Effect of the Different Dressing Procedures and Tanning Methods on Breaking Strength of Rabbit Hair

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ABSTRACT

Hair keratin is a type of keratin that is a structural protein found in hair and nails. A mass of chemical reagent are used for different processes and tanning methods, including acid, alkali and oxidizing agent and reducing agent, which can react with keratin, consequently, altering the structure of hair. This article measures the breaking strength and breaking elongation rate of rabbit hair by different processing procedures and tanning methods. The results show that the different processing procedures reduced the breaking strength of rabbit hair. The extent of the devastation was different from the procedures. Bating and pickling process was the most important effect. The different tanning methods could improve the breaking strength of guard hair. The effect of chrome tanning and fatty aldehyde tanning was significant. Subsequently these results provide a theoretical basis for effective modification to rabbit hair, which could help to reduce the damage to hair during tanned process.

Key Words: Process; Tanning; Rabbit Hair; Breaking Strength

INTRODUCTION

With the rapid development of rabbit industry in China, the major processing and utilization of rabbit skins have become more economically important. The rabbit skins is a kind of advanced natural animal fiber, with the white, soft, smooth, breathable, moisture absorption, insulation and other excellent characteristics, which is one of precious animal fiber in Chinese unique (Liu 2005). As its softness and good appearance, rabbit skins used to make hats, bags, gloves, scarf, collar and the coat of children and women, which get the favour of people. However, during the processing of rabbit skin, including traditional soaking, degreasing, bating, picking and tanning *etc*., addition of the chemical and mechanical factors will cause the rabbit hair shedding from skin plat easily. Especially in the softening and picking process, the acid and enzyme have different degree effects on fastness and fiber strength of hair and skin plate. The fiber fracture of rabbit hair is also affected by absorbent, the elongation at break of guard hair of rabbit was declined compared to the dry one (Xi et al. 2005).

Rabbit hair is composed of hair keratin, which is one of the important structural proteins. There are two types of hair keratin: the acidic type I hair keratin and the basic type II hair keratin (McKittrick & Chen 2012). It is well known that proteins could react with acid, alkali and oxidizing agent. Low concentration acid mainly affect salt bond, but do not damage chemical structure and physical properties of hair. However, high concentration acid may hydrolyze peptide bond, along with reducing the mechanical strength of keratin (Xu et al. 2009). Because of alkaline can hydrolysis disulfide bond, alkaline will still further damage the keratin with temperature increasing and time extending. Reductant and oxidant, which can hydrolyze disulfide bond, will make keratin dissolved. A lot of experimental data indicate that one of the reasons regarding losing hair is rabbit hair breakage itself.

So far, domestic and international scholars have done few studies with broken-hair of rabbit. This paper investigated the effect of the different processing procedures and tanning methods on breaking strength of rabbit hair. Subsequently these results provide a theoretical basis for effective modification to rabbit hair, which could help to reduce the damage to hair during tanned process.

MATERIALS AND METHODS

Chemical reagent and materials

All chemicals used included: salt, soda ash, baking soda, formic acid, sulfuric acid, a preservative, formaldehyde, FB (a kind of fatty aldehyde from clariant company), alum, chromium salt, NM enzyme (used during soaking process), degreasing agent (JA-50 and TS-80), bating enzyme (ARS), and a wetting agent (HAC).

Dry-salted Sichuan rabbit skins which were bought from traditional agri-product market were chosen as raw material.

Equipment

A GI-heat pump cycle stainless steel control temperature drum (Wuxi Xinda light industry machinery limited company), fully-automatic flip oscillator (Changzhou Boke Test Equipment Institute), YG001A-electronic single fiber strength tester.

Methods and procedures

Two Sichuan rabbit skins of 6 × 12 cm were marked as 1# and 2#. All of them were kept as the original primary processing technology, including soaking, degreasing, bating and picking. The guard hair of the samples which were cut from rabbit skins by the end of each working procedure was put in the cool and ventilate place to make them dry naturally. Then the samples were transferred into YG001A-electronic single fiber strength tester to measure the breaking strength.

In Table 1, the conditions for the primary processing technology method for white rabbit skins are shown.

Table 1. The primary process for tanning rabbit skins

Processes	Materials	Amount	Temperature	Time (min.)	Remarks
Soaking					Dry-salted hide
	Water	1 : 20			
	Wetting agent HAC	0.5 g/l			
	Salt	25 g/l		30	
	Sulfuric acid	0.25 g/l			pH = 5~6
	NM enzyme	0.5 g/l		60	Run for 1 hour, over night, fleshing
Degreasing			35°C		
	Water	1 : 20			
	JA-50	1 ml/l			
	TS-80	3 ml/l			
	Soda	0.5 g/l		60	After running for 1 hour, washing
Bating and pickling			32°C		
	Water	1 : 20			
	Salt	60 g/l			Baume degree is 5~7
	Formic acid	3 ml/l		30	pH 3.0
	Bating enzyme ARS	0.5 g/l		120	Over night
	Formic acid	4 ml/l		30	
	Sulfuric acid	1 ml/l		60	pH 2.0, after running for 1 hour, over night

Cut the middle of the harvested acid skins to divide into four pieces. Eight samples obtained from cutting the two acid skins were divided into four groups, which were tanned by formaldehyde, formaldehyde-Al, chromium salt and FB-Al, being numbered 1 through 4, respectively. The guard hair of the samples which were cut from rabbit skins by the end of each working procedure was put in the cool and ventilate place to make them dry naturally. Then the samples were transferred into YG001A-electronic single fiber strength tester to measure the breaking strength.

YG001A-electronic single fiber strength tester was used to determine the breaking strength and elongation of guard hair. Control the clamping length 10 mm, and tensile rate 8 mm / min. Each sample was measured 12 times to retain average (Zhang 2000).

RESULTS AND DISCUSSION

The structure of rabbit hair

The large number of guard hair is distributed on the surface of rabbit skin. From hair root to top, guard hair coarsens and shapes a spindle structure. The special structure is one of the reasons that guard hair is easy to be broken.

Effect of the different processing procedures on breaking strength of rabbit hair

The properties including breaking elongation rate and breaking strength of the guard hair were tested under the different conditions. The results are shown in Figure 1 and Figure 2.

From Figure 1 and Figure 2, it is quite clear that breaking elongation rate ranged from 2.50 to 3.97, and variation range was small. With the machining processing, breaking strength of the guard hair had a sharp decreased. In addition, bating and pickling process was the most important effect. The PI of the Keratin is 5-7. In bating and pickling process, solution pH was 2.5-3. Acid could directly make the keratin disulfide bond and salt bond cleaved, which was one of the most important reasons that led to reduce the breaking strength of the guard hair. Acids tend to cause less damage to the keratin, under the condition of low concentration of acid and low temperature.

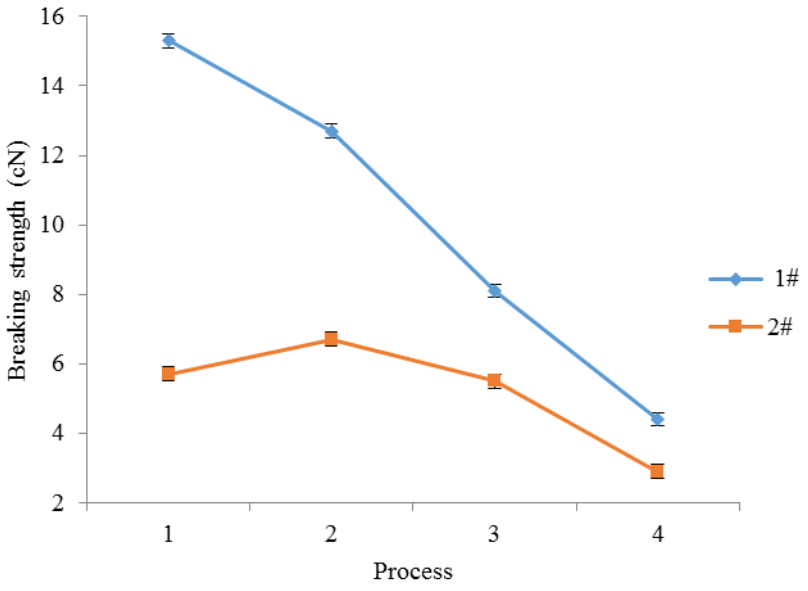
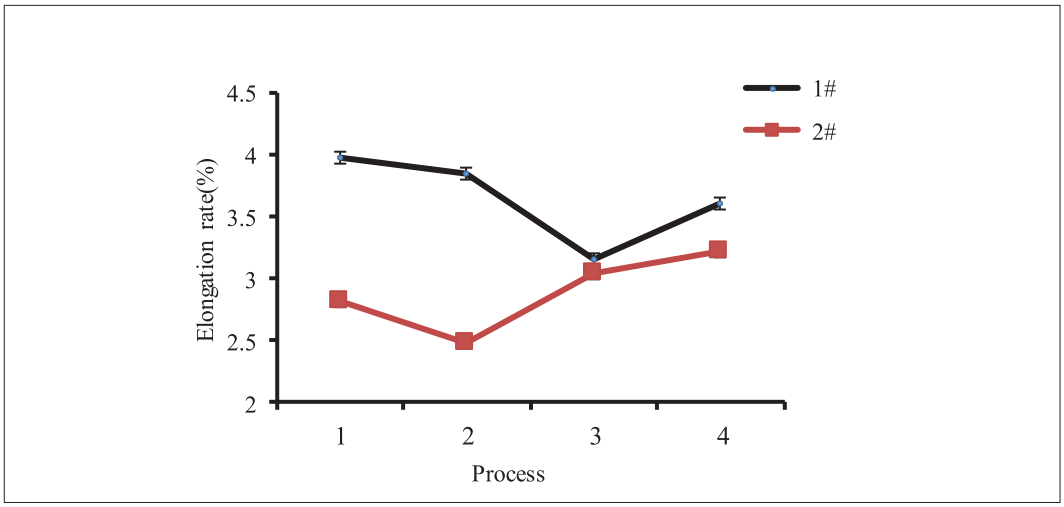


Figure 1. Effect of the different processing procedures on breaking strength of rabbit hair



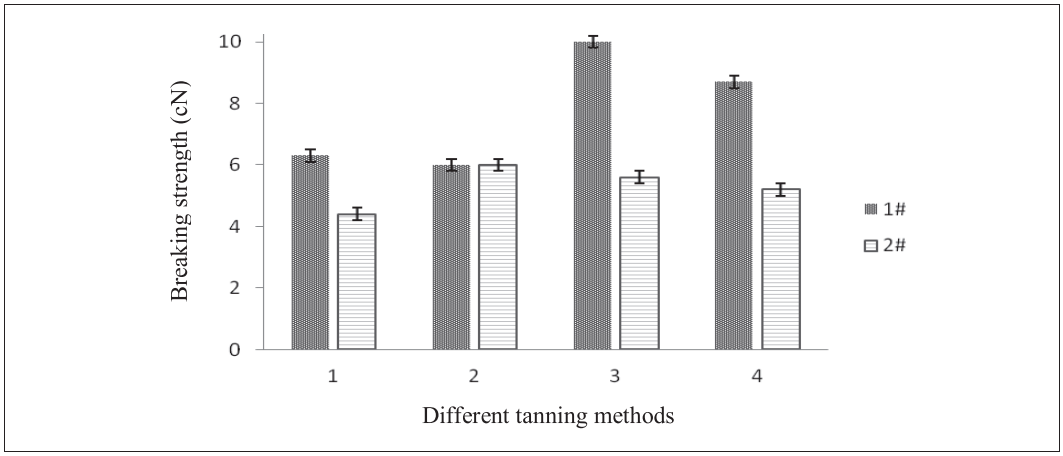
*The x axis from 1 to 4 stand for rabbit skins pre-treated by soaking, degreasing, bating and picking, respectively

Figure 2. Effect of the different processing procedures on elongation rate of rabbit hair

Thus, during the bating and pickling process, the temperature and the dosage of acid minimized to reduce the hair damage. Effectively manage function time which may reduce the damage. The numbers also demonstrate that individual difference existed in breaking strength. 1# was significantly higher than 2#. From soaking to pickling, breaking strength of sample 1# induced 10.9cN. Despite the extent of the decreased breaking strength of sample 2# was smaller than sample 1#, both of them could reflect that the different processing procedures reduced the breaking strength of rabbit hair.

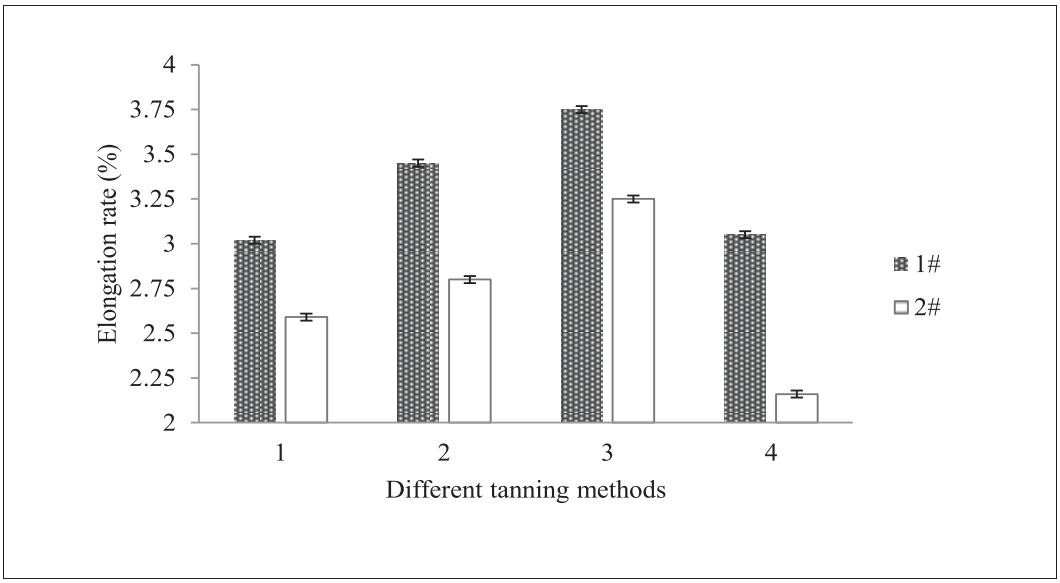
Effect of the different tanning methods on breaking strength of rabbit hair.

The properties including breaking elongation rate and breaking strength of the guard hair were tested under the different tanning methods. Results are shown in Figure 3 and Figure 4.



*The x axis from 1 to 4 stands for rabbit skins tanned by formaldehyde, formaldehyde-Al, chrome, FB-Al respectively

Figure 3. Effect of the different tanning methods on breaking strength of rabbit hair



*The x axis from 1 to 4 stands for rabbit skins tanned by formaldehyde, formaldehyde-Al, chrome, FB-Al respectively

Figure 4. Effect of the different tanning methods on elongation rate of rabbit hair

It can be clearly seen from Figure 3 and Figure 4 that breaking elongation rate of four tanning methods was controlled in certain scale. The results showed the significant differences among four tanning methods. When comparing Figure 1 with Figure 3, the breaking strength of all rabbit hairs was obviously improved after tanning. Chrome tanning and combination FB-Al tanning seriously increased the breaking strength of sample 1#, which was much higher than sample 2#. Although the breaking elongation rate exist obviously difference between the two skins, the changing trend is similar. Those results indicated that tanning process could improve the breaking strength of guard hair of rabbit. However, the breaking strength could not recover exactly to the beginning of fur wet-processing.

CONCLUSIONS

During rabbit wet processing, guard hair that was produced with the different processing procedures was broken. The extent of the devastation was different from the procedures. A very small amount of the chemical reagent which could react with keratin from soaking and degreasing made the degree of damage to the guard hair low. On the contrary, enzyme and acid from processes of bating and pickling did the large damage to guard hair.

The different tanning methods could improve the breaking strength of guard hair. The effect of chrome tanning and fatty aldehyde tanning was significant.

As a double-edged sword, the chemical reagent could be used to modify guard hair to reduce the damage.

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