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| RESEARCH ARTICLE

Physicochemical Charastaristics of *Leather* Goat Quality from less *Tanning Process*

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| ABSTRACT
This research is to determine the percentage of chromium and the type of solvent in terms of the physicochemical quality of wet blue and leather from the waterless tanning process. This research was carried out from November 2021 to February 2022 at the Laboratory of the Yogyakarta Center for Leather, Rubber, and Plastics. The research method used was a Nested Completely Randomized Design (CRD) with 2-factor nested patterns, Factor 1 is percentage of chromium (A = 3%, B = 4% and C = 5%) and factor 2 namely different types of solvents (L1 = Water, L2 = Ethanol and L3 = acetone) with 3 replications. The materials used in this study were Etawa crossbreed goat skin and chromium, and the type of solvents was water, ethanol, and acetone. The variables observed were the physicochemical quality of the finished leather (stricter strength, tensile strength, elongation at break, moisture content, total chromium, ash content, fat content, and pH). The data obtained from the results of the research were analyzed using Analysis of Variance (ANOVA) if there were significantly different results obtained, followed by Duncan's Multiple Range Test (DMRT). On the physicochemical quality of the finished leather (leather), the results of this study showed that the type of solvent had a very significant difference ($P < 0.01$) in the physicochemical quality of the leather except for pH. The percentage of chromium nested in the type of solvent showed a very significant difference ($P<0.01$) in the quality of the finished leather. Based on the results of the research, the percentage of chromium nested in the type of solvent was about SNI 2981:2009; from this study, it can be concluded that Phase I research had the physicochemical quality of finished leather with an average stricter strength of 14.40 N/ cm2, tensile strength 15.40 N/cm2, elongation at break 54.32%, water content 4.76%, total chromium 3.64%, ash content 4.62%, fat content 2.44% and pH 4.41.

| KEYWORDS

Leather, physicochemical quality, percentage chrome, type of solvent, tanning

| ARTICLE INFORMATION

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1. Introduction

The goat is one of the livestock that produces meat, milk, and skin. Goat skin can be used as a product that has a selling value by going through a processing process. The first skin processing process is preservation; the purpose of preservation is to increase shelf life. Mustakim, Widati, and Kurniawan (2010) study revealed that the principle of tanning leather is to insert tannery material (chrome) into the leather fiber network so that a chemical bond is formed between the tanning material and the leather fiber. Leather tanning will improve the properties of the leather, including resistance to heat, chemical influences, and microorganism activity.

The process of tanning leather has problems related to waste that causes environmental pollution. Liquid waste is waste that still contains chromium in high concentrations, so it pollutes and is even dangerous for the environment if it is not processed further. According to Ardinal, Salmariza, and Anwar (2014), chrome is classified as a hazardous material and is of the B3 type that can endanger health. Implementation of a clean production system (cleaner *production)* is a strategy that can be done to minimize

environmental pollution. The clean production strategy is carried out by identifying each process flow to investigate which parts will be repaired to minimize environmental toxicity (Nugraha, Suparno, and Indrasti, 2018).

The use of solvents in tanning process *usually* uses water as the solvent. Water is widely used because it is cheap, easy to obtain, non-toxic, and non-volatile. According to the Decree of the Minister of Environment No.03/Men.KLH/II/1991, the use of water in the tanning process is a maximum of 70 liters for every kg of rawhide. According to (Paul, Phillips, Covitong, Evan, and Antunes, 2013), the leather tanning industry produces large volumes of liquid waste. In the tanning process of 1 ton of wet leather, ±40 m3 of water is needed, and then it will be disposed of as liquid waste mixed with chemical residues from the process and dissolved leather components during tanning.

The quantity of water needed is very high, so environmental management efforts are needed, especially in the empowerment of water resources. In the tanning process, water is used for hydrolysis, diffusion, distribution, and fixation of chromium in the collagen matrix of the skin to produce leather that is resistant to physical, chemical, and biological damage. Another solvent that can be used in the tanning process is ethanol because it has relatively high solubility and is inert, so it does not react or affect other ingredients. According to research conducted by Silambarasan, Aravindhan, Rao, and Thanikaivelan (2015), the tanning process using ethanol solvent has a higher chromium absorption rate in all parts of the skin but has a fairly high wrinkle temperature compared to water solvents. The use of ethanol can reduce the quantity of waste generated in the tanning process. Zulharmitta, Deriska, and Harrizul (2010) stated that acetone is the simplest ketone used as a polar solvent in organic reactions. Acetone is a colorless and flammable compound, so acetone can be used as a solvent in the tanning process. The use of solvents using chromium in tanning will affect the tear strength, sewing strength, and tensile strength. The results of research conducted by Mustakim, Thohari, and Rosyida (2007) stated that the use of 10% chrome could increase the tear strength, while the use of 8% chrome can meet the minimum requirements for the sewing strength of tanned leather.

2. Research Materials and Methods

2.1 Research sites

The research was carried out at the Tanning Process Laboratory and the Chemical and Physical Laboratory of Leather Goods at the Center for Research and Development of Leather, Rubber, and Plastic Goods (BBKKP), Jl. Sukonindi No. 9 Yogyakarta.

2.2 Research Material

The research material used was goat skin obtained from the Center for Leather, Rubber, and Plastics (BBKKP) Yogyakarta. The chemicals used are: chromium, water, acetone, ethanol, quicklime ($Ca(OH)_2$), sodium sulfide (Na_2S), hustapol ND, fielder bate pb, formic acid, aquades, concentrated sulfuric acid ($H_{2)}.SO_4$), sodium carbonate (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), ammonium sulfate (ZA), formaldehyde (Fa), teepol, oropon, prevent, salt (NaCl), *pedicel while blossoms* (PWB), *synthetic oil*, *polyurethane soft* (promul c81), *polyurethane hard* (top aqua in), protein binder (melio top 239), *compact binder*, acrylic resin, *polyurethane hard* (top aqua in)**,** hexane, selenium mix, sodium hydroxide (NaOH), and the BCG indicator. Equipment for research procedures *stainless steel drums*, analytical balances, *toogle drying*, scissors, knives, stoves, basins, pipettes, measuring cups, pipettes, and pH paper. The tools used to test the quality of *wet blue* and *leather* are *tensile strength tester* brand KT-700 D2 series 74134, *tioh testing machine*.

2.3 Research methods

The method used in this study is a nested experiment using a completely randomized *design* (CRD) with two factors and three replications. The observed factors were the solvent and the percentage of chromium embedded in the type of solvent. The solvent type factor is divided into three, namely water solvent (L1), ethanol (L2), and acetone (L3). The chromium percentage factor was tested using 3 chromium percentages, namely 3% (A), 4% (B), and 5% (C). This test consisted of 9 treatments and 3 replications to obtain 27 experimental units. The data obtained from the research results were analyzed using *Analysis of Variance* (ANOVA). If the results are significantly different, then proceed with Duncan's Multiple Distance Test (UJBD) at a confidence level of 0.05 and if the results are very significantly different, then continue with Duncan's Multiple Distance Test (UJBD) at a confidence level of 0.01.

2.4 Observation Variable

The variables observed in this study are; water content, ash, fat (SNI, 1989), total chromium, pH, tear strength (SNI. 06-1794-1990), tensile strength, and elongation (SNI. 06-1795-1990).

3. Results and Discussion

3.1 Tear Strength

The results of the analysis of variance showed that the different types of solvents showed that the percentage of chromium (3%, 4%, and 5%) in the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on the tear strength. The type of solvent had a very significant effect (P<0.01) on the tear strength.

The tear strength indicates the maximum extent the skin can be torn. Leather that has a high tear strength means that the tanning material is well absorbed during the tanning process. The tear strength value is proportional to the tensile strength and inversely proportional to the elongation value. If the tear strength and tensile strength are high, the elongation value will be low. This is explained by Ertherington and Robert (2000) that the value of tear strength or tensile strength is influenced by the type of tanning material, tanning time, and the type of leather used (species and age).

Table 1. Average Tear Strength of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Tear Strength (N/cm ^{2})	
		T(P)	P
L1	A	12.43±0.20 ^{b}	12.45±0.21 ^{a}
	B	12.39±0.17 ^{a}	
	C	12.55±0.30 ^{c}	
L2	A	14.20±0.13 ^{a}	14.34±0.44 ^{c}
	B	14.40±0.07 ^{b}	
	C	15.40±0.03 ^{c}	
L3	A	14.19±0.15 ^{a}	14.58±0.18 ^{b}
	B	14.36±0.18 ^{b}	
	C	14.48±0.09 ^{c}	

Based on Table 1, it can be seen that the type of solvent treatment will reduce the tear strength of the *leather*. The highest tear strength was 14.58 N/cm ^{2} obtained from the acetone type treatment, while the lowest tear strength was 12.45 N/cm ^{2} obtained from the water solvent type treatment. The increase in the average tear strength of the *leather* is caused by the type of solvent used during the *tanning process*. The use of the right tanner produces a good quality of tear strength, and according to SNI standards, the use of an inappropriate tanner will reduce the physical quality of the tanned leather itself. The percentage of tanneries has a very close relationship between the total chromium bound in the collagen and the tear strength of the tanned leather. If the amount of bonded chromium increases, then the tear strength will increase. Based on research by Mustakim, Thohari, and Rosyida (2007), 11% chromium tanning reduces the tensile strength of the leather. This result proves that the use of high chromium does not necessarily result in good physical quality leather.

Based on Table 1, the percentage of chromium (3%, 4%, and 5%) in the type of solvent (water, ethanol, and acetone) showed a very significant difference in the tear strength of the finished leather (*leather*). The higher the chromium used, the higher the tear strength value should be. This is explained by Mustakim et al. (2007) that the higher the percentage of tanner used during the process, the higher the tear strength of the resulting leather. This result occurs because the tanner is absorbed into the protein molecules that make up the leather so that cross-links are formed between the tanner and the polypeptide chain, which determines the physical strength of the leather.

The value of high tear strength and tensile strength is inversely proportional to the elongation value, so if the tear strength value is high, the elongation value will be low. This is explained by Ertherington and Robert (2000) that the value of tear strength or tensile strength is influenced by the type of tanning material, tanning time, and the type of leather used (species and age). The high tear strength is caused by tannins that bind to the carboxyl groups of proteins. In addition, the tear strength is influenced by the quality factor of the skin fibers themselves. Low tear strength indicates that the fiber quality is low and easy to degrade (Mustakim, Widati, and Purnaningtias, 2007).

3.2 Tensile strength

The results of the analysis of variance showed that the different types of solvents showed that the percentage of chromium (3%, 4%, and 5%) in the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on the tensile strength. The type of solvent had a very significant effect (P<0.01) on the tear strength. Kholifah, Darmanto, and Ima (2014) stated that tensile strength describes the strength of the bond between the collagen fibers that make up the skin and the tanning agent. The tensile strength of the leather that is less than the requirements will cause the skin to easily break or crack

Table 2. Average Tensile Strength of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Tensile Strength (N/cm ^{2})	
		T(P)	P
L1	A	11.33±0.12 ^{a}	11.96±0.89 ^{a}
	B	11.46±0.36 ^{b}	
	C	13.07±0.47 ^{c}	
L2	A	14.00±0.48 ^{a}	15.08±0.63 ^{b}
	B	15.40±0.06 ^{b}	
	C	15.86±0.72 ^{c}	
L3	A	14.22±0.21b ^{a}	14.62±0.94 ^{b}
	B	14.45±0.17 ^{b}	
	C	15.21±0.86 ^{c}	

Based on Table 2. it can be seen that different types of solvents give different results on the tensile strength of *leather*. The highest tensile strength was 15.08 N/cm ^{2} obtained from the treatment of ethanol solvent type, while the lowest tear strength was 11.96 N/cm ^{2} obtained from the water solvent type treatment. The value of tensile strength is one of the most important indicators in determining the quality of the leather. The nature of the skin is influenced by the structure of the skin tissue, namely collagen, which is a constituent of the skin whose shape is intertwined, irregular, and branches in all directions. The tensile strength of the leather is affected by the thickness of the leather used. Leather that is too thin or too thick produces poor tensile strength. One of the processes in tanning that affects the tensile strength is the *fleshing process* if it is done manually because the leather results obtained are uneven. Poor skin structure makes the absorption of chromium less than perfect, so the quality of the tensile strength test is less than optimal. According to Faishal, Swastawati, and Anggo (2017), tanned leather's tensile strength can be influenced by several factors, such as skin thickness, skin structure, and the percentage of chromium used in the tanning process. The percentage of chromium used affects the stability of the skin due to the formation of cross-links between chromium and protein. Tensile strength is the maximum force required to pull the skin to break; tensile strength is expressed in kg/cm ^{2} and Newton/cm ^{2}. Tensile strength is a parameter that is used as a standard for the quality of leather. According to Sitorus, Riyadi, and Susanto (2020) that a high tensile strength value causes the leather to flex, while a low tensile strength value (<1000N/cm2) will cause the leather to break or crack, thereby reducing the quality of the leather.

The results of the analysis of variance showed that there was an interaction between the percentage of chromium (3%, 4%, and 5%) with the type of solvent (water, ethanol, and acetone) on the tensile strength. The type of solvent has a very significant effect (P<0.01) on the tensile strength. The percentage of chromium nested by the type of solvent had a very significant effect (P<0.01) on the tensile strength. The use of a low amount of oil can cause the fat to not fully absorb into the leather fibers so that the leather becomes too dense and breaks easily when pulled, but if the amount of oil is too high, it will cause the bonds between the fibers to become weak and unable to withstand the pull. According to Maharani, Darmanto, and Riyadi (2015), the use of a high percentage of oil results in a low tensile strength value because a high percentage of oil will make the surface of the leather fiber coated with oil and the skin becomes weaker and easier to stretch. In this condition, the skin fiber bonds become loose and the skin's ability to withstand tensile loads decreases.

3.3 procrastination

The results of the analysis of variance showed that the different types of solvents showed that the percentage of chromium (3%, 4%, and 5%) contained in the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on elongation.

The type of solvent had a very significant effect (P<0.01) on elongation. A high elongation to break value indicates that the leather is of good quality, not easily damaged, not stiff, and has high elasticity. Elongation is the increase in the length of the skin when it is pulled until it breaks, divided by the original length, expressed in percent (%) (Nurjanah, Anggriyani, and Juhana, 2021).

Table 3. Average Elongation of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Elongation (%)	
		T(P)	P
L1	A	77.08±0.15 [c]	73.73±5.76 [b]
	B	74.52±1.58 [b]	
	C	69.59±1.80 [a]	
L2	A	64.69±2.22 [c]	62.20±4.56 [b]
	B	54.32±2.26 [b]	
	C	53.12±1.16 [a]	
L3	A	67.64±2.19 [c]	57.37±3.51 [a]
	B	60.84±1.64 [b]	
	C	58.14±1.95 [a]	

Based on Table 3, it can be seen that different types of solvents give different results in the elongation of the finished leather (*leather)*. The highest elongation was 73.73% which was obtained from the treatment of the water solvent type, while the lowest elongation was 57.37 N/cm ^{2} which was obtained from the acetone type of solvent treatment. The average elongation value *is* inversely proportional to tear strength and tensile strength. When the elongation value is high, the tear strength and tensile strength values will be low. The value of tensile strength is one of the most important indicators in determining the quality of the leather. A low elongation value indicates that the quality of the skin is getting better, and the higher the elongation value, the more easily the skin changes shape and size. For example, in leather shoe products where the expected elongation is low because it will affect comfort when wearing. Factors that can affect the elongation value include the sex and age of the animal. This is explained by Ibrahim, Salamah, Hak, and Komalasari (2014) that the sex and age of the animal are the factors that can affect the tensile strength of the skin tissue structure. Animals with tanned skin have less tensile strength than female animals. Older animals have lower tensile strength than younger animals.

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) in the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on elongation. The type of solvent had a very significant effect (P<0.01) on elongation. In general, limp skin has high tensile strength, so when it receives the maximum tensile force until it breaks, it will be more elastic and provide a greater increase in length (Pertiwiningrum et al. 2010). The compact structure of the skin can inhibit the absorption of oil as a relaxing agent, causing the skin to become stiff. It can be seen that the greater the content of tanner, the smaller the elongation. This is because more and more cross bonds in the form of hydrogen bridges are formed. Cross-links are formed between the phenolic OH groups of vegetable tanners and the carbonamide groups of collagen (Afsar and Sekeroglu, 2008).

Skin elongation is related to the resulting skin elasticity. The tanned skin becomes weak due to the reduction of elastin in the process of calcification and erosion of the skin. According to Farid et al. (2015), if the elongation value is high, this is due to the loss of elastin due to processes ranging from pickling to tanning. Elastin is a fibrous protein that forms very elastic fibers because it has amino acid chains that form an angle so that when tension occurs, it will return straight as before. So when the skin elasticity in the skin protein reduces the elasticity of the tanned skin; This is explained by Mustakim (2009) that the structure of the skin tissue and the processing process affect the physical properties of the leather. The structure of the skin tissue that affects the physical quality is the collagen fibers contained in the chromium layer, which are bonded to each other. The angle formed by the bonding and density of collagen fibers determines the high and low tear strength of the leather. In addition, the *fleshing process* affects the tear strength. The *fleshing process* that uses a machine will produce the same thickness, while the manual separation of the meat using a knife produces an uneven or unequal skin thickness. In addition, the weakness of the skin is caused by the stretching process.

3.4 Water content

The results of the analysis of variance showed that the different types of solvents showed that the percentage of chromium (3%, 4%, and 5%) contained by the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on the water content. The type of solvent has a very significant effect (P<0.01) on the water content.

Table 4. Average Moisture Content of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Elongation (%)	
		T(P)	P
L1	A	77.08±0.15 [c]	73.73±5.76 [b]
	B	74.52±1.58 [b]	
	C	69.59±1.80 [a]	
L2	A	64.69±2.22 [c]	62.20±4.56 [b]
	B	54.32±2.26 [b]	
	C	53.12±1.16 [a]	
L3	A	67.64±2.19 [c]	57.37±3.51 [a]
	B	60.84±1.64 [b]	
	C	58.14±1.95 [a]	

Based on Table 4, it can be seen that different types of solvents give different results on the moisture content of the *leather*. The highest water content was 13.16% which was obtained from the treatment of the water solvent type, while the lowest water content was 4.14 % which was obtained from the acetone type of solvent treatment. In this study, the use of the same percentage of chromium resulted in different values due to the use of different types of solvents. In the water solvent type, the water content value has a higher average water content compared to the ethanol and acetone solvent types. This is because acetone is a semipolar solvent which means it can attract polar and semipolar compounds (Troy, 2005). The use of chrome in the tanning process affects the moisture content. In addition, tanning material has the function of reducing water activity in the skin to prevent skin damage caused by water content. According to Fahima *et al.* (2006), the use of chromium aims to form a complex bond between the collagen and polypeptide components of the skin, which prevents the penetration of water in the pores of the skin to avoid decay. In the tanning process, there is an *olation process,* namely the binding between two similar molecules into a larger molecule by removing water. The release of free water and bound water in the tanning process can reduce the water in the skin. In addition, the use of different types of solvents shows different values. The use of water has an average value of water content higher than ethanol and acetone.

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) in the solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on the water content. The type of solvent has a very significant effect (P<0.01) on the water content. The *fat liquoring process* usually uses synthetic oil; high water content can be caused by imperfect interaction between synthetic oil and skin collagen and causes free water in collagen not to be emulsified perfectly so that there is a lot of water in the skin collagen cavity. The *finishing process* has the aim of removing the skin that is still left on the skin to be reduced so that the final result obtained is according to the standard. According to Yilmaz, Cheaburu, Gulumser, and Vasile (2011) that leather *finishing* is a process to improve several physical properties such as tear strength, heat resistance, and moisture content. The water content will affect the quality of the leather. Water content that is too high triggers the growth of microorganisms such as bacteria and fungi so that the skin is damaged quickly and cannot be stored for long. The perfect drying process will produce leather with a moisture content according to standards without affecting the quality of other leather. The purpose of drying is to remove the moisture content in the skin or chemically bound.

3.5 Chromium Level

The results of the analysis of variance showed that the different types of solvents showed that the percentage of chromium (3%, 4%, and 5%) contained in the type of solvent (water, ethanol, and acetone) had a very significant effect (P<0.01) on the chromium content. The type of solvent had a very significant effect (P<0.01) on the chromium content.

Table 5. Average Chromium Content of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Chromium Oxide Concentration (%)	
		T(P)	P
L1	A	1.82±0.10 [a]	2.74±0.79 [a]
	B	2.79±0.17 [b]	
	C	3.63±0.19 [c]	
L2	A	2.47±0.06 [a]	3.49±0.87 [b]
	B	3.64±0.30 [b]	
	C	4.38±0.39 [c]	
L3	A	2.42±0.08 [a]	3.51±0.92 [c]
	B	3.62±0.28 [b]	
	C	4.50±0.13 [c]	

Based on Table 13, it can be seen that the different types of solvents give different results to the chromium content in the finished leather (*leather)*. The highest chromium content was 3.51%, obtained from the acetone type treatment, while the lowest elongation was 2.74 %, obtained from the water solvent type treatment. The highest absorption of chromium is leather *with the use* of ethanol as solvent and a percentage of 5%. This shows that the use of ethanol with a percentage of 5% has a more perfect and homogeneous Cr 2 O 3 solubility so $_{\text{that the}}$ absorption of Cr_2O_3 into the skin is increasing and perfect cross-linking occurs. In addition, the influencing factor is the concentration of the solution, namely the amount of water used. If the amount of water used is less, the solution will be more concentrated, and the penetration will be faster. The chemical quality that becomes the leather parameter is the content of chromium oxide, which determines the leather's resistance to decomposition. The average content of chromium oxide in the skin in this study was 3.3, which is above the minimum standard.

The results of the analysis of variance in Appendix 19 show that there is an interaction between the percentage of chromium (3%, 4%, and 5%) and the type of solvent (water, ethanol, and acetone) on the chromium content. The type of solvent has a very significant effect ($P<0.01$) on the water content. The percentage of chromium nested by the type of solvent had a very significant effect ($P<0.01$) on the chromium content. The chromium content in the *leather* shows the amount of chromium bound by the skin collagen. According to Mustika (2001), the fibers that have been exposed in the *pickling process* will make it easier for the tanner to enter the skin fiber network. The bond formed between the chromium tanner and the collagen protein will change the nature of the raw leather into leather that is resistant to physical and chemical influences.

3.6 Fat level

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) contained in the type of solvent (water, ethanol, and acetone) had a very significant effect ($P<0.01$) on the fat content. The type of solvent has a very significant effect ($P<0.01$) on the fat content (*leather*).

Table 6. Average Goat *Leather Fat Content*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Fat level (%)	
		T(P)	P
L1	A	1.12±0.11 [a]	1.33±0.24 [a]
	B	1.23±0.12 [b]	
	C	1.57± 0.22 [c]	
L2	A	2.11 ± 0.18 [a]	2.62±0.32 [c]
	B	2.44 ± 0.05 [b]	
	C	3.08 ± 0.08 [c]	
L3	A	2.18 ± 0.12 [a]	2.49±0.44 [b]
	B	2.51 ± 0.27 [b]	
	C	2.80 ± 0.20 [c]	

Based on Table 6, it can be seen that the different types of solvents give different results in the fat content of the finished leather (*leather)*. The highest ash content was 2.62% which was obtained from the treatment of ethanol solvent type, while the lowest fat content was 1.33 % which was obtained from the water solvent type treatment. The value of fat content is proportional to the addition of the added oil concentration. High levels of fat on the skin indicate that the skin is too weak and easy to mold, while if the oil is too low, it means that the skin will crack or break if exposed to heat. In this study, the use of the same percentage of chromium resulted in different values due to differences in the type of solvent used. The use of ethanol and acetone has a lower value than the use of water. Another factor that affects the value of fat content of which is the *degreasing process,* which aims to remove the remains of meat and fat that are still attached to the skin using a fleshing knife. The remaining meat and fat need to be removed so as not to hinder penetration in the tanning process. The *fleshing process* needs to be done carefully so that the goat skin does not tear. The skin that has been *fleshed out is* then washed clean and weighed to produce the bloten weight. According to Nur, Fahrullah, Tala, and Ibrahim (2017) that the degreasing process is carried out to remove fatty substances found on the skin. If the attached fat is not removed, it will make it difficult for the tanner to absorb the tanner, resulting in a high-quality product.

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) in the solvent (water, ethanol, and acetone) had a very significant effect ($P<0.01$) on the fat content of *the leather*. The type of solvent had a significant effect ($P<0.01$) on the fat content of *the leather*. The *fat liquoring* process is the process of adding oil to get slack on the skin. The higher the added oil, the higher the fat content value. This is because the collagen fibers are lubricated with more oil.

In this study, the value of fat content in all treatments was per the standard value (8.5 - 15). The value of the fat content should not exceed 15 because the high-fat content if left in an open room (exposed to sunlight), will undergo an oxidative reaction and will cause a rancid odor. This is due to the hydrolysis process with water vapor which produces free fatty acids. The formation of fatty acids is what will cause an oxidation reaction (oxygen is bound to one of the C atoms, while unsaturated fatty acids have a lone pair of electrons with a characteristic rancid odor). Oxidation of unsaturated fatty acids will produce peroxides, and then aldehydes are formed, which give rise to an unpleasant or (rancid) odor. Air humidity, light, high temperature, and the presence of destructive bacteria are factors that cause high rancidity of fat (Pertiwiningrum et al. 2010).

3.7 Ash Level

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) contained by the type of solvent (water, ethanol, and acetone) had a significant effect ($P<0.01$) on the ash content. The solvent type had no significant effect ($P>0.01$) on the ash content.

Table 7. Average Goat *Leather Ash Content*

Solvent Treatment	Chromium Percentage	Test Parameters	
		Ash Content (%)	
		T(P)	P
L1	A	2.86±0.08 [a]	3.92±0.81
	B	4.44±0.12 [b]	
	C	4.49±0.23 [b]	
L2	A	3.10±0.34 [a]	4.22±0.91
	B	4.62±0.54 [b]	
	C	4.97±0.20 [c]	
L3	A	3.25±0.19 [a]	4.10±0.87
	B	4.13±0.94 [b]	
	C	4.92±0.09 [c]	

Based on Table 7, it can be seen that different types of solvents give different results on the ash content of the finished leather (*leather)*. The highest ash content was 4.10%, obtained from the treatment of ethanol solvent type, while the lowest ash content was 3.92 %, obtained from the water solvent type treatment. Ash content is the remnants of material left over as a result of high-temperature heating. The rest of the ashing results are generally metal content in the skin, while organic matter will be lost when heating. Herawati (1996) states that the value of ash content can be influenced by the addition of chromium in the tanning process. Tanning material (chrome) is an inorganic compound (ash) found in leather. The chromium content in the leather and the ash content will maintain a directly proportional value. If the chromium content used in the tanning process is high, the ash content will also be high.

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) in the solvent (water, ethanol, and acetone) had a very significant effect ($P<0.01$) on the ash content. The type of solvent had no significant effect ($P>0.01$). Several factors that affect the value of ash content are the ability of the skin to bind additional minerals. For example, during the lime disposal process, if it is not carried out properly, the ash content produced will be high. Lime (CaO) used in the liming process will cause high ash content, especially in the form of hydroxylating salts (Fahrul, 2005). Lime (CaO) used in the liming process causes an increase in ash content, especially in the form of carboxylic salts.

The high value of ash content is due to the higher the chromium binding of the leather, the higher the ash content of the leather. The ash content of the tanned goat skin sample has met the requirements where the final result of the leather tanning will be made into a bag product; the maximum requirement for the ash content is 10%. The content of ash content that exceeds the requirements will inhibit the entry of tanning materials into the skin's collagen fibers. According to Kasmudjiastuti et al. (2015), the ash content of tanned leather shows the number of minerals in the skin. Some of the mineral elements are; potassium, calcium, chloride, sulfate, and carbonate. Every leather working process will experience a decrease or increase in weight due to the use of chemicals bound to the skin, as well as weight loss due to the degradation of certain components in the skin.

3.8 pH

The results of the analysis of variance showed that the percentage of chromium (3%, 4%, and 5%) in the solvent (water, ethanol, and acetone) was found to affect the tear strength. The chromium percentage factor had no effect ($P>0.05$) on the pH value.

Table 8. Average pH of Goat *Leather*

Solvent Treatment	Chromium Percentage	Test Parameters	
		pH	
		T(P)	P
L1	A	4.03 ± 0.03 [a]	4.11±0.16
	B	4.10 ± 0.05 [ab]	

	C	4.21 ± 0.21 [c]	
L2	A	3.97 ± 0.03 [a]	4.08±0.08
	B	4.11 ± 0.09 [bc]	
	C	4.07 ± 0.05 [b]	
L3	A	3.96 ± 0.09 [a]	4.03±0.13
	B	4.15 ± 0.06 [b]	
	C	4.32 ± 0.07 [c]	

Based on Table 8, it can be seen that the different types of solvents gave no different results to the pH of the finished leather (*leather)*. The highest pH was 4.11, which was obtained from the treatment of the water solvent type, while the lowest pH was 4.03, which was obtained from the acetone type of solvent treatment. Kusmaryanti et al. (2002) explained that pH has the same effect on tanners because, during the final *tanning process*, pH is neutralized using baking soda, so the average pH value for different types of solvents is not much different. The neutralization process using baking soda aims to remove any remaining free acids or sticking to the skin. After the neutralization process is complete, it can be controlled using the *Bromocresol green* (BCG) indicator. Part of the skin was cut and then dripped with the BCG indicator. If the neutralization process is sufficient, the cross-section of the skin that has been dropped will be blue, and the pH has reached 5.0-6.0.

4. Conclusion

The use of 4% chromium percentage with ethanol solvent gave the best results on the quality of the *leather*. with the following characteristics tear strength 14.40 N/cm ^{2} , tensile strength 15.40 N/cm ^{2} , elongation 54.32% , moisture content 4.76%, total chromium 3.64%, ash content 4.62%, fat content of 2.44% and pH 4.41.

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