(REFEREED RESEARCH)

# EFFECT OF DIFFERENT ATMOSPHERIC CONDITIONS ON SOME PHYSICAL PROPERTIES OF LEATHER

# ATMOSFERİK KOŞULLARDAKİ DEĞİŞİMİN BAZI DERİ FİZİKSEL ÖZELLİKLERİNE ETKİSİ


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**ABSTRACT**

In this study, the effect of conditioning under standard and tropical atmospheric conditions on physical properties of leather was investigated. For this purpose, garment sheep leathers were conditioned under standard atmospheric conditions of 23 °C ± 2 °C temperature and % 50 ± relative humidity suggested in TS EN ISO 2419, and under tropical atmospheric conditions of 27 °C ± 2 °C temperature and % 65 ± 5 relative humidity suggested in ISO/DIS 2419. Then, changes in leather physical properties were investigated statistically. According to results, for sheep leather conditioned under standard atmospheric conditions, percentage extension was 53.47 ± 4.10, Young's modulus was 77.32 ± 23.34 N/mm, double edge tear load was 38.03 ± 8.47 N, water vapour permeability was 6.18 ± 0.55 mg/cm2.h, while under tropical atmospheric conditions, percentage extension was 57.67 ± 5.36, Young's modulus was 69.42 ± 13.87 N/mm, double edge tear load was 43.06 ± 10.50 N, water vapour permeability was 6.61 ± 0.47 mg/cm2.h. The difference between these physical properties was determined to be statistically significant. Changes in tensile strength and single edge tear load were not significant.



**Key Words:** Leather, Temperature, Humidity, Conditioning, Physical properties.



**ÖZET**

Çalışmada, standart ve tropikal atmosfer koşullarında kondisyonlamanın bazı deri fiziksel özelliklerine etkisi incelenmiştir. Bu amaçla; giysilik koyun derileri TS EN ISO 2419'da önerilen 23 °C ± 2 °C sıcaklık, % 50 ± 5 nispi nemdeki standart atmosfer koşulları ve ISO/DIS 2419'da önerilen 27 °C ± 2 °C sıcaklık, % 65 ± 5 nispi nemdeki tropikal atmosfer koşullarında kondisyonlanmışlardır. Ardından bazı deri fiziksel özelliklerindeki değişimler istatistiksel olarak incelenmiştir. Araştırma sonuçlarına göre; standart atmosfer koşulunda kondisyonlanan koyun derilerinin uzama yüzdesi 53.47 ± 4.10, Young modülü 77.32 ± 23.34 N/mm, çift kenar yırtığı 38.03 ± 8.47 N, su buharı geçirgenliği 6.18 ± 0.55 mg/cm2.h olarak, tropikal atmosfer koşullarında ise derilerin uzama yüzdesi 57.67 ± 5.36, Young modülü 69.42 ± 13.87 N/mm, çift kenar yırtığı 43.06 ± 10.50 N, su buharı geçirgenliği 6.61 ± 0.47 mg/cm2.h olarak saptanmıştır. Bu fiziksel özellikler arasındaki farkın istatistiksel olarak önemli olduğu belirlenmiştir. Çekme mukavemeti ve tek kenar yırtığı değerlerindeki değişimin ise istatistiksel olarak önemli olmadığı tespit edilmiştir.



**Anahtar Kelimeler:** Deri, Sıcaklık, Nem, Kondisyonlama, Fiziksel özellikler.

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## 1. INTRODUCTION

Major climate changes and increasing temperatures around the world are among the vital problems affecting ecosystem directly (1). In the last century, earth's temperatures rose dramatically and it continues to rise (2-3). Today, almost half of the world population lives in tropical or subtropical areas. In these areas, where almost 3 billion people live, it is estimated that temperatures will rise on average between 1.5 and 4.5°C within the next 50 years due to global warning and climate change (4). Climate change will negatively affect the quality of life and it should be remembered that it changes the performance values of textile and leather goods widely used in our daily lives. Leather goods, unlike textile, do not have a homogenous structure, and these structural properties make leather goods different than other materials in terms of usage area and aesthetic properties, as well as physical and mechanical properties (5).

Performance values of finished leather exhibit differences according to usage area (upholstery shoes, garments, gloves etc.) (6). It is estimated that, due to its structure, leather's tensile and elasticity properties will be affected by changing atmospheric conditions more than other goods (7-10). It was reported in previous studies that temperature and humidity are important environmental factors that effect leather's structural properties.

For these reasons, what type of changes global warming will cause in physical properties of leather has been a subject of interest, and study of changes due to humidity and temperature in leather goods became necessary. At this point, the importance of conditioning circumstances of processed leather prior to physical tests becomes apparent. International committees on leather standards have reached some decisions for the investigation of this subject. In this study, the effect of standard and tropical climate conditioning on some properties of garment leather was investigated statistically.

## 2. MATERIAL and METHOD

### 2.1. Material

In this study, African origin garment sheep leather, processed with the same production recipe, with an average of 6-6,5 square foot belonging to the same party, was used.

### 2.2. Method

#### 2.2.1. Conditioning and physical tests

Garment sheep leathers were split in to two along backbone, and made into wings. Right wings were conditioned under stand atmospheric conditions recommended in TS EN ISO 2419 in 23 °C ± 2 °C temperature and % 50 ± 5 relative humidity (11). The left wings were conditioned under revised ISO/ DIS 2419 in 27 °C ± 2 °C temperature, % 65 ± 5 relative humidity (12). By doing this, it was aimed to identify the effect of two different conditioning circumstance on physical tests.

For laboratory analyses, sampling of leathers was carried out according to TS ISO 2418, thickness identification according to TS 4117 EN ISO 2589, single edge tear load TS 4118 EN ISO 3377-1, double edge tear load TS 4118 EN ISO 3377-2, determination of tensile strength and percentage extension according to TS 4119 EN ISO 3376, and determination of water vapour permeability was carried out according to TS EN ISO 14268 (13-18).

For the determination of tensile strength, percentage extension, single and double edge tear load, Shimadzu AG-IS, for the determination of water vapour permeability Satra STM 473 test instrument was used.

#### 2.2.2. Statistical analysis

Significant differences among groups were determined using t-test for paired two sample means at P ≤ 0.05 and P ≤ 0.01. Standard deviation of the mean (SD) was also calculated from the sixty replicates. All computation and statistical analyses were done using SPSS package version 16.0.

## 3. RESULTS and DISCUSSION

In previous studies, it was pointed out that environmental factors such as temperature, radiation and humidity are important factors affecting leather properties (8). It is thought that changes in environmental conditions resulting from global warming may bring about important changes in physical and mechanical properties of leather. In our study, the findings about differences in physical properties of leather due to atmospheric conditions are given in Figure 1.

Statistical analysis results of data obtained in our study are given as groups in Table 1.

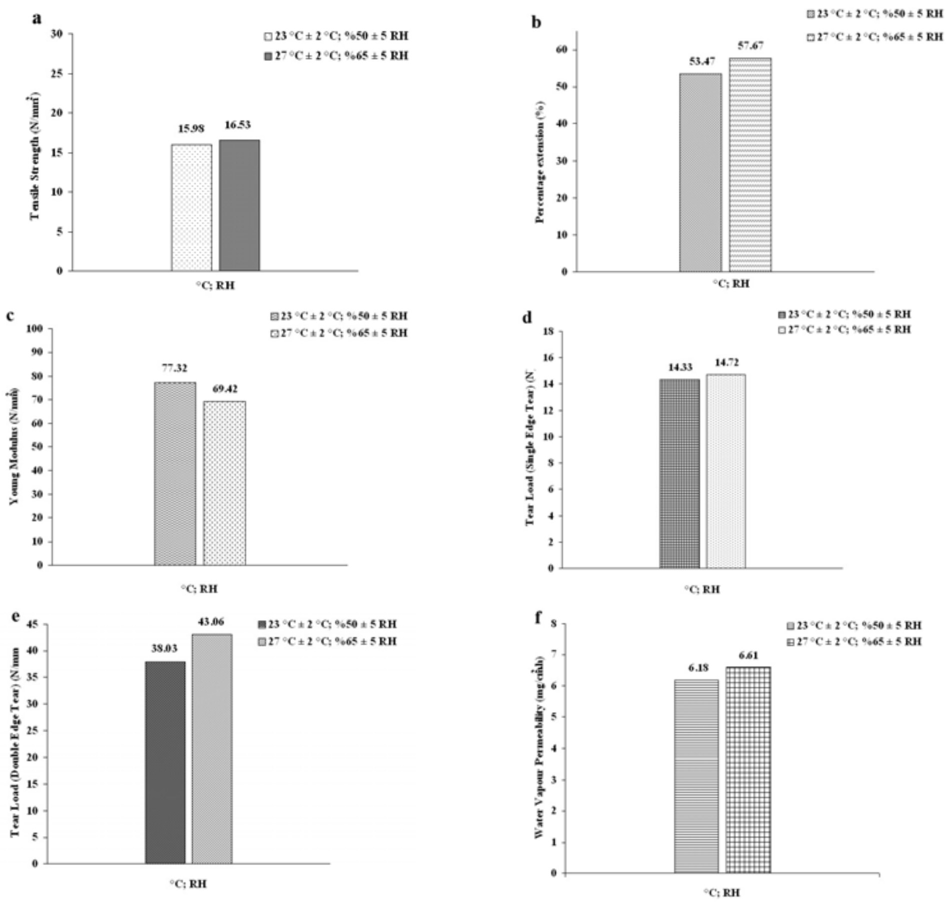


**Figure 1.** Changings in different atmospheric conditions (a: tensile strength, b: percentage extension, c: Young's modulus, d: single edge tear load, e: double edge tear load, f: water vapour permeability). Results are the means of sixty replicates samples ±SD.

**Table 1.** Statistical analysis of the results

| Conditioning | Tensile strength ($N/mm^2$) | Percentage extention (%) | Young's modulus ($N/mm^2$) | Single edge tear (N) | Double edge tear (N) | Water vapour permeability ($mg/cm^2.h$) |
|---|---|---|---|---|---|---|
| 23 °C ± 2 °C; %50 ± 5 RH | 15.98 ± 5.19 | 53.47 ± 4.10 | 77.32 ± 23.34 | 14.33 ± 2.64 | 38.03 ± 8.47 | 6.18 ± 0.55 |
| 27 °C ± 2 °C; %65 ± 5 RH | 16.53 ± 11.43 | 57.67 ± 5.36 | 69.42 ± 13.87 | 14.72 ± 3.03 | 43.06 ± 10.50 | 6.61 ± 0.47 |
| | NS | ** | * | NS | * | ** |

NS, *, **, Nonsignificant or significant at $P \leq 0.05$, or 0.01, respectively. Significant differences among groups were determined using t-test for paired two sample means at $P \leq 0.05$, or 0.01.

Change in leather condition under various humidity and temperature conditions can cause differences in mechanical behaviors and this affects behavior of leather products during use. In a study, it was determined that increase of humidity level caused decrease in leather color fastness and mechanical durability, whereas certain level of UV radiation along with increasing humidity caused improvement in leather color fastness and mechanical durability (8).

Milasiene (9) investigated the effect of environmental temperature on various mechanical properties of leather and established that temperature clearly affects the tensile strength and Young's modulus. According to his findings, temperature decrease alone, without taking into account the humidity factor, causes a decrease in tensile strength and Young's modulus.

Yıldırım et al. (10) investigated ageing behaviors of leather samples with protein based fibre structure against UV light and under various environmental conditions. By exposing test samples to environmental conditions of UV ligth at 50 °C, 50 °C / %70 humidity and -50 °C; they determined changes in tear load, tensile strength and percentage extension of leather. They found that, under environmental conditions of UV ligth at 50 °C and 50 °C / %70 humidity, as well as -50 °C, tear load of leather increased compared to control, while tensile strength and percentage extension decreased.

It was stated that tensile strength is one of the most important quality features of materials and that it plays an important role in properties and performance of manufactured goods (19-20). As seen in Figure 1, there is an increase in tensile strength parallel to increase in temperature and humidity factors in this study. However, this increase is not statistically significant (Table 1). It can be concluded that tensile strength can still increase parallel to increase in temperature and this increase could become statistically significant.

Yıldırım et al. (10) determined that percentage extension of leathers they aged under the environmental conditions of 50 °C and %70 humidity decreased compared to control sample. It can be seen in Figure 1 that there is change in the percentage extensions of leathers in various atmospheric conditions; percentage extensions of leathers increase with the increase of temperature and humidity, and this increase is statistically significant.

It can be seen in Figure 1 that there is a decrease in Young's modulus values with the increase in temperature and humidity values. This decrease was determined to be statistically significant (Table 1). It is thought that this obvious decrease in Young's modulus could be due to increase in flexibility of leather with parallel to increase in temperature and humidity, against constant force applied to leather in elastic zone.

As given in Figure 1 and Table 1, it was identified that there was an increase in single edge tear load with increase in temperature and humidity, but this increase was not statistically significant. The increase in double edge tear load, however, was statistically significant. The cause of increase in tear strength was thought to be the result of leather fibres moving freely and coming closer, consequently resisting to applied force as a whole (10).

In our study, it was determined that, with the increase in temperature and humidity, the increase in water vapour permeability of leather became statistically significant (Table 1). Since leather fibre has a hygroscopic structure, it can display various absorbsion and desorbsion features, depending on environmental conditions. When the humidity in the air is high, leather absorbs humidity; and when the humidity decreases, it releases humidity out by desorbsion. The change in the amount of humidity can cause changes in physical properties and mechanical behaviors of leather (21).

## 4. CONCLUSIONS

In this study, the effects of global climatic changes on usage performances of leather goods were investigated, and statistically significant differences were determined in percentage extension, Young's modulus, double edge tear load and water vapour permeability of garment leather conditioned under the conditions of 23°C ± 2 °C temperature, % 50 ± 5 relative humidity and 27 °C ± 2 °C temperature; % 65 ± 5 relative humidity. Consequently, it was concluded that various conditioning circumstances affect physical and mechanical properties of leather goods.

Because of fibrous lattice nature of its tissue, strength and flexibility of leather is affected significantly from changing atmospheric conditions. Considering that average temperatures will continue to rise in the coming years due to global warming, it is postulated that physical properties of leather may exhibit more changes as a result of environmental conditions. It becomes obvious that they should be taken into account when determining suggested quality values for processed leather and when regulating the conditions of test and analysis of leather. For these reasons, addressing the effects of various atmospheric conditions on processed leather in detail is very important in terms of determining useful life and performance values of processed leather goods.

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Textile Machinery

## German Technology for the Vietnamese Textile Industry – Online registration for conference in Ho-Chi-Minh City

Frankfurt / Main, 22 February 2011 - On initiative of the VDMA Textile Machinery Association, the conference and exhibition “German Technology for the Vietnamese textile industry” will take place in the New World Hotel in Ho-Chi-Minh City on 6 and 7 April 2011. The symposium is officially supported by the German Ministry for Economics and Technology as well as by AGTEK, the Association of Textile and Apparel in Ho-Chi-Minh City.

The two-day event themed “Innovation for successful business” will present machinery and technology solutions comprising all fields of the textile chain. In about 20 lectures, German textile machinery manufacturers will report about their latest developments and technical innovations that enable textile producers in the region to enhance their position in the world market.

Decision makers from the Vietnamese textile industry have the unique chance to find out about current developments and technical innovations to meet the increased request for quality products. The use of modern textile technologies results in lower production costs as well as reduced energy consumption and material use.

Throughout the last years, Germany has been one of the main exporters to Vietnam. After two difficult years, the exports picked up again in 2010. From January to November 2010, German exports of textile machinery to Vietnam increased by almost 84 % to 27 million EU27 million EUR compared with the respective period in 2009. The Vietnamese demand for German textile technology has been particularly strong since August 2010.

The Textile Machinery Association within VDMA (German Engineering Federation) is looking forward to welcome all interested companies and organisations to the event. The participation is free of charge. All information about the symposium as well as the registration sheet is available on **www.cotex-vietnam.german-pavilion.com**.