FUR SKIN – A VALUABLE MATERIAL, CONSIDERATIONS ON QUALITY ASSESSMENT

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ABSTRACT. This work is intended to reveal the most important physico-chemical and physico-mechanical characteristics of the fur skins that determine their quality. Values of these characteristics are discussed as depending on the semifinished product related to technological significance and consequence for the user. The main characteristics and values for fine furs are proposed, thus providing some guidelines in evaluating their quality. Investigations in this field can lead to the determination of some new quality characteristics of woolen sheepskins and fine furs. A case study on fine and common furskins is presented and reveals the uniqueness and versatility of the combination of two protein layers, represented by natural furs, composed of collagen and keratin, unmatched by any synthetic material.

KEY WORDS: woolen sheepskin, fine furs, quality evaluation

BLĂNURILE – MATERIAL VALOROS, CONSIDERAȚII ASUPRA EVALUĂRII CALITĂȚII

REZUMAT. Această lucrare are ca scop să prezinte cele mai importante caracteristici ale blănurilor care definesc calitatea acestora. Valorile acestor caracteristici sunt discutate în funcție de modul lor de prelucrare și domeniul de utilizare al produselor semifinite. Principalele caracteristici și valorile acestora pentru blănurile nobile sunt propuse, oferind astfel câteva repere în evaluarea calității acestora. Cercetările în această direcție pot conduce la identificarea unor noi caracteristici cu potențial de utilizare crescută a produselor finite. Un studiu de caz asupra blănurilor nobile și comune este prezentat și dezvăluie unicitatea și versatilitatea combinației dintre două proteine, colagenul și cheratina, neegalată de niciun material sintetic.

CUVINTE CHEIE: blănuri de ovine, blănuri nobile, evaluarea calității

LA FOURRURE – MATÉRIAU DE VALEUR, CONSIDÉRATIONS SUR L'ÉVALUATION DE LA QUALITÉ

RÉSUMÉ. Cet article présente les caractéristiques les plus importantes des fourrures qui définissent leur qualité. Les valeurs de ces caractéristiques sont discutées en fonction de leur transformation et du domaine d'utilisation des produits semi-finis. Les principales caractéristiques et valeurs des fourrures nobles sont proposées, donnant ainsi quelques repères pour évaluer leur qualité. La recherche dans ce sens peut conduire à l'identification de nouvelles fonctionnalités avec un potentiel d'utilisation accrue des produits finis. Une étude de cas sur les fourrures nobles et communes est présentée et révèle l'unicité et la polyvalence de la combinaison de deux protéines, le collagène et la kératine, inégalée par toute matière synthétique.

MOTS CLÉS : peau de mouton, fourrures nobles, évaluation de la qualité

INTRODUCTION

Fur skin production is one of the oldest human activities, remaining largely traditional in many regions worldwide. Recent archeological discoveries and analyses [1] showed that leather and fur skins clothing has been processed for 120,000-90,000 years. Apart from the climate hostility, the symbolistic and ornamental clothes were the main functions of animal skin clothes. The bone tools for animal skinning were found and identified next to sand fox, golden jackal, and wildcat remains. It is known that 120,000 years ago, 67 vertebrate species of animals were hunted for meat and hide in North Africa. It can be concluded that food procurement was always connected to the processing of hides or skins in imputrescible materials for clothes, contributing to the survival of the human species.

Fur wearing knew different social significance in historical human development eras, from efficient material for cold protection to decorative accessory for social status expression [2].

Nowadays wild furs (beaver, raccoon, muskrat, sable, coyote, red fox, lynx, cat lynx, marten, otter, wolf, wolverine and black bear) represent 15-20% of the traded fine fur skins and are hunted under programs set by governmental authorities in agreement with environmental biologists [3]. The most important fine fur skin production is generated by intensive breeding of minks, foxes, chinchilla, swakara and rabbit, especially for luxury goods [4]. The fine fur skins

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durability depends on the animal species [5], the most durable being water animal fur skins (the otter has the coefficient 100%), followed by mink (70%), marten (65%), karakul and sable (65%), muskrat, red fox (50%), blue fox (40%), chinchilla and farm rabbit (20%) and hare (5%). The main important farming producers are Denmark, Finland, the Netherlands, Poland, and China.

Woolen sheepskins represent more accessible and popular furs, traditionally produced in countries with developed animal husbandry sectors, like UK, Spain, Romania, Greece, France, Italy, etc. [6]. Fur skins are recognized as irreplaceable materials due to their unique resistance to water, thermal insulation, hygienic transfer of water vapors from inside to outside, and natural aspect [7]. The use of wild Canadian bear skins in royal army caps from UK, Belgium, Canada; karakul or merinos fur skins for collars or caps of the ceremonial or regular army are a few examples of fur skins uniqueness. The ethical aspects of fur skins wearing transcend the animal protection issues (hunting regulations, protected species, life quality of intensively grown animals) and rich global issues such as regenerative agriculture [8]. Fur skin production could be divided into the area of the woolen sheepskins – the most widespread and popular, and fine fur skins – very diverse and valuable. The present problems of competition, consumer protection, and quality assurance, as well as ecological ones, also call for this area of activity to find some specific methods for quality quantification and attestation. In this context the paper's aim is to point out some aspects of fur skin quality, which can be useful for scientists, state regulators, producers and commercial agents.

Quality Control of Fur Skins

The most important factors influencing the fur skin quality could be classified in factors during animal life (*in vivo*) and factors during fur skin processing (*in vitro*), all being summarized in Figure 1. Figure 1 shows that when estimating the quality of the processed fur skins, a lot of factors are influencing its level. The control of shown processing stages could ensure the manufacture of high-quality products. With woolen sheepskins, the relationship between hair fineness and leather strength is often in an inverse ratio ordering the end destination of the woolen sheepskin to the assortments processed on the leather or on the wool. Suede shearlings are usually made from coarse woolen skins, but have a strong leather able to undergo the buffing.

Final quality control for these woolen skins consists of organoleptically assessing the leather (elongation, softness, feel, fullness), the wool (fineness, defaulting level, hair length, individualization level of hairs, etc.), physical-mechanical, chemical tests, and by assessing the usable area. Physical-mechanical and chemical tests revealing the quality of suede shearlings and standardized values to the semifinished products are shown in Table 1 [8].

Table 1 presents tests mostly applied to leather, which must show good levels for elongation at break and load at the tensile break, stitch-tear strength, or tear strength so that it would be suitable for manufacturing clothes. The values for shrinkage tests, as well as the amount of chrome oxide, show the tannage level for these assortments and provide for the dimensional steadiness during processing. Wool dye manufacturers [9] suggest even higher values for these characteristics for tone-in-tone assortments requiring wool dyeing at 60-65°C.

The final appearance of the wool cover depends highly on the defaulting level and finishing method. Tests for to-and-fro rubbing fastness of leather dyeing, and colour fastness to water spotting are also particularly important for clothes durability. Fat and total ash levels in leather could give information about the final weight of fur clothes, which is an important characteristic for wearers' comfort. The pH of the aqueous extract ensures the clothes manufacturer and wearer that no undesirable acid hydrolysis phenomena will take place, which could affect the stitch strength. The test for wetting fastness requires slightly hydrophilic leather, allowing the fur clothes to be worn in rain without straining. Water repellency of nappalan fur skins (dermal layer covered with film forming polymers or with transfer foils) clothes as well as their soil repellency are very much appreciated as more durable and comfortable versions for dynamic persons. For woolen sheepskins processed on wool, the quality control is made organoleptically by assessing the look of leather (softness, bending resistance, fullness, elongation, smoothness, thickness, etc.), wool (hair length, felting level, gloss, individualization of hair, etc.), usable area, by physical-mechanical and chemical tests (Table 2) [9].

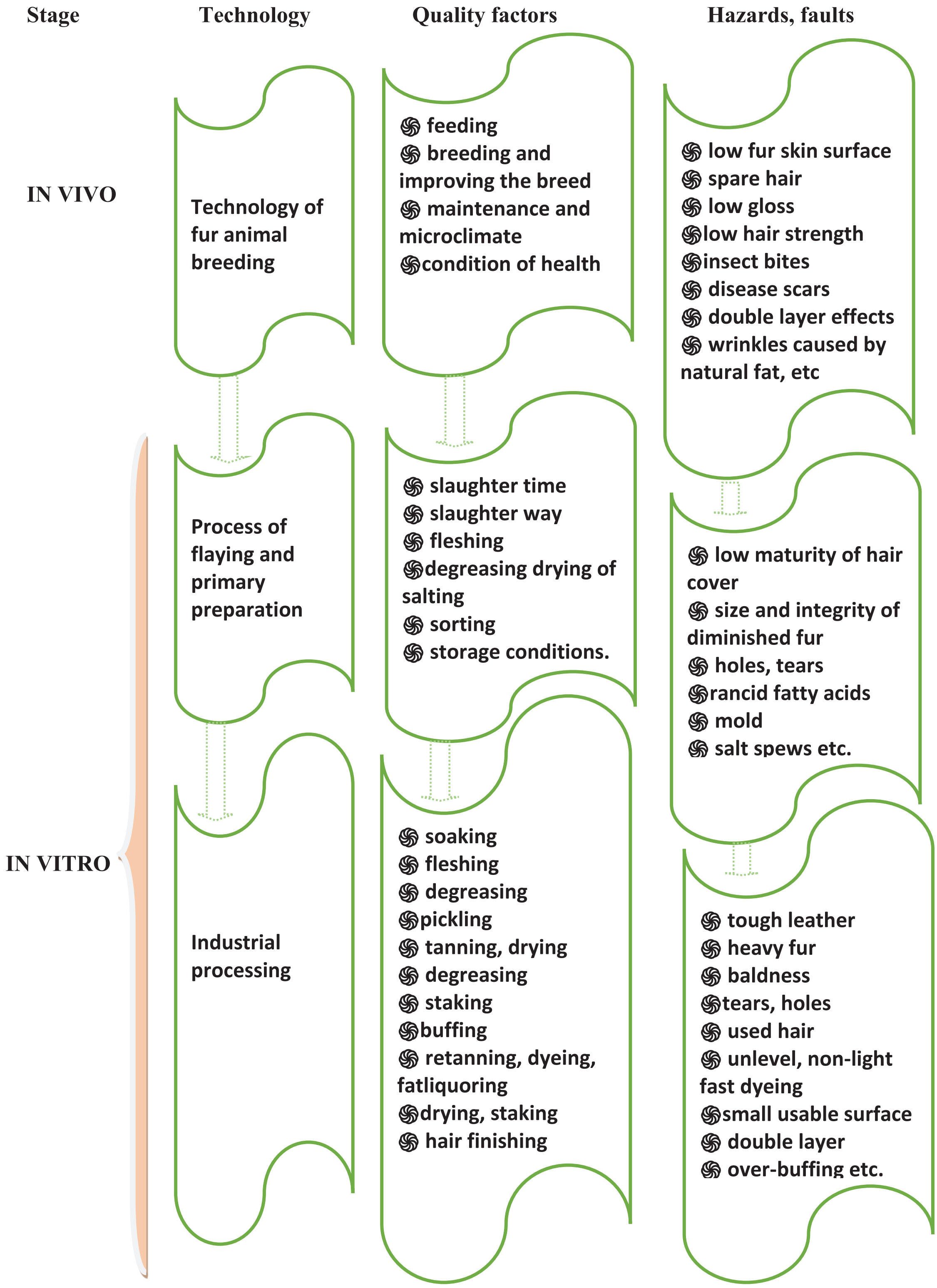


Figure 1. Diagram of *in vivo* and *in vitro* quality factors for fur skins

Table 1: Physical-chemical and physical-mechanical characteristics for shearling suede sheepskins

Characteristic	Admissible value	Method
Load at tensile break, longitudinal (N), min	100	ISO 3376
Load at tensile break, transversal (N), min	70	ISO 3376
Load at tensile crack of surface (N), min	40	ISO 3376
Elongation at break, longitudinal (%), min	40	ISO 3376
Elongation at break, transversal (%), min	45	ISO 3376
Elongation at 30N stress (%), min	20	ISO 3376
Stitch-tear resistance (N), min	30	ISO 23910
Tear load (N), min	15	ISO 3377-2
Pull strength (N), min	Good	Manual from 4 points
Colour fastness to to-and-fro rubbing (colour change and staining), 20 dry white felt cycles: - colour change of the leather, min - the staining of the felt, min	 4-5 3	ISO 11640
Colour fastness to water spotting	No halo after 14 h	ISO 15700
Shrinkage temperature (°C), min	80	ISO 3380
Boiling test at 80°C (%), min	5	IUP 24
Volatile matter (%), max - in leather - in wool	 14 10	ISO 4684
Total ash (%), max	5	ISO 4047
Cr_2O_3, (%), min	1	ISO 5398-1
Aqueous extract pH, min	4	ISO 4045
Dichloromethane extractable substances (%), max: - in leather - in wool	 7-16 2	ISO 4048

Table 2: Physical-chemical and physical-mechanical characteristics for woolen sheepskins processed on wool

Characteristic	Admissible value	Method
Load at tensile break, longitudinal (N), min	110	ISO 3376
Load at tensile break, transversal (N), min	80	ISO 3376
Load at tensile crack of surface (N), min	40	ISO 3376
Elongation at break, longitudinal (%), min	45	ISO 3376
Elongation at break, transversal (%), min	50	ISO 3376
Elongation at 30N stress (%), min	21	ISO 3376
Stitch-tear resistance (N), min	25	ISO 23910
Tear load (N), min	15	ISO 3377-2
Pull strength (N), min	Good	Manual from 4 points
Colour fastness to to-and-fro rubbing (colour change and staining), 20 dry white felt cycles: - colour change of the leather, min - the staining of the felt, min	 4-5 3-4	ISO 11640
Wool colour fastness to light: - colour change of the wool, min - colour change of the textile, min	 6 3	ISO 105-B02

Shrinkage temperature (°C), min	80	ISO 3380
Volatile matter (%), max - in leather - in wool	 14 10	ISO 4684
Total ash (%), max	4	ISO 4047
Cr_2O_3, (%), min	1	ISO 5398-1
Aqueous extract pH, min	4	ISO 4045
Dichloromethane extractable substances (%), max: - in leather - in wool	12 2	ISO 4048

Table 2 shows that the admissibility levels are similar to those for shearling suede, some slightly higher levels are noted for break tests, thus revealing a derma structure closer to native structure, able to orientate itself in the stress direction because of the simpler technology and less interfibrillarily deposited chemical auxiliary materials.

More attention is paid to the dyeing fastness tests for wool where the rating 6 (for dark shades) assumes a severe dyestuff selection. Oxidizing dyestuffs, which could be a possible hazard for wearers, are not allowed.

Quality control for karakul fur skins is made by assessing the quality of wool cover (curling characteristics, shape, uniformity, density, strength, colour, gloss, elasticity, and fineness), leather (extensibility, suppleness, smoothness, defaulting level, size), the type and size of faults and physical-mechanical and chemical tests. Physical-mechanical and chemical characteristics and admissible values for karakul fur skins are shown in Table 3 [10].

Table 3: Physical-chemical and physical-mechanical characteristics for karakul and half-breed karakul fur skins

Characteristic	Admissible value	Method
Load at tensile break, longitudinal (N), min	40	ISO 3376
Load at tensile break, transversal (N), min	30	ISO 3376
Load at tensile crack of surface (N), min	20	ISO 3376
Elongation at break, longitudinal (%), min	40	ISO 3376
Elongation at break, transversal (%), min	40	ISO 3376
Elongation at 30N stress (%), min	18	ISO 3376
Stitch-tear resistance (N), min	30	ISO 23910
Tear load (N), min	6	ISO 3377-2
Colour fastness to to-and-fro rubbing (colour change and staining), 20 dry white felt cycles: - colour change of hair, min - the staining of the felt, min	 5 3	ISO 11640
Wool colour fastness to light: - colour change of the wool, min Wool colour fastness to light and weather: - colour change of the wool, min	 4 4	ISO 105-B02
Shrinkage temperature (°C), min	80	ISO 3380
Volatile matter (%), max - in leather - in wool	 14 10	ISO 4684
Total ash (%), max	5	ISO 4047
Cr_2O_3, (%), min	1.5	ISO 5398-1

Aqueous extract pH, min	4	ISO 4045
Dichloromethane extractable substances (%), max: - in leather	10-16	ISO 4048

The immature collagen structure of karakul skins brings about low break, tear and surface crack strengths. The constant light and weather fastness assure the wearer of a good behavior of the products made from these skins.

Regarding the fine fur skins, their small surface area, the high importance of the fur cover which has to be processed so as to preserve the native colour and integrity as much as possible, all these elements make the organoleptic assessment fundamental. One of the most important stages in assessing the quality of fine fur skins is in the raw stage when they are offered for sale in auctions. The Scandinavian classification system is one of the most appreciated systems from this point of view alongside other grading systems like Nafa, Kopenhagen Fur and Sojuzpushnina [12]. General characteristics like skin size, sex, colour shade and the quality of fur cover are important. The most important quality evaluating criteria for fur skins refer preponderantly to the fur cover: underfur density, guard hair length, the ratio of underfur to guard hairs, guard hair density, gloss, softness and resilience and finally the colour clarity. Sorting the fur skins and evaluating their quality when selling by auction are done by highly experienced persons. In this case, only the fur skin size can be measured by instrumental methods.

But this quality evaluation does not ensure the preservation of this level of quality after processing the fur skins. Therefore, it is recognized that hidden defects play an important role in the risks of fur processing. The processing of fine fur skins is made largely (95% of total fine fur skins) for assortments with fur outward and less for those with fur inward (nappalan, etc.). The native look of fur cover is generally kept by performing white tannages (without basic chrome salts imparting an unpleasant green shade) and a severe selection of fatliquoring and degreasing materials.

However, some unavoidable faults of fur cover, also the fashion requirements impose an elevation of their quality by dyeing or shearing. In this case, the rubbing, light and weather fastness of dyeing are very important properties for the wearer. A system for evaluating the fur skin quality must involve a minimum of physical-mechanical and chemical tests attesting and assuring the quality both for clothes manufacturers and wearers.

Thus, beside the organoleptic assessment which remains very important, we consider the following tests to be important:

- load at tensile break, longitudinal and transversal (ISO 3376) with recommended values of 14-50 N;
- shrinkage temperature (ISO 3380) with recommended values of 55-80°C;
- chromium oxide content (ISO 5398-1) with recommended values of 0.5-1.5%;
- volatile matter (ISO 4684) with recommended values of max. 14%;
- pH of aqueous extract (ISO 4045) with recommended values of min. 3.5;
- dichloromethane extractable substances from leather and hair (ISO 4048) with recommended values of 10-25% and maximum 2%, respectively;
- colour fastness to to-and-fro rubbing (ISO 11640) with recommended values of min. 3;
- artificial light and weather fastness (ISO 105:B02) with recommended values of min. 4.

For every type of fur skin, the allowable limits must be specified.

The requirements related to the wearer's health assurance have imposed a series of allowable limits for possibly hazardous substances. These characteristics and their limits are shown in Table 4.

Table 4: Hazardous substances in fur skin and their limits

Critical chemical substances	Admissible value	Method
Azo dyes (aryl amines), mg/kg, max	20	ISO 17234-1 and ISO 17234-2
Chlorophenols content, including isomers as applicable, mg/kg, max	0.5	ISO 17070
Formaldehyde, mg/kg, max	20	ISO 17226-1 and ISO 17226-2
Chromium VI, mg/kg, max	3	ISO 17075
Extractible heavy metals, mg/kg, max		ISO 17072-1
Cr	100	
Pb	0.8	
Cd	0.1	
As	0.2	
Hg	0.02	
Sb	5	
Co	1	
Cu	50	
Ni	4	
Zn	100	
Ba	100	
Se	100	
Dimethyl fumarate, mg/kg, max	0.1	ISO 16186
Organotin compounds, mg/kg, max	0.1	ISO 16179

MATERIALS AND METHODS

Four kinds of fur skins were purchased from fur skins producers: polar fox, dyed mink, woolen sheepskin processed on wool (Pannofix type) and suede shearling sheepskin. The fur skins were analyzed by standard methods for physical-chemical, physical-mechanical and fastness tests according to methods in force. Scanning electron microscopy was performed using a FEI Quanta 200 microscope for showing the features of wool and hair morphologies for sheep skins and fine fur skins in correlation to wearing characteristics. Wearing tests were performed according to a method described in STAS 13134 based on the initial and final weighing of fur skins rubbed on the fur. The results are expressed in percentages and the higher the value, the lower the wear resistance. These results were correlated with cystinic sulfur content of wool or hair analyzed according to SR 13206. Other tests were performed for water vapour absorption behavior determination and light resistance of fur skins at 96% relative humidity (Binder MKF 56) in order to evaluate the wearing performances of different fur skins, according to ISO 4684 and ISO 105-B02 methods.

RESULTS AND DISCUSSIONS

Research on Fur Skin Quality Control – A Case Study

Four kinds of fur skins were assessed with the final aim of understanding the correlation of structural and processing characteristics with chemical, mechanical, and wear properties. The selected furs skins were: polar fox, mink, suede sheepskin, and wool-on sheepskin. The main physical-chemical characteristics presented in Table 5 show the high diversity of structural and processing-specific properties. The high content of ash suggests that the fur skins have a high weight.

Table 5: Chemical characteristics of fine fur skins, suede, and wool-on sheepskins

Fur skin	Moisture	Ash	Fat extract	Metal oxides	Cr_2O_3	pH of extract
Polar fox	11.16	6.78	18.08	3.00	1.04	4.1
Mink	16.60	5.53	22.08	2.60	0.74	4.8
Wool on sheepskin	11.26	5.23	14.88	4.82	3.08	4.1
Suede Fur sheepskin	13.53	3.82	10.02	3.42	2.21	4.1

Table 6 shows that wool on sheepskin has values for most of the physical-mechanical tests under admissible limits, while mink and fox fur skins show very high values (with exception of tear load of polar fox fur skin).

Table 6: Physical-mechanical characteristics of fine fur skins, suede, and wool-on sheepskins

Fur skin	Load at tensile break, longitudinal, N	Load at tensile break, transversal, N	Tear load, N	Stitch-tear resistance, N
Polar fox	140	55	5	25
Mink	192	72	17	33.7
Wool on sheepskin	30	14	6	32.2
Suede Fur sheepskin	100	144	19.5	46.7

The correlation of cystinic sulphur of wool and hair [13] with wear fastness [14] (STAS 13134) of different processed woolen sheepskins and fine furskins (mink, polar fox) showed a good correlation as it can be seen in Figure 2. Higher value of wear fastness means low wear resistance and higher wool/hair deterioration. In Figure 3 a comparison of sulfur cystinic of degreased raw wool, woolen-sheepskin and suede sheepskin demonstrates that the higher the degree of wool processing, the lower the cystinic sulfur content. It is known that the woolen sheepskins are intensely processed on wool with acid, aldehydes, alcohol solution at high temperatures for getting a very straight, defibrated and bright wool. These kinds of fur skins are made from fine wool breeds of sheep such as merinos. Scanning electronic microscopy images of wool/hair of studied fur skins confirm the more degraded state of woolen sheepskins as compared to the other fur skins (Images 1- 4).

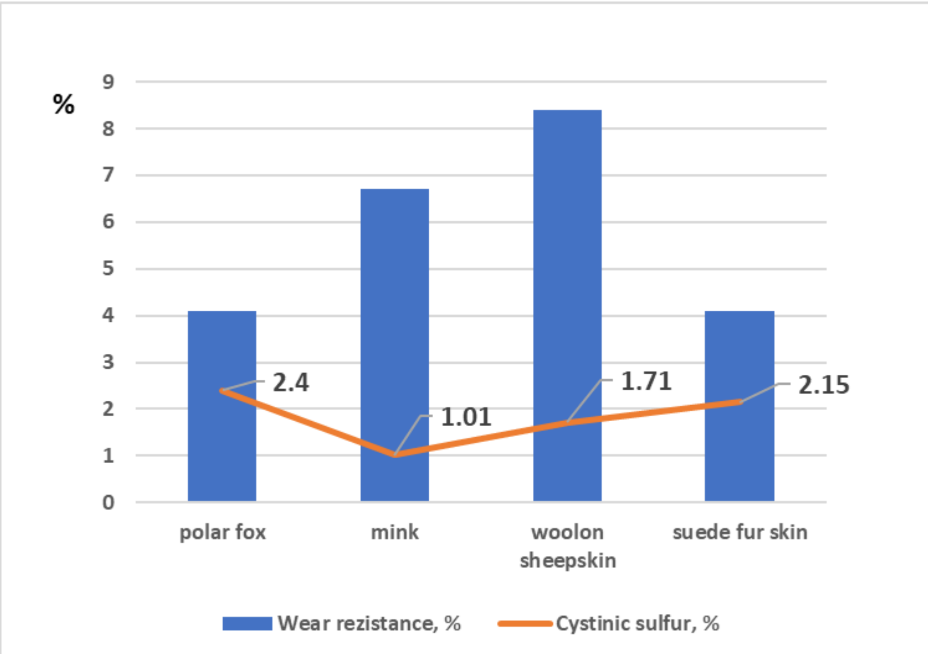


Figure 2. The correlation of wear resistance with cystinic content of wool/hair

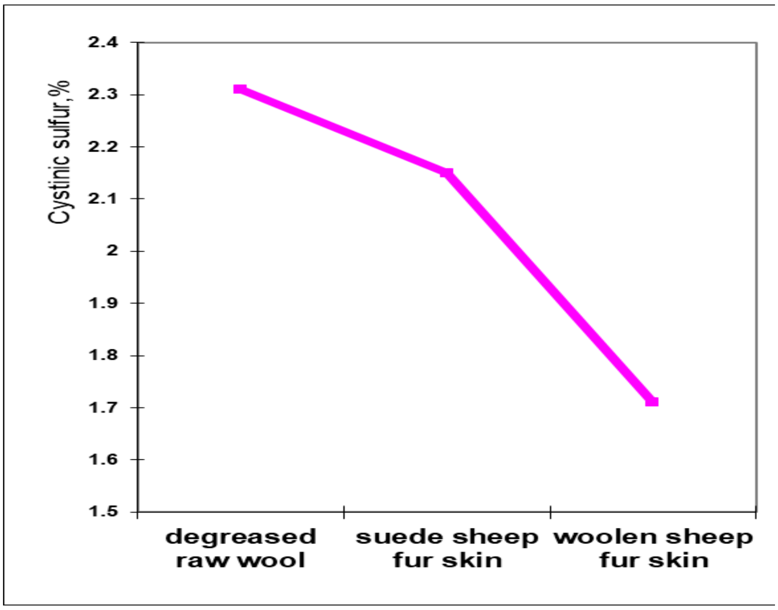
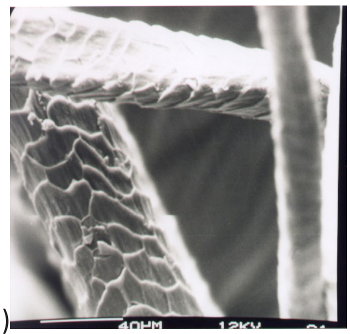
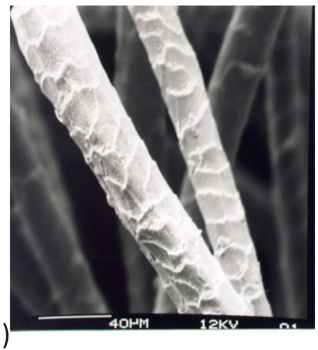
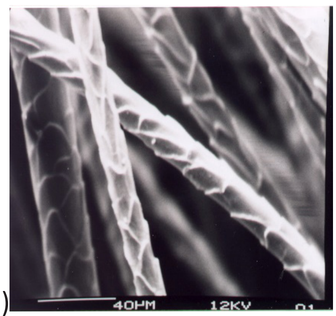


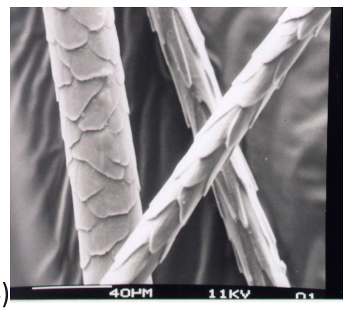
Figure 3. Cystinic sulfur as a function of wool processing degree

A study on the behavior of fur skins in humid atmosphere revealed that the fur skins with long hair can protect the wearer from moisture absorption and cold feeling. It is recognized that collagen, the main protein of dermal layer has the native property to absorb 50% water of its weight, as compared to keratin, with 30% water absorption ability. Different chemical auxiliary materials can change this native property. In Figure 4 it can be seen that the polar fox fur skin has the behavior against moisture very similar with hair behavior and dermis layer shows to be more hydrophilic. Figure 5 shows the woolen sheepskins behavior against moisture which is more stable due to the processing chemical materials with hydrophobic properties. Woolen sheepskin behavior is closer to dermis than to the wool due to the more consistent dermis layer and short wool length (15 mm).

1) 

2) 

3) 

4) 

Images 1-4. Wool of: 1 – suede sheep fur skins; 2 – woolen sheepskin. Guard and down hair of: 3 – polar fox; 4 – mink

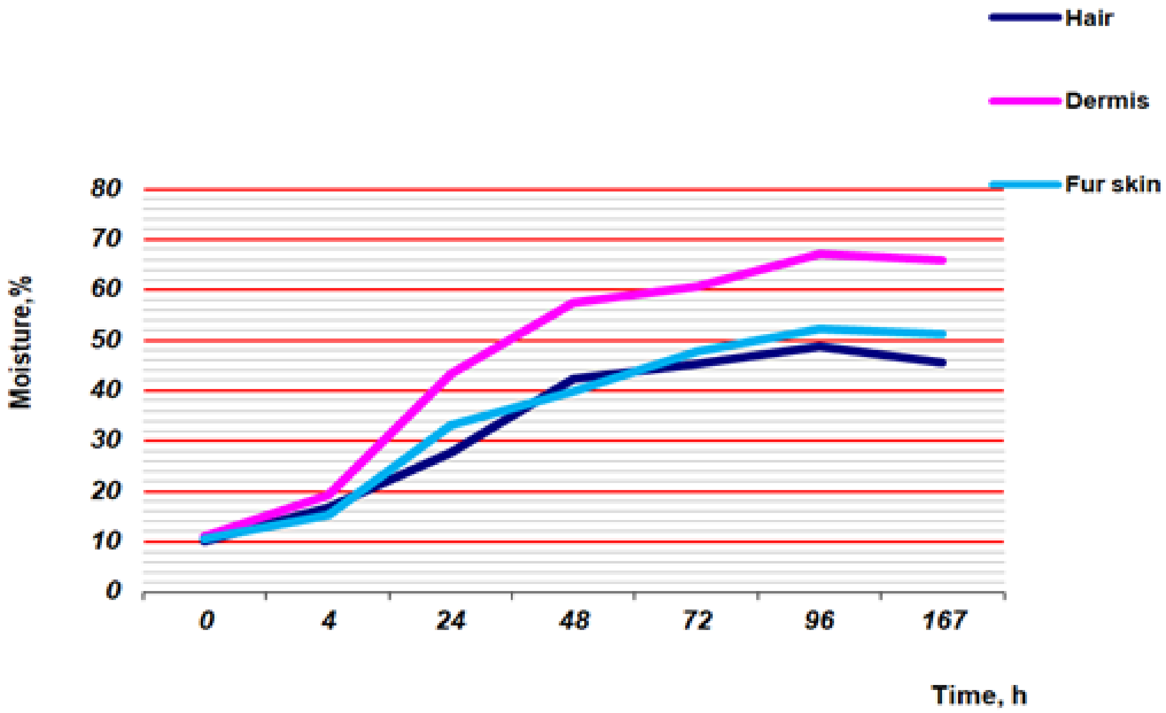


Figure 4. Polar fox hair, dermis and fur skin behavior against moisture (96% RH), over time

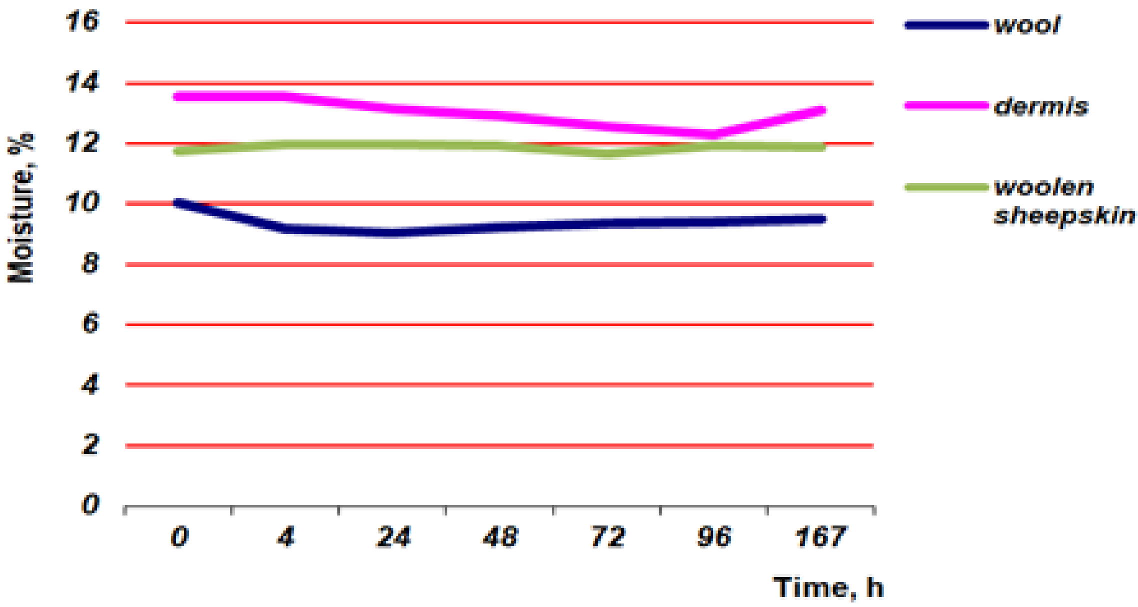


Figure 5. Wool, dermis and woolen sheepskin behavior against moisture (96% RH), over time

The influence of moisture on light fastness of fur skins is very important for clothes durability and quality. The polar fox furs are more sensitive to light when the moisture is high because they are not dyed as other fur skins whose resistance is excellent or very good (Figure 6).

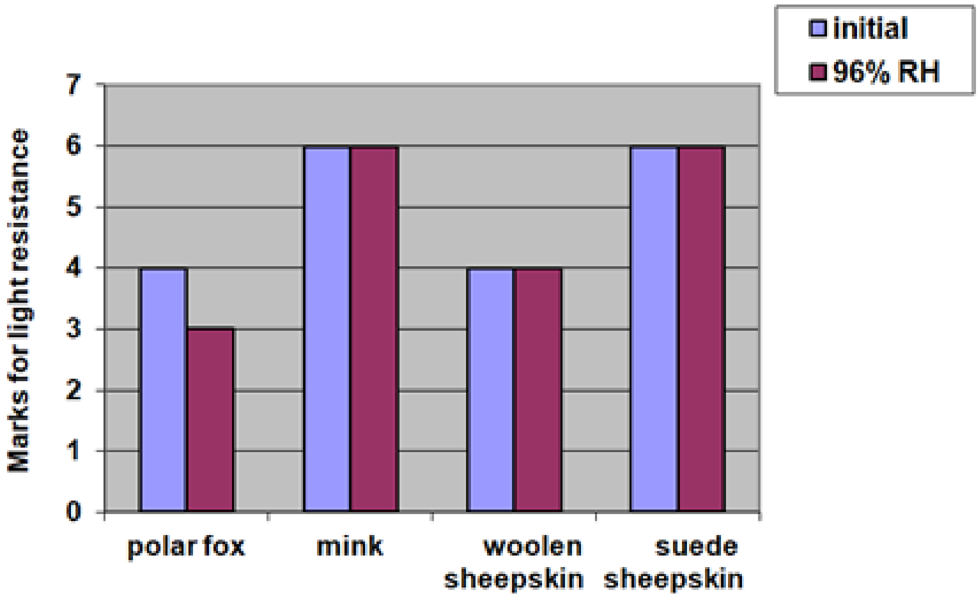


Figure 6. Light fastness of fur skins under the influence of moisture (96% RH)

Fine furs or sheep skins represent smart and versatile materials, a source of beauty and elegance, protection and durability. The responsible exploitation of fur skins from hunting, farming, slaughtering, tanning to post end of life represents an ecological activity, contributing to environmental and human protection and evolution. The scarce information on fur skin properties and research data on this material demands for more knowledge generation with the final benefits for legislative authorities, economical entities, consumers and science.

CONCLUSIONS

Investigations for quantification of fur skins quality will contribute prevailing empiric knowledge with modern requirements of quality assurance, consumer and environmental protection. A data base on fur skins quality assessment and values is needed for international standards elaboration, technical specifications in commercial transaction and consumer protection. The elaboration of commercial specifications will benefit from a recognized data base of information which can be useful for fur skin producers and traders.

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