USE OF GELATIN BINDER AS A BASE COAT IN THE FINISHING PROCESS OF TANNED RABBIT SKIN

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ABSTRACT. Research on the use of bovine split hide gelatin protein binder for the finishing process of rabbit crust skin has been carried out. This research aimed to study the use of gelatin as a protein binder as a substitute for patent binders for finishing tanned rabbit crust skin and to obtain the best percentage of using gelatin as a protein binder in the finishing process of tanned rabbit skins. The materials used in this study were 20 sheets of Rex rabbit skin with an area of 21.25 square feet (sqft), bovine split hide gelatin, casein, and tanning agents. The research treatment was T1 base coat solution plus 50 parts of gelatin, T2 plus 70 parts, T3 plus 90 parts and TK using casein binder as much as 70 parts with five repetitions. Data were analyzed using a one-way completely randomized design, if there were differences between treatments it was continued with Duncan's Multiple Region tests. The results showed that there were significant differences in each parameter except for the drop test before the base coat. The results for the drop test before base coat ranged from 12-14 seconds, after base coat 18-33 seconds, tensile strength around 9.31-13.72 kgf/m^2, elongation 41.27-60.28%, water absorption after 2 hours 206.15-228.81%, water absorption after 24 hours 212.43 -241.43%, wet rubbing resistance slightly fading (3/4), dry rubbing resistance not fading (4) and ring 25 flexibility between 4.6-5.2 cm. Gelatin from bovine split hide can replace casein as a binder in finishing solutions. The use of gelatin up to 70 parts can be used in the finishing solution for rabbit crust skin and can replace casein.

KEY WORDS: finishing solution, gelatin, protein binder, rabbit skin

UTILIZAREA GELATINEI CA LIANT ÎN STRATUL DE BAZĂ APLICAT ÎN PROCESUL DE FINISARE A PIELII DE IEPURE

REZUMAT. S-au efectuat cercetări privind utilizarea liantului proteic din gelatină din piele șpalt de bovine pentru procesul de finisare a pielii crust de iepure. Această cercetare și-a propus să studieze utilizarea gelatinei în calitate de liant proteic ca înlocuitor al lianților comerciali pentru finisarea pielii de iepure tăbăcite și să obțină cel mai bun procent de utilizare a gelatinei ca liant proteic în procesul de finisare a pieilor de iepure. Materialele utilizate în acest studiu au fost 20 de piei de iepure Rex cu o suprafață de 1,974 m^2, gelatină din piele șpalt de bovine, cazeină și agenți de tăbăcire. Tratamentul a constat într-o soluție pentru strat de bază T1 plus 50 de părți gelatină, T2 plus 70 de părți, T3 plus 90 de părți și TK folosind liant de cazeină până la 70 de părți cu cinci repetări. Datele au fost analizate folosind un design unidirecțional complet randomizat, dacă au existat diferențe între tratamente, s-a continuat cu testul Duncan pentru intervale multiple. Rezultatele au arătat că au existat diferențe semnificative pentru fiecare parametru, cu excepția testului de permeabilitate la apă înainte de a aplica stratul de bază. Rezultatele testului de permeabilitate la apă înainte de a aplica stratul de bază au variat între 12-14 secunde, după aplicarea stratului de bază 18-33 secunde, rezistența la tracțiune a fost în jur de 9,31-13,72 kgf/m^2, alungirea 41,27-60,28%, absorbția de apă după 2 ore 206,15-228,81%, absorbția de apă după 24 ore 212,43-241,43%, rezistența la frecare umedă cu ușoară decolorare (3/4), rezistența la frecare uscată fără decolorare (4) și rigiditatea inelară 25 între 4,6-5,2 cm. Gelatina din pielea șpalt de bovine poate înlocui cazeina ca liant în soluțiile de finisare. Se poate utiliza gelatina în proporție de până la 70 de părți în soluția de finisare a pielii crust de iepure și poate înlocui cazeina.

CUVINTE CHEIE: soluție de finisare, gelatină, liant proteic, piele de iepure

L'UTILISATION DE LA GÉLATINE COMME LIANT DANS LA COUCHE DE BASE APPLIQUÉE DANS LE PROCESSUS DE FINITION DE LA PEAU DE LAPIN

RÉSUMÉ. Des recherches ont été menées sur l'utilisation de liant protéique gélatine provenant de la croûte de bovin pour le processus de finition du cuir en croûte de lapin. Cette recherche visait à étudier l'utilisation de la gélatine comme liant protéique en remplacement des liants commerciaux pour la finition des peaux de lapin tannées et à obtenir le meilleur pourcentage d'utilisation de la gélatine comme liant protéique dans le processus de finition des peaux de lapin. Les matériaux utilisés dans cette étude étaient 20 peaux de lapin Rex d'une superficie de 1 974 m^2, de la gélatine de croûte de bovin, de la caséine et des agents tannants. Le traitement consistait en une solution de couche de base T1 plus 50 parties de gélatine, T2 plus 70 parties, T3 plus 90 parties et TK utilisant un liant caséine jusqu'à 70 parties avec cinq répétitions. Les données ont été analysées à l'aide d'un plan unidirectionnel entièrement randomisé. S'il y avait des différences entre les traitements, elles ont été suivies par le test à plages multiples de Duncan. Les résultats ont montré qu'il y avait des différences significatives pour chaque paramètre, à l'exception du test de perméabilité à l'eau avant l'application de la couche de base. Les résultats du test de perméabilité à l'eau avant l'application de la couche de base allaient de 12 à 14 secondes, après l'application de la couche de base de 18 à 33 secondes, la résistance à la traction était d'environ 9,31 à 13,72 kgf/m^2, l'allongement de 41,27 à 60,28 %, l'absorption d'eau après 2 heures 206,15-228,81 %, l'absorption d'eau après 24 heures 212,43-241,43 %, la résistance au frottement humide avec légère décoloration (3/4), la résistance au frottement à sec sans décoloration (4) et rigidité annulaire 25 entre 4,6-5,2 cm. La gélatine de la croûte de bovin peut remplacer la caséine comme liant dans les solutions de finition. La gélatine peut être utilisée jusqu'à 70 parts dans la solution de finition du cuir en croûte de lapin et peut remplacer la caséine.

MOTS CLÉS : solution de finition, gélatine, liant protéique, peau de lapin

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INTRODUCTION

The leather tanning industry is an industry that manages raw animal skins that easily rot or break down into tanned leather or also called finished leather. Tanned leather can be processed into various products that have a higher economic value than raw leather.

Leather finishing is the final stage of the leather tanning process, and is responsible for the final properties and characteristics of the leather, such as hydrophobicity, fastness, abrasion resistance, gloss, and color evenness. The composition of the finishing formulation determines these properties. Finishing formulations include film-forming materials which can be divided into protein-based or resin-based formulations. Standard properties such as color fastness, hydrophobicity, binding to skin pigment particles, providing adhesion to the skin, providing flexibility so that the final product can be stretched with the skin, and also to protect the skin surface are provided by resin-based formulations [1], while protein-based formulations provide a more natural appearance [2, 3]. Protein binders provide a fine grain pattern, good air circulation, and a natural feel [4].

Coloring, oiling, and drying are the final stages of the rawhide (hide and skin) process to become finished leather, while dyeing is the final stage of refinement after the skin is tanned. A topcoat on tanned leather will determine consumer appeal. This finishing process aims not only to cover the damage to the grain by dyeing it but also to improve quality, even out the color, handling, fastness, reduce stickiness and add beauty so that the skin surface becomes more attractive [5].

Binder or adhesive in leather tanning is often used in leather finishing processes or top coat. The purpose of this cover painting is to enhance the attractiveness and durability of the finished skin, namely the appearance of the grain like the original, for example, glacé goat skin, python skin, lizard skin, chicken claw skin, fish skin, and crocodile skin and rabbit skin. Almost all glacé and reptile skins use protein/casein binder top coat. Acrylic, polyurethane, butadiene, and protein binders are binders for creating natural finishing processes with various particle sizes and degrees of hardness to achieve the desired final result (glossy, matte), as well as physical and mechanical characteristics such as tensile strength, elongation, tear strength, and paint rub resistance [6].

There are two kinds of binders, namely natural binders (proteins) and synthetic binders. Protein binders can be made from egg white, milk, cow blood, and gelatin, while synthetic binders are made from ethyl cellulose, polyvinyl alcohol, and poly acrylic acid [7]. Binder from gelatin is obtained by extracting animal skin or bones using hot water. Gelatin can be made from bovine split hide, which is a by-product of the leather tanning industry in the form of split leather of the flesh resulting from liming [8]. The skin of this split still contains collagen, which when hydrolyzed produces gelatin. It was explained further, that the characteristics of gelatin from the bovine split hide are almost the same as commercial gelatin, so bovine split hide gelatin can be used as a substitute for commercial gelatin, which means it can be used in various usage applications.

The functions of gelatin include as a stabilizer, thickening agent, gelling agent, emulsifier, forming a thin film, a suspension, increasing the elasticity, consistency, and stability of the product. Film-forming polymers play an important role in the physical performance of leather finishes. However, the practical use of gelatin as a binding polymeric material may be limited by its relatively poor mechanical properties. Binders are often used in finishes to improve the properties (such as stability, water resistance, and molecular weight) of the polymer binders used in the topcoat [9].

Research related to protein binders for leather finishing includes: using waste which was hydrolyzed with NaOH as a protein binder [10]; the use of vegetable peel waste which is extracted with enzymes as a protein binder [11]; comparison of protein binders and acrylic binders as color binders [12]; comparison of various protein binders in finishing chicken claw skin [3]; examining the effect of egg white protein binder on tilapia skin finishing [13].

This research will be conducted to apply gelatin from bovine split hide which is used in the finishing of rabbit crust skin with different concentrations, compared to commercial gelatin binder (casein) by measuring its physical properties parameters. Many rabbit breeders do not use their rabbit skins, most rabbit skins are just thrown away or stored in a preserved salt form whenever someone needs it. This research utilizes rabbit skin to become tanned leather to increase its usability and apply gelatin as a binder in the finishing process to improve the appearance of rabbit skin as a tanned leather product and have a higher selling value.

EXPERIMENTAL

Materials and Methods

Instruments

The tools used in this study were tanning drums, compressors, spray guns, digital scales, glass beakers, measuring cups, Petri dishes, stirrers, filters, crock meters, grayscale, Mechanical Universal Testing Machine (Zwick/Z 0.5), softness leather test ST 300 and stopwatch.

Materials

The material used in the study was 20 sheets of rabbit skin with an area of between 1-1.5 sqft each, type A gelatin from a bovine split hide (which is extracted using the acid method) as a film-forming agent or adhesive. The physical and chemical properties of the gelatin used are water content 6.28%, protein 69.07%, fat 0.32%, ash 0.3%, viscosity 3.83 cP and gel strength 153.53 bloom. Tanning agents and finishing materials such as direct paint as a coloring agent, silicone emulsion, glycerin, 10% formaldehyde solution as a fixative and water as a solvent, ammonia, thinner, and lacquer.

Experimental Design

Statistical analysis was used using a Completely Randomized Design (CRD) with 5 replications where the percentage of gelatin binder was used as a treatment: 50, 70, and 90 parts and 70 parts casein binder as a control.

The Process of Tanning Rabbit Skin

The tanning process uses 20 pieces of fresh Rex rabbit skin which are selected without defects due to disease and cleaned of remaining meat and fat, then weighed to determine the wet weight of 21.25 kg as a chemical calculation. Tanning is done with a combination of chrome and vegetable tanning agent based on quebracho powder. The tanning process formula is presented in Table 1.

Table 1: Formulation of Rabbit Skin Vegetable Chrome Tanning Process

Process	%	Chemical	Product patent	Time (minutes)	Control	
					pH	Other
Sorting and Measuring						Fresh skin selection and measurement
Weighing						As fresh weight
Soaking	400 1 0.05	H_2O Wetting agent Disinfectant	Water Peramit MLN Preventol ZL			diluted 1:10 Wet conditions
Green fleshing	200 4 0.5					The remains of flesh and blood were cleaned
De-hairing		H_2O Na_2S $Ca(OH)_2$	Water Lime	60 30		Stir slowly Continued intermittently: run 5′ of 15′
Fleshing						

Process	%	Chemical	Product patent	Time (minutes)	Control	
					pH	Other
Scudding Weighing						
Deliming	300	H_2O	Water			
	4	$(NH_4)SO_4$	ZA	60	Bloten	
	0.5	HCOOH	Formic Acid	30	weight	
	1	Degreasing agent	Gelon PKN	45		
Drain, Wash, Drain						
	200	H_2O	Water			Minimum 6° Be
Pickling	18	NaCl	Salt			
	1.5	HCOOH	Formic Acid			
	0.5	H_2SO_4	Sulfuric Acid			
	100	Pickle water				6-8° Be
Tanning	8	Chrome tanning agent	Chromosal B			Translucent check
	0.45		Mgo			
Ageing Sammying						
Saving						1 mm
Trimming Weighing						
Wetting back	200	H_2O	Water	60		
	0.5	Wetting agent	Piramid MLN			
Drain						
Neutralisation		H_2O	Water	6 x 10		
	200	$NaHCO_3$	Natrium			
	1.5		bicarbonate			
Retanning		Acrylic resin	Tergotan ESN	20		
	2	Vegetable	Quebracho	20		
	5	Vegetable	Mimosa	60		
	5					
Drain						
Fatliquoring	100		Temperature water 80°C			
	3		Peramid SLW		5-5.2	
	5	Sulphited oil	Derminol OCS	60		
	2	Lecithin oil	Trianol LC 60			
	1	Emulsifier	Peramit MLN			
	3	HCOOH	Formic acid			
	0.02	Antifungal	Preventol C			
Setting out Tacking wet Drying Finishing						

Preparation of Base Coat Solution

To gelatin with variations of 50, 70, and 90 parts, were added 20 ethyl glycol, 100 acrylic, 150 acrylic medium, 50 parts wax, and water up to 1000 ml volume. pH should be 8–9; if not reached, ammonia is added. The base solution formula is shown in Table 2.

Table 2: Rabbit Skin Base Coat Formula

Material	TK	T1	T2	T3
Binder	70	-	-	-
Casein	-	50	70	90
Water	610	630	610	590
Ethyl glycol	20	20	20	20
Acrylic	100	100	100	100
Acrylic Medium	150	150	150	150
Wax	50	50	50	50
Total	1000	1000	1000	1000

Preparation of Top Coat Solution

Laq water 200 parts, silicone emulsion 20 parts, and water were added to a volume of 1000 ml and stirred until homogeneous.

Preparation of Clearing Solution

Wetting agent 20 ml, ammonia 10 ml were mixed and added water to a volume of 1000 ml and stirred until homogeneous.

Application to the Skin

Rabbit crust skin is sprayed with clearing solution, was left to stand until dry then coated with base coat, allowed to dry, then coated with top coat solution using a spray gun, and after drying fixed with 10% formalin.

Measurement of Rub Fastness (INS ISO 20433:2013) [14]

The parameters observed were testing the rub fastness of rubbing paint on a wet cloth and a dry cloth. The paint's rubbing resistance was tested using a Crock meter equipped with a Gray Scale.

Measurement of Tensile Strength (INS ISO 3376:2012) [15]

Tensile strength values were measured using a Mechanical Universal Testing Machine. The sample was cut according to the pattern in the ISO 3376. The tensile strength value is calculated based on the maximum force (N) with the skin area (mm^2) that is applied until the skin breaks.

TS = (F max)/A (1)

F max = The force needed until it breaks (N)

A = The cross-sectional area of the film (mm^2) (Axl)

S = Tensile Strength (kgf/m^2)

Measurement of Elongation (INS ISO 3376:2012) [15]

The measurement of elongation is carried out simultaneously with tensile strength. Elongation is an increase in the length of the skin that is pulled from the length of the first to the maximum length.

EL = (Lc-Lo)/Lo x 100% (2)

Lc = Maximum film length

Lo = The length of the first film

EL = Elongation (%)

Measurement of Drop Test (EN ISO 5404:2021) [16]

Done by dripping a drop of water to the surface of the skin and then calculating with a stopwatch how many seconds it takes the water to be absorbed perfectly into the skin.

Measurement of 2 and 24 Hours of Water Absorption with the Petri Dish Method (SNI ISO 17229:13) [17]

Water absorption is done by making a circular skin sample with a diameter of 7 cm. The skin sample is soaked in a Petri dish at room temperature for 2 hours and 24 hours. After the desired soaking, the sample was removed and drained and then weighed.

Water Absorption = (W2-W1)/W1 x 100% (3)
W1 = Initial sample weight
W2 = Sample weight after soaked for 2 or 24 hours.

Measurement of Skin Softness (ISO 17235:2015) [18]

Standard Testing Skin softness was carried out according to ISO 17235. Standards Using Softness Leather Test ST 300. Softness Leather Test ST 300 was used to read data.

Statistical Analysis

Data obtained from treatment were analyzed with ANOVA (Ko variant analysis) based on a completely random design. If there is a difference, it was followed by Duncan's new Multiple Range Test [19]. The level of statistical significance was set at P<0.05. The statistical software package SPSS 15.0 (SPSS, Inc., Chicago, IL, USA) was used for these data analyses.

RESULTS AND DISCUSSIONS

Data on the results of research on the use of gelatin protein binder for the finishing process of rabbit crust skin can be seen in Table 3.

Drop Test

The drop test is used to determine the quality of water penetration into the skin. Drop test before being given a layer of base coat (crust skin) is not significantly different between treatments. This is because the samples have not been treated with a finishing layer, so there is no effect of binder on the absorption of skin water. The drop test value before the base coat ranges between 13-14 seconds. A drop test with an absorption time of under 20 seconds shows that the level of penetration and surface tension of the skin is good so that it can be continued for the finishing stage, namely the base coat [20].

Table 3 shows the addition of gelatin in the base coat solution, the increase in the amount of gelatin causes the longer absorption of water into the skin. This is because the addition of gelatin which acts as a binder in the base coat solution will form a layer of film on the skin so that the layer of the film can inhibit or hold the water into the skin. Protein binder coating will reduce air permeability [21]. Binder is the main ingredient in forming a film in finishing leather. The more additional binder will form a layer of film that is thicker and the longer the water seeps into the skin [7].

Table 3: Research Data on the Use of Protein Binders for the Finishing Process of Rabbit Crust Skins

Parameter	Treatment			
	T1	T2	T3	TK
Drop test before base coat (second)	12.50±0.71	13.50±0.71	13.50±0.71	13.50±0.71
Drop test after base coat (second)	18.50±0.71^a	22.50±0.71^b	32.50±0.71^d	24.50±.71^c
Tensile strength (kgf/m^2)	9.89±0.81^a	12.10±0.81^a	13.13±0.76^b	12.97±1.06^b
Elongation (%)	57.83±0.50^c	43.96±0.57^b	41.89±0.88^a	59.83±0.64^d
2 hours of water absorption (%)	206.76±0.86^a	212.67±0.90^b	215.11±0.55^b	227.975±1.18^c
24 hours of water absorption %)	212.60±0.23^a	217.79±0.30^b	224.95±0.47^c	240.66±1.09^d
Dry rub fastness	4 (No fade)	4 (No fade)	4 (No fade)	4 (No fade)
Wet rub fastness	¾ (A little faded)	¾ (A little faded)	¾ (A little faded)	¾ (A little faded)
Softness ring 25 (cm)	5.1±0.00c	4.85±0.07b	4.6±0.00a	5.15±0.07c

Note: Values followed by different letters in the same row indicate a significant difference (P<0.05). T1 = 50 parts gelatin binder, T2 = 70 parts gelatin binder, T3 = 90 parts gelatin binder, TK = 70 parts casein binder (control)

Tensile Strength

The increase in the addition of gelatin as a binder in the base coat solution also increases the tensile strength of rabbit skin. Statistics show that there are real differences between T1 and T2 and T3 and TK. This shows that the addition of gelatin in the base coat solution causes a layer that covers the surface of the skin, and the greater the addition of gelatin, the thicker and stronger layers become to increase the tensile strength. The final layer must have a degree of bonding to the skin surface which will be used to improve the physical properties of the skin [4]. When using egg white binder in the finishing process of tanned tilapia skin, with an increase in the concentration of egg whites, tilapia skin tensile strength also increases [13].

The tensile strength test results ranged from 9.31 to 13.72 kgf/m^2, these results are below INS 06-4586 [22]. Quality requirements for tanned leather with a minimum tensile strength value of 1.500 N/mm^2 (152.97 kgf/m^2). This is because the INS standard uses goat leather, where the thickness of the leather is different from rabbit leather. One of the factors that determines the size of the tensile strength is determined by the thickness of the skin, length of the sample, type of skin and type of tanning agent.

Elongation

The elongation of the skin is related to the softness or elasticity of the resulting skin. The elongation value of the rabbit skin as a result of the test is presented in Table 3. With the increased use of gelatin in the base coat solution, the elongation value of the rabbit skin decreased and was lower than the control treatment using a casein binder. The elongation is inversely proportional to the tensile strength, if the elongation is low, the tensile strength will be high. This value is following the results of a study, who used egg white binder in the finishing process of tilapia skin; with increasing egg white concentration the elongation of tilapia also decreased [13]. The role of the gelatin binder is to fill the empty spaces in the rabbit's skin so that the skin becomes dense and filled which causes low elongation.

The elongation of rabbit skin ranged from 41.27%-60.28%, this result exceeds the INS 06-4586-1998 standard, which is a maximum of 30%. High elongation can be caused by the tanning agent used. The research rabbit skin tanning process uses chromium as a tanning agent with vegetable retanning materials. The explanation is that in chrome tanning, the final product becomes soft and supple to the touch, the color remains the same throughout life, high quality and high hydrothermal stability [23].

Two and 24 Hours of Water Absorption

Water absorption was carried out at 2 and 24 hours, intended to determine the ability of the skin to absorb water. With the increase in the use of gelatin in the base coat solution, the water absorption value of the rabbit skin at 2 and 24 hours of the rabbit skin increased, but it was lower than the control treatment using casein binder. This is because the film that is formed is thicker, and the film that is formed from protein binders is hydrophilic, so the thicker the film layer, the more it absorbs water when immersed in water.

The results of the variance calculation in Table 3 show that water absorption at 2 and 24 hours is significantly different ($P<0.05$) in each treatment. This is because the nature of gelatin when it becomes a sol is hygroscopic, and will absorb water when soaked in water, so that the film layer formed becomes gel and the skin absorbs more water.

The results of water absorption in rabbit skin for 2 hours ranged from 206.15%-228.81% and 24 hour absorption ranged from 212.43% - 241-43%. This result exceeds the standard INS 0234 [24], which requires water absorption for 2 hours a maximum of 80%, and 24 hours for a maximum of 100%. The high water absorption exceeds the SNI standard because gelatin is a protein binder that absorbs water.

Rubbing Fastness

The rubbing fastness of leather is a physical test to determine the color fastness of finished leather. Rubbing fastness is an organoleptic assessment by comparing the color change after the skin is rubbed with a crock meter with a standard color change (Grayscale). The results of the rub fastness test are shown in Figure 1. The average dry rub fastness of rabbit skin is 4 (good enough/does not fade). Casein and protein as the adhesive power of the binder and lacquer solvent emulsion for the top layer are strong enough to adhere to the surface of the skin [25].

The addition of gelatin to the dry rub fastness base coat solution showed no fading. This is because the binder as a film-forming material has the function of binding the materials in the finishing process so that the material will stick to the surface of the skin [26]. Discoloration can also be corrected by adding a top coat [27]. The higher the amount of binder used, in this case, gelatin, the stronger the ability to bind the finishing materials so that the skin does not experience discoloration. The top coat solution determines the final appearance and grip of the leather surface [4].

Plating treatment with 90°C heat treatment also affects the skin and does not fade. Heat in the plating treatment helps to flatten the formed film layer, so that the film layer becomes compact and permanent and is resistant to rubbing [28]. The rubbing fastness of the wet cloth was the same for all treatments including the control, which was 3/4 (medium/slightly faded). This could be because the binder used is a water-soluble protein binder. When rubbed with a wet cloth, the film layer that is formed is wet so that the bonded finishing material is not tightly bound and does not stick to the skin surface. This condition causes the skin to experience discoloration when tested with a crock meter. The rub fastness resistance for wet fabrics is because the biopolymer film may experience swelling, which tends to open and weaken the polymer structure causing the pigment to diffuse out [9].

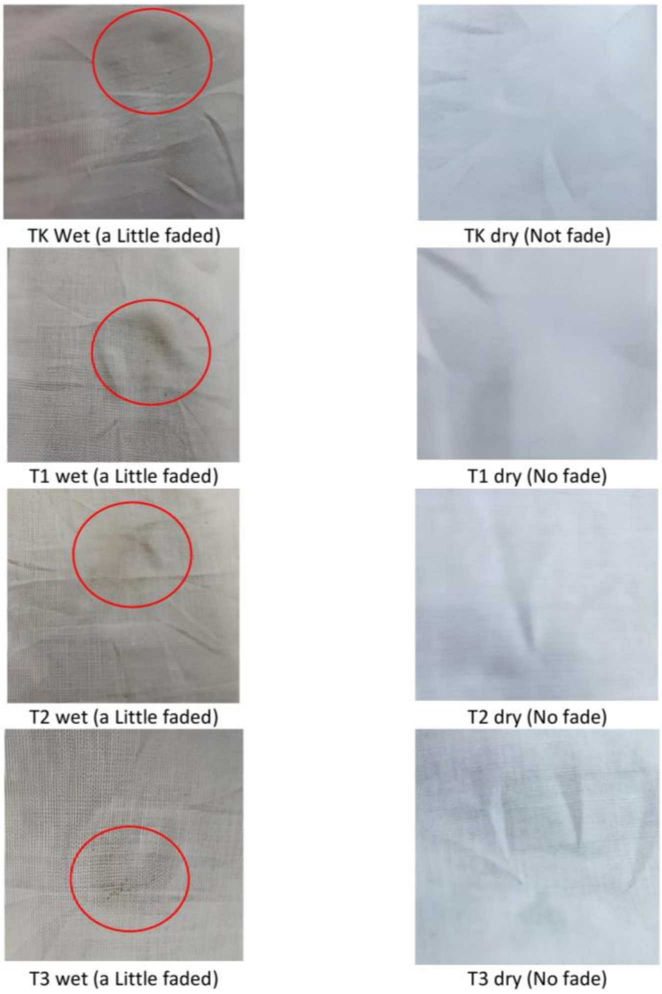

Figure 1. Test results for rubbing fastness of tanned rabbit skin
TK wet = Addition of 70 parts casein to wet rubbing fastness
TK dry = Addition of 70 parts casein to dry rubbing fastness
T1 wet = 50 parts addition of gelatin on wet rubbing fastness
T1 dry = 50 parts addition of gelatin on dry rubbing fastness
T2 wet = 70 parts addition of gelatin on wet rubbing fastness
T2 dry = 70 parts addition of gelatin on dry rubbing fastness
T3 wet = 90 parts addition of gelatin on wet rubbing fastness
T3 wet = 90 parts addition of gelatin on dry rubbing fastness

Softness

The addition of different gelatin to the base coat solution had a significant effect on the softness of the tanned rabbit skin ($P<0.05$). Table 3 shows that the more gelatin is added to the base coat solution, the lower the laxity. This is because the more gelatin is added the thicker the finishing layer will be, causing the skin to stiffen and reduce its flexibility. According to Smiechowski *et al*. (2014), skin laxity depends on skin thickness to a small extent [29]. These results indicate that the addition of gelatin to the base coat solution affects the thickness of the finishing layer. The role of gelatin in this case is as a binder that binds chemicals to the finishing solution so that the finishing material can adhere firmly to the skin and this will affect the skin's elasticity. A mixture of binders and finishing materials including pigments has a supple and flexible effect on the skin [30, 31]. Meanwhile, a combination of binders and finishing materials can provide adhesion, softness, and flexibility to the skin [32]. Control treatment (TK) using casein 70 gave almost the same or not significantly different ($P>0.05$) with T1 using 50 parts gelatin. This shows that gelatin can replace casein with a smaller amount and can produce the same parameter values as casein. Softness is directly proportional to elongation, the higher the percentage of elongation, the higher the softness. The results of the rabbit skin elongation test showed that the more gelatin was added to the base coat solution, the lower the elongation, as well as the lower the skin softness test results.

CONCLUSIONS

Gelatin as a protein binder added to the base coat solution in the finishing process of rabbit skin can be used to replace casein. The use of gelatin up to 70 parts as a protein binder in a rabbit skin finishing solution has been able to replace casein as a control treatment. Variation in the amount of gelatin used as a binder in the finishing process showed a significant effect on all parameters, namely drop test after base coat solution, tensile strength, elongation, water absorption 2 and 24 hours, rubbing fastness, and skin softness with a 25 cm ring and had no effect on the drop test before the base coat.

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