fiber density
The results of the one-way ANOVA analysis of collagen fiber density can be seen in Table 2. Among these groups, group P1 has the highest thickness of collagen fibers compared to other groups. Meanwhile, the P3 group had a collagen fiber density that was not much different from the P1 group. The PN group was the group with the lowest density of collagen fibers compared to the other groups. One-way ANOVA analysis found a p<0.001 which means that there is a significant difference in the treatment group (p <0.005).

DISCUSSION
The selection of wistar rats (Rattus norvegicus) as experimental animals was based on the similarity of skin structure with humans. In addition, the selection of the age of the selected mice is related to the intrinsic aging process that has not occurred in the mice of that age. Male rats were selected as experimental models to minimize the effect of hormonal cycles on the skin of experimental animals.

Collagen is matrix extracellular protein that gives structural support in the form of fibers. Collagen can be found in all of organs that display strength and power. One example is skin organ. Collagen has various subtypes and in the skin, the most subtypes are collagen type I (80%) and type III (15%). Through the aging process, collagen synthesis will decrease with age. In addition, there is also a change in the physical properties of collagen. In photoaging, the collagen in the skin becomes hard and stiff. Wrinkles on the skin are one of the manifestations that can be seen as a sign of skin aging.

Table 1. One-Way ANOVA Analysis of Collagen Fiber Thickness.
<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN</td>
<td>6</td>
<td>1.5147</td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>6</td>
<td>1.7217</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>6</td>
<td>2.0343</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>P3</td>
<td>6</td>
<td>1.9757</td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td>6</td>
<td>1.1607</td>
<td></td>
</tr>
</tbody>
</table>

*Significant (p<0.05)

Table 2. One-way ANOVA analysis of collagen fiber density.
<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN</td>
<td>6</td>
<td>53.87%</td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>6</td>
<td>70.93%</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>6</td>
<td>68.37%</td>
<td>&lt;0.001</td>
</tr>
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<td>P3</td>
<td>6</td>
<td>70.22%</td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td>6</td>
<td>67.50%</td>
<td></td>
</tr>
</tbody>
</table>

*significant (p<0.05)
shows the difference of collagen structure in each group.

Collagen density and thickness in PN treatment had low values compared to the other groups. This happened because the PN treatment group received a base cream that did not have efficacious substances for repairing skin collagen. In the absence of efficacious active substance, the process of collagen synthesis will be low and the inflammatory period that occurs will trigger the photoaging process. Vitamin C give good effect on collagen fiber thickness and density. Application of vitamin C will increase collagen I and III mRNA activity. Vitamin C also play a role in stabilizing collagen structure in the skin. Antioxidant activity of vitamin C is strong and it can be useful for overcoming ROS accumulation. The activity of endogenous antioxidants also increased in the application of vitamin C. But, vitamin C has several drawbacks, such as being easily oxidized and hard to absorb topically. This drawback will make the bioactivity of vitamin C can't work properly.

The application of Gayo Arabica coffee pulp extract cream was proven to increase the thickness and density of collagen fibers exposed to UV light. A significant difference in the treatment group indicates this. The increase in thickness and density of collagen fibers is inseparable from the content of secondary metabolites in Gayo Arabica coffee pulp cascara which can increase collagen synthesis and are protective against oxidative stress (antioxidants). Previous research found that Arabica coffee pulp cascara has good antioxidant activity through one of the largest constituent compounds, namely caffeine. Caffeine is able to increase proline and peptidase D (PEPD) activity to increase (collagen production. Also, it can inhibit MAPK pathway to block collagen degradation. Other beneficial compounds for skin health are hydrolyzate, chlorogenic acid, and caffeic acid. Previous studies have shown that these compounds can inhibit MMP expression and simultaneously stimulate the expression of procollagen which is beneficial in the process of collagen synthesis.

CONCLUSION
From the result obtained, it can be concluded that the application of cascara pulp arabica Gayo coffee extract cream in 5%, 7.5%, and 10% can protect skin from photoaging process through the prevention of collagen density and thickness decrease.

DICLOSURE CONFLICT OF INTEREST
The author reports no conflicts of interest in this work.

ETHICAL CONSIDERATION
This study has been approved by Ethical Committee Faculty of Veterinary Medicine, Universitas Syiah Kuala, with ethical clearance reference number 130/KEPH/XII/2021.

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AUTHOR CONTRIBUTION
All authors had contributed to manuscript writing, and agreed for final version of the manuscript for publication.

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