Alpaca Fiber
What We Know
What We Need to Know
The Huacaya

Huacaya fiber has loft and is well suited for knitted and crocheted products as well as woven applications.

Huacaya fiber has brightness and crimp.
THE SURI

Suri fiber is smooth and heavy. Because of its lack of loft, suri is best used in lighter weight woven applications.

Suri has a very smooth scale structure which gives it its luster.
Alpaca fleece comes in 18 official natural colors with 100s of shade variations

Official Natural Colors:

White
Beige
Fawn – light, medium, dark
Brown – light, medium, dark
Bay Black
True Black
Silver Grey – light, medium, dark
Rose Grey – light, medium, dark
Indeterminate Dark
Indeterminate Light
Micron Relationships to End Uses

- 18-20 – underwear, high fashion fabric, suiting
- 20-23 – fine to medium knit-wear, men’s suiting, lightweight worsteds, hand knitting yarn
- 23-26 – woven outwear, machine and hand knitting yarns
- 24-29 – socks, fine felting, and heavy woven outerwear
- 30+ interior textiles, carpets, and industrial felting
AOBA Fiber Characteristics Study
2009-2012

- Three Phase Study
- Managed and coordinated by AOBA Fiber Committee
- Validation of Fiber Characteristics Claims
- Utilization of College and University Testing/Use of Standard Methods
- Literature Search for Research Papers
Goals of the Study

- To validate claims made about alpaca fiber using scientific data
- Intrinsinc Values of Alpaca Fiber
- Characteristic Values of Alpaca Fiber as compared to other fibers
Phase One
Literature Review

- Locating studies performed on alpaca fiber worldwide
- Locating studies and values for wool, cotton, silk and synthetic fibers
- Establishing values and charts for comparison purposes
Pertinent Alpaca Studies


- A comprehensive report of several studies on the processing of alpaca as compared to wool in commercial scouring and processing mills in Australia.
Wang et al Studies - Conclusions

- Alpacas Are Dirty
- Alpaca fiber can be cleaned at lower temperatures than wool
- Alpaca fiber has the same softness comfort as wool at higher micron levels.
- Alpaca must be processed slower than wool, but has better yield.
Wang et al Studies

- Alpaca has less pilling than wool
- Alpaca is fuzzier and sheds more than wool
- The twist factors for alpaca yarns should be different than wool
- Alpaca has lower resistance to compression than wool.
Wang et al Studies

- Alpaca fiber may be bleached and dyed
- Alpaca dehairing is not cost effective
  - Approximately 30% loss at dehairing
  - Only 50% of the guard hair present was removed
Pertinent Alpaca Studies

  - A study of microns, length and tensile strength of raw alpaca fiber with regional, color and age comparisons
  - Conclusions: there are differences
Pertinent Alpaca Studies

  - A comparison of scale structure of suri alpaca and huacaya, llama and wool
- Conclusion: There are differences
Handle Claims

- Scale structure
  - Smoother scale = better handle
- Uniformity of micron
  - Products created with a very uniform micron will produce a more pleasing handle than their micron size indicates

Photo from National Geographic ca 1990
Phase One

- Three parameters identified
  - Flammability
  - Thermal Conductivity (insulating factors)
  - Moisture Retention (wickung, absorption, desorption)
- Intrinsic Properties of Alpaca Fiber
  - Using roving processed under controlled conditions
  - Huacaya, suri, and variable colors and alpaca ages
Phase One Testing Plan

- Utilization of Gaston College Textile Technology Center, Belmont, NC
- Summer/Fall 2009
- Using 15 lbs of roving/felt
- Moisture Regain %
- Gaston College Staff and Summer intern from NCSU
Phase One Testing 2010

- Continuation of Testing
  - Utilizing woven, knitted, felted fabric
  - Flammability
  - Moisture Management
  - Thermal Conductivity
- Beginning of comfort values claim establishment
- Comparisons to other fibers from literature
Test Methods

- Moisture Regain
- Absorbency
- Wicking
- Abrasion/Pilling
- Thermal conductivity
- Flammability
# The Fiber Samples

<table>
<thead>
<tr>
<th>Color/type</th>
<th>microns</th>
</tr>
</thead>
<tbody>
<tr>
<td>H - Grey</td>
<td>24</td>
</tr>
<tr>
<td>H-White</td>
<td>19</td>
</tr>
<tr>
<td>H-Rose Grey</td>
<td>22</td>
</tr>
<tr>
<td>H-Black</td>
<td>30</td>
</tr>
<tr>
<td>H-Brown</td>
<td>28</td>
</tr>
<tr>
<td>H-Fawn</td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color/type</th>
<th>microns</th>
</tr>
</thead>
<tbody>
<tr>
<td>S- White</td>
<td>34</td>
</tr>
<tr>
<td>S- Fawn</td>
<td>20</td>
</tr>
<tr>
<td>S-Black</td>
<td>26</td>
</tr>
<tr>
<td>W - Shetland</td>
<td>25 est</td>
</tr>
<tr>
<td>W- Merino</td>
<td>18 est</td>
</tr>
<tr>
<td>C/H - White</td>
<td>20/28</td>
</tr>
</tbody>
</table>
Moisture Results

- Moisture Regain %
  - Indicates a part of the "comfort"
  - Higher % equals warmth/resistance to static
  - Standard test in the textile industry
  - Published data readily available for all fibers
# Moisture Regain %

<table>
<thead>
<tr>
<th>Fabric</th>
<th>Moisture Regain %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpaca*</td>
<td>8.0</td>
</tr>
<tr>
<td>Wool</td>
<td>16</td>
</tr>
<tr>
<td>Silk</td>
<td>9</td>
</tr>
<tr>
<td>Cotton</td>
<td>8</td>
</tr>
<tr>
<td>Polyester</td>
<td>0.3</td>
</tr>
<tr>
<td>Nylon</td>
<td>4</td>
</tr>
<tr>
<td>Rayon</td>
<td>11</td>
</tr>
<tr>
<td>Soy silk</td>
<td>8</td>
</tr>
<tr>
<td>Milk silk</td>
<td>5.5</td>
</tr>
<tr>
<td>Bamboo</td>
<td>13</td>
</tr>
<tr>
<td>Tencel</td>
<td>10</td>
</tr>
<tr>
<td>Corn silk</td>
<td>0.5</td>
</tr>
<tr>
<td>Cashmere</td>
<td>16</td>
</tr>
<tr>
<td>Linen</td>
<td>12</td>
</tr>
</tbody>
</table>

* From AOBA test results at Gaston College
Moisture Regain Conclusions

- Alpaca compares to cotton and silk
- Alpaca has a lower moisture regain than wool
- Explains why alpaca usually feels lighter and less “sticky” than wool under use conditions
- Paper published Alpacas Magazine 2012
Flammability

- Flame resistance
- Class I fiber by FTC/CPSC methods
  - 16 CFR Part 1610 Standards for Flammability of Clothing Textiles
- Flammability, vertical test
- Marginally flame retardant, char 15 in, after flame 70 sec, after glow 0 sec
  - FTMS 191A 5903, Vertical Flammability Test
Absorbency

- A reflection of the absorbency of the fabric in resistance to wetting
- Drop test AATCC 79-1995, Absorbency of Bleached Textiles
- Spray test AATCC 22-2005, Water Repellency Spray Test
## Drop Test Results

<table>
<thead>
<tr>
<th>Color/type</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>H - Grey</td>
<td>0/60 min</td>
</tr>
<tr>
<td>H-White</td>
<td>0/60 min</td>
</tr>
<tr>
<td>H-Rose Grey</td>
<td>0/60 min</td>
</tr>
<tr>
<td>H-Black</td>
<td>0/60 min</td>
</tr>
<tr>
<td>H-Brown</td>
<td>0/60 min</td>
</tr>
<tr>
<td>H-Fawn</td>
<td>0/60 min</td>
</tr>
<tr>
<td>S- White</td>
<td>0/60 min</td>
</tr>
<tr>
<td>S- Fawn</td>
<td>0/60 min</td>
</tr>
<tr>
<td>S-Black</td>
<td>0/60 min</td>
</tr>
<tr>
<td>W - Shetland</td>
<td>0/60 min</td>
</tr>
<tr>
<td>W - Merino</td>
<td>0/60 min</td>
</tr>
<tr>
<td>C/H - White</td>
<td>4/30 min</td>
</tr>
</tbody>
</table>
# Spray Test Results

<table>
<thead>
<tr>
<th>Color/type</th>
<th>Spray Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>H - Grey</td>
<td>70</td>
</tr>
<tr>
<td>H-White</td>
<td>70</td>
</tr>
<tr>
<td>H-Rose Grey</td>
<td>70</td>
</tr>
<tr>
<td>S-White</td>
<td>70</td>
</tr>
<tr>
<td>W-Shetland</td>
<td>80</td>
</tr>
<tr>
<td>W-Merino</td>
<td>70</td>
</tr>
<tr>
<td>C/H White</td>
<td>50</td>
</tr>
<tr>
<td>Cotton Sock</td>
<td>0</td>
</tr>
</tbody>
</table>
Wicking

- A reflection of the absorption in wicking moisture away from the skin
- Vertical wicking test
  - British Standard 2424
## Wicking Results

<table>
<thead>
<tr>
<th>Sample</th>
<th>2 min</th>
<th>5 min</th>
<th>10 min</th>
<th>20 min</th>
<th>30 min</th>
<th>1 hr</th>
<th>12 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>H White</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>5 mm</td>
<td>7 mm</td>
<td>9 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>S White</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>3 mm</td>
<td>5 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>H Black</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>5 mm</td>
<td>9 mm</td>
<td>20 mm</td>
</tr>
<tr>
<td>S Fawn</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>5 mm</td>
<td>5 mm</td>
<td>7 mm</td>
<td>18 mm</td>
</tr>
<tr>
<td>H Grey</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>3 mm</td>
<td>5 mm</td>
<td>7 mm</td>
<td>18 mm</td>
</tr>
<tr>
<td>W Shetland</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>3 mm</td>
<td>7 mm</td>
</tr>
<tr>
<td>H Grey sock</td>
<td>14 mm</td>
<td>35 mm</td>
<td>75 mm</td>
<td>121 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton sock</td>
<td>45 mm</td>
<td>114 mm</td>
<td>165 mm</td>
<td>170+ mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Absorbency Conclusions

- Alpaca is resistant to absorbency
- Alpaca is similar to wool in absorbency
- Alpaca can wick away moisture when knitted appropriately for use
Thermal Conductivity

- ASTM F1868, Thermal and Evaporative Resistance of Clothing Materials
- Measured in three values
  - Clo values, the heat comfort/insulation value
    - 1 = men’s suit
  - Permeability, the heat retention value
    - 1 = totally permeable (air)
  - Total Heat Loss, reflective of the amount of metabolic heat generation that can be exerted without comfort loss
**Thermal Conductivity**

**TAFS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Weight Oz/ sq yd</th>
<th>Thickness mm</th>
<th>Clo Value</th>
<th>Permeability</th>
<th>Total Heat Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suri woven</td>
<td>10.06</td>
<td>1.30</td>
<td>0.867</td>
<td>0.618</td>
<td>417.354</td>
</tr>
<tr>
<td>Huacaya woven</td>
<td>14.69</td>
<td>1.94</td>
<td>0.903</td>
<td>0.603</td>
<td>388.288</td>
</tr>
</tbody>
</table>

**Preliminary conclusions:**
- Clo value, comfort for indoor wear
- Permeability, the fabric will “breathe” and not create sweating
- Total Heat loss, one could theoretically dig trenches without the need for cooling.
Abrasion and Pilling

- Related to the structure of the fabric
- Indicates wear and tear and aesthetics
- Specs are described for upholstery use
- Minimum upholstery value >15000 abrasion
- No pilling 5, excessive pilling 1
Abrasión/Pilling

The Alpaca Blanket Project

- Abrasion
  - 15,000 cycles – good resistance
- Pilling
  - Value of 3, good pilling resistance
Craft Felting Study

- Study for publishing to the craft industry
- Compares huacaya and suri to wool
Pertinent Alpaca Studies

  - A study of the felting of wool vs alpaca fibers in a commercial scouring setting

Conclusion: Alpaca has a higher propensity to felt during scouring.
Felting Method

- 3 layers perpendicular, about 2 oz fiber
- 15 X 24 rectangle wetted
  - 600 ml water, 10 ml detergent
- Prefelt
- 50 throws to full felt
# Time to Prefelt

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Prefelt time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huacaya</td>
<td>15</td>
</tr>
<tr>
<td>Suri</td>
<td>45</td>
</tr>
<tr>
<td>Merino</td>
<td>10</td>
</tr>
<tr>
<td>Shetland</td>
<td>15</td>
</tr>
<tr>
<td>Huacaya/cotton</td>
<td>25</td>
</tr>
</tbody>
</table>
## Shrinkage Results

<table>
<thead>
<tr>
<th>Color/type</th>
<th>% Shrink</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>H - Grey</td>
<td>22.6</td>
<td>33.3</td>
<td></td>
</tr>
<tr>
<td>H-White</td>
<td>20.8</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>H-Rose Grey</td>
<td>18.2</td>
<td>21.6</td>
<td></td>
</tr>
<tr>
<td>H-Black</td>
<td>16.7</td>
<td>26.7</td>
<td></td>
</tr>
<tr>
<td>H-Brown</td>
<td>16.7</td>
<td>26.7</td>
<td></td>
</tr>
<tr>
<td>H-Fawn</td>
<td>16.6</td>
<td>20.8</td>
<td></td>
</tr>
<tr>
<td>S- White</td>
<td>16.6</td>
<td>33.3</td>
<td></td>
</tr>
<tr>
<td>S- Fawn</td>
<td>12.5</td>
<td>33.0</td>
<td></td>
</tr>
<tr>
<td>S-Black</td>
<td>12.5</td>
<td>36.7</td>
<td></td>
</tr>
<tr>
<td>W - Shetland</td>
<td>29.2</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>W- Merino</td>
<td>34.5</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>C/H - White</td>
<td>14.5</td>
<td>24.5</td>
<td></td>
</tr>
</tbody>
</table>
Felting Properties

- **Conclusions**
  - Alpaca felts differently than wool
  - Huacaya felts as easily as wool
  - Suri is more resistant to felting for the craft industry
  - Shrinkage is less than wool widthwise, more than wool lengthwise
Where Do We Go From Here?

Continuation of Testing
Fleece Characteristics Claims Made

- Is unusually strong and resilient – stronger than wool
- Strength does not diminish as it becomes finer
- More thermal capacity in its fiber than almost any other animal
- Contains microscopic air pockets creating lightweight garments with high insulation values
Fleece Characteristics Claims

• 26 micron alpaca feels like 16 micron wool

• Considered to be hypoallergenic
  – lack of lanolin
  – unique scale structure and low micron diameter
  – low prickle factor
The Fiber Fairy

Is It All True???

More Validation Needed!
Increase demand for alpaca fleece and fleece products throughout North America

Explanation: This strategy addresses the desire to see an increase in demand for North American alpaca fleece and fleece related products, including options for getting fleece from farm to market.

Strategy 4.1 — Sponsor studies about alpaca fleece to get the science and comparison data to backup statements on strength, weight, warmth, etc., then utilize that information in national marketing efforts
Phase Two
Comparisons to Other Fibers

- “Stronger than Wool”
- Softer than Cashmere
- Alpaca 26 micron feels like wool 16 micron
- Combination of Consumer/Laboratory Evaluations
Phase Two

- Continuation of Testing
  - Utilizing woven, knitted, felted fabric
- Beginning of comfort values testing
- Consumer perception and attitudes toward alpaca fiber, comparisons to other fibers
- Utilizing various colleges and universities
- Engineering, Consumer Sciences
Phase Two
Other Attributes

- Utilization of test values for raw fiber:
  - Micron ranges
  - Curvature values
  - Tensile strength ranges
- Survey of % fiber by age, color, type
- Statistical analysis of data
Phase Two
Hypoallergenic Claims

- The most costly
- Nearly a medical claim
- Development of testing protocol
- Sensitivity to fibers
- Comparison to other allergens
- Dander? Lanolin? Prickle?
Phase Three

- Exploration of other attributes for:
  - Functional Fabrics
  - Technical Fabrics
- Blending for Optimization
- Color Studies