COMPARATIVE STUDY OF THE SURFACE PROPERTIES FOR SOME DIFFERENT TYPES OF LEATHER FINISHES

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A surface characteristic of leather is an important parameter in shoe industry. During the usage, the surface of shoes is the main barrier against the environment (mostly water). The macroscopic and microscopic evaluation is useful to see the surface aspect (surface defects, continuity of finish, cracks). Test for hydrophilic/hydrophobic activity is important for the leather. In this way we can estimate if the finishing touches absorb or repel the water. Microbiological test is also important, because during an intense usage, inside the shoes are released a lot of chemicals through foot perspiration that can provide a perfect environment for development of mold and bacteria in the main structure of the shoe. The samples for this study will be five bovine leathers with different finishes.

Keywords: leather, hydrophilic/hydrophobic activity, microbiologic activity

INTRODUCTION

Leather industry produces a material that can be used in different other fields. One of these fields is footwear manufacturing. As we know, shoes are products with intense usage and if we take this in mind, we understand that all the components of a shoe must have some specific characteristics. Because leather is the main component that stands between the foot and the exterior environment, surface characteristic of leather is an important parameter (Serenko *et al*., 2014). From the start, we must assess the surface status, in order to be sure that it does not have any structural or/and mechanical defects such as holes, uneven continuity of finish, cracks so in this way, the microscopic evaluation of the samples will be performed. Permanent usage of shoes exposes them to water, that can, in time, infiltrate into the layers of leather and after a while deteriorate the inner structure of leather (Serenko *et al*., 2014) and finally destroy it. The hydrophilic/hydrophobic activity is an important test for the leather. It is possible to estimate if the finishing touches absorb or repel the water (Leroux and Leising, 2014). The deterioration of a shoe does not come only from the exterior. Our feet secrete perspiration (Orlita, 2004), the perfect liquid, full of chemicals, perspiration that can provide a perfect environment for development of mold and bacteria in the main structure of thr shoe (Oruko *et al*., 2019). The samples for this study will be five bovine leathers with different finishes.

MATERIALS

Nutrient agar and nutrient broth were purchased from Novachim (Bucharest, Romania). *Staphylococcus aureus* (S. aureus, ATCC 6538), *Escherichia coli* (E. coli, ATCC 10536), *Klebsiella pneumoniae* (ATCC Klebsiella pneumoniae ATCC 4352) were purchased from Novachim (Bucharest, Romania). Leather samples were prepared from cow hide leather tanned in our institute’s pilot station.

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METHODS

Microscopic determination - S8AP0 stereomicroscope (LEICA) – it was used for surface evaluation of samples.

The dynamic contact angle modification for water was measured using a contact angle analyzer - VCA Optima XE.

Microbiological test was performed using ISO 16187:2013 standard - Footwear and footwear components. Test method to assess antibacterial activity.

RESULTS

Macroscopic test of samples – Figure 1 – provides information regarding the leather aspect and due to the different surface pattern, it is possible to estimate a potential destination for the final product. The samples P1, P2 and P3 have uniform pattern colors that recommend these leathers to be used in a small area of product. Still, P3 possesses a shiny aspect, that can be exploited on a much larger area. P4 and P5 have a graphical motif, lending itself to application on a larger surface.

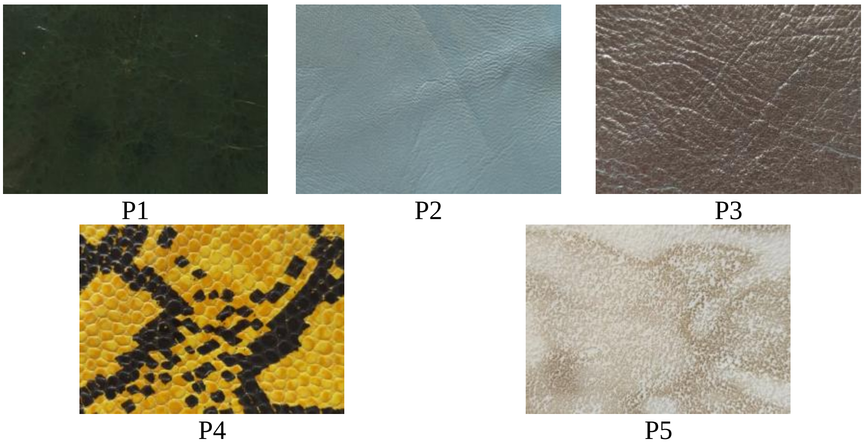

Figure 1. Macroscopic aspect of leather samples

Microscopic images – Figure 2 – have been made using 20 x magnifications for all analyzed samples. In this way we can see that the surface is smooth, no cracks or defects are present on the surface. Because of this observation, all leathers can be used to obtain footwear uppers.

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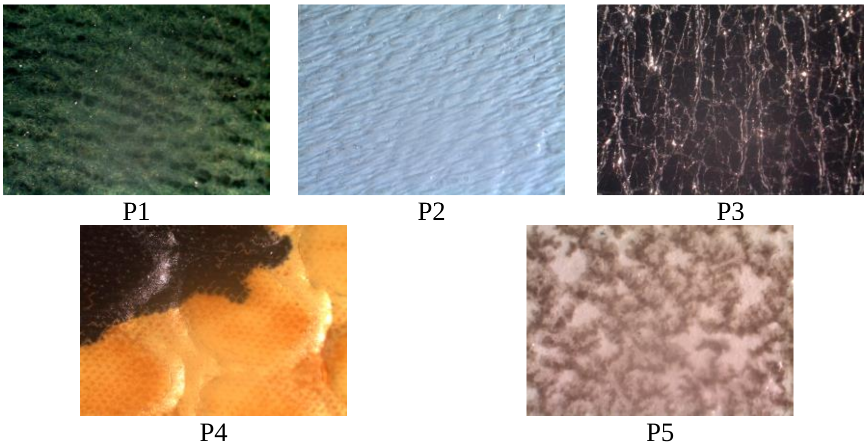

Figure 2. Microscopic aspect of leather samples

Water contact angle test provides the information regarding the ability of water to wet the leather sample – Figure 3. Depending on the angle of water droplet, we have tree aspects:

- 0° - 90° - surface is wettable, **hydrophilic surface**;
- 90° - 180° - surface is not wettable, **hydrophobic surface**;
- close to 180° - **ultrahydrophobic surface -** completely liquid-repellent, lotus effect.

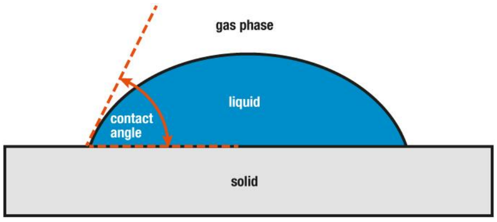

Figure 3. Contact angle example

In order to see the water behavior on leather samples the VCA Optima XE analyzer was used. Results of the individual tests are displayed in Table 1.

Table 1. Contact angle of leather samples

No.	Sample	ca, °
1	P1	92.74
2	P2	103.17
3	P3	99.59
4	P4	116.63
5	P5	102.14

A graphical representation of contact angle is seen in Figure 4. Based on information provided regarding the contact angle, all the samples are hydrophilic. We can see that the samples P1, P3, P5 and P2 have values close to 100° (92.74°, 99.59°, 102.14°,

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103.17°) and this indicates that they can provide some protection against water. On the other hand, for sample P4 an angle of 116.63° was recorded, which tells us that the leather finish will provide very good protection against water.

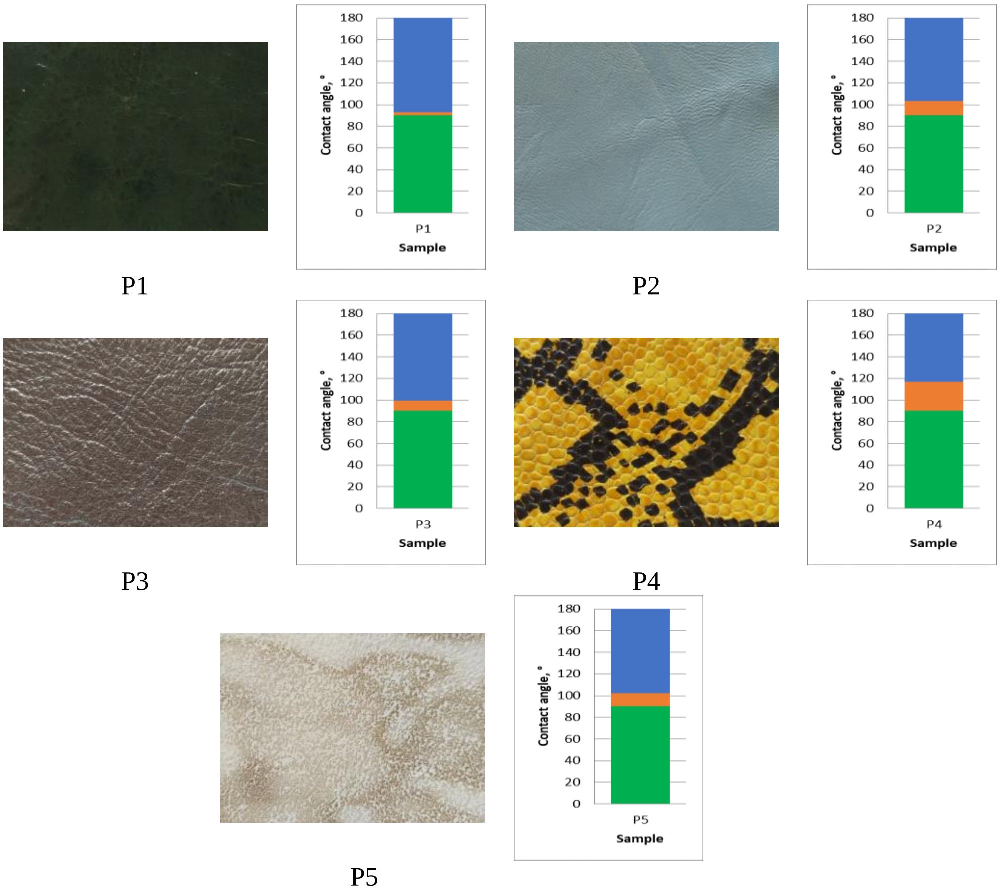

Figure 4. Contact angle of leather samples

Antibacterial activity was determined for all five samples – Figure 5. Results show that all the samples have very good antibacterial activity; just after 24 h, the percentage of bacteria that was annihilated was between 99.68% and 100%.

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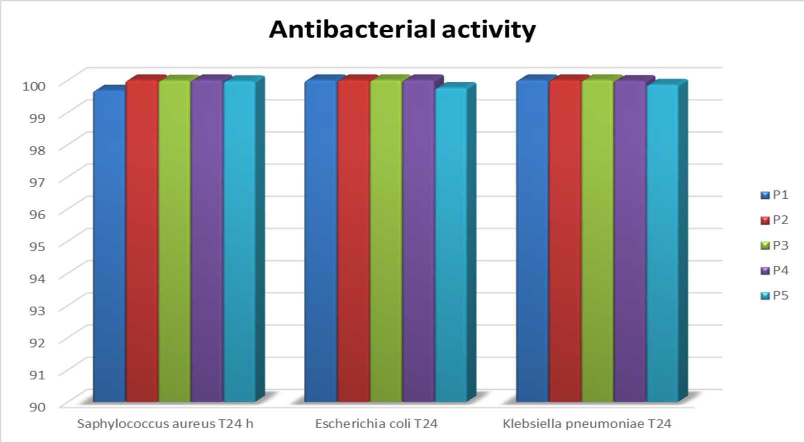

Figure 5. Antibacterial activity

CONCLUSIONS

Based on microscopic results, all the samples show a smooth surface, without cracks. The contact angle test reveal values over 90° for all the samples, which indicates that leathers are hydrophobic.

All the leathers have an interesting design that can be useful to manufacture handbags, purses and/or shoes.

The antibacterial activity is very high, the *Staphylococcus aureus* (S. aureus, ATCC 6538), *Escherichia coli* (E. coli, ATCC 10536), *Klebsiella pneumoniae* (ATCC Klebsiella pneumoniae ATCC 4352) are eliminated in proportion of minimum 99.68% after 24 h, therefore these types of leathers provide you a clean and safe micro environment.

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