면씨껍질의 물리적 구조와 화학적 조성

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Physical Structure and Chemical Composition of Cotton Seed Coat

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1. Introduction

Seed coat fragments (SCF's) are small portions of seed coat that have been broken from the cotton seeds during ginning, a mechanical process that separates the cotton lint from the seed. Seed coat fragments have drawn attention because they are one of the major imperfections that affect the appearance and quality of cotton yarn and fabrics [1,2]. Seed coat fragments in the yarn and fabric cause uneven dyeing and hence, become very obvious. In addition, the remaining SCF's cause many problems at yarn manufacturing. They interrupt the smooth flow of fibers during the drafting process resulting in sliver irregularity. Seed coat fragments are also associated with increased end breaks during the spinning process, leading not only to machine stops while operating but also to irregularity in the yarn [3]. In fact, SCF's comprised most of the yarn faults of medium count yarns and nearly 30 percent of small count yarn defects in a study by Bargeron and Garner [4].

In spite of those many problems, not many studies have been done in this area. The ultimate purpose of this project is removal of the seed coat fragments from the cotton. In order to accomplish this project, the physical structure and chemical composition of the cotton seed coat was investigated in this study as a first step.

2. Experimental

The cottonseeds were obtained for this study from ginning facility in Georgia.

Free hand-cut sections and thin microtomed-sections were used for examining the physical structure and chemical constituent of the cotton seed coat, respectively. The hand-cut sections were examined under light microscopes and a scanning electron microscope. The thin-sections were stained with a series of stains to identify the chemical constituents.

3. Results and Discussions

3.1 Structure of Seed Coat

There was no particular structural difference among the different regions of the seed except that the chalazal has a thick inner epidermis compared to the other regions. An additional layer attached to the thick inner epidermis of the chalazal seems to be the same as the sponginess tissues referred to in the literature [7]. Figures 1 and 2 show the difference of the inner epidermis of the chalazal and middle region. The hand-cut cross-sections of the seed coat showed each layer with its own natural color (Figure 3). This thickness of the cross-sections was about 100 microns.

3.2 Chemical Composition of Seed Coat

The schematic diagram of stained cross section of seed coat is shown in Figure 4. Ruthenium Red reacted with the inner epidermis layer and upper palisade layer intensively, with the outer pigment layer moderately, and weakly with the outer epidermis. A more intensely stained thin layer (stained at 50° C for 30 minutes) was sometimes seen between the epidermal cells where the fiber was detached. It was of particular importance because this region is the connection of the fiber to the seed coat. These results were confirmed by staining fibers that are pulled from the seed coat. A pink color was evident on the fiber shank and bottom of the fiber foot to which the fibers attached [Figures 5 and 6]. The scores for stained shanks of the fibers (Figure 7) from different regions of the seed coat using Ruthenium Red drew attention because a difference in pectin content among the different regions was observed. Fibers that were strongly attached by pectin to the seed coat in the chalazal region would produce more seed coat fragments when they are pulled out.

4. Conclusion

Cross-section of the cotton seed coat was visualized through this study. Most layers were shown as identified in the literature. However, two distinct palisade layers were discovered from this work. Pectin was the adhesive material between

the cotton fibers and the seed coat. The research provided background information that could lead to specific and more efficient removal of the seed coat fragments.

5. References

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Figure 1. Seed Coat -Chalazal (SEM)

Figure 2. Seed Coat - Middle (SEM)

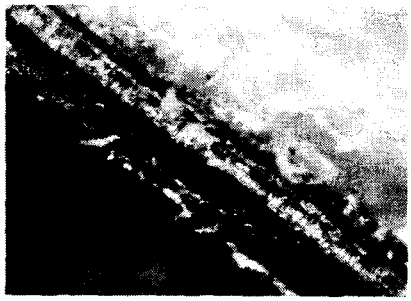

Figure 3. Optical Photomicrograph of Seed Coat Cross-Section (100X)

Figure 5. Fiber Shanks Stained with Ruthenium Red (200X)

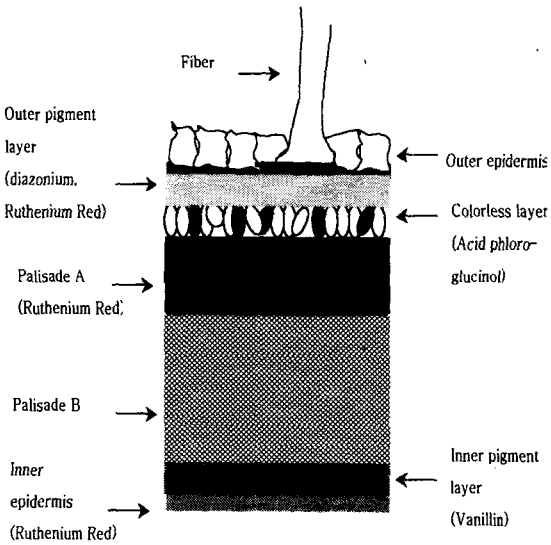

Figure 4. Schematic Diagram of Seed coat

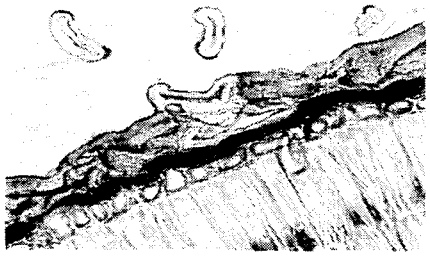

Figure 6 Cross-Section of Seed Coat Stained with RR (500X)

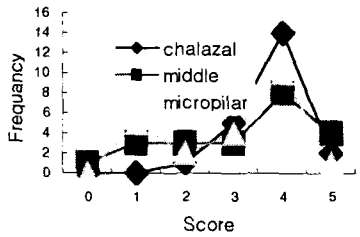

Figure 7. Staining Intensity of Ruthenium Red on Fibers