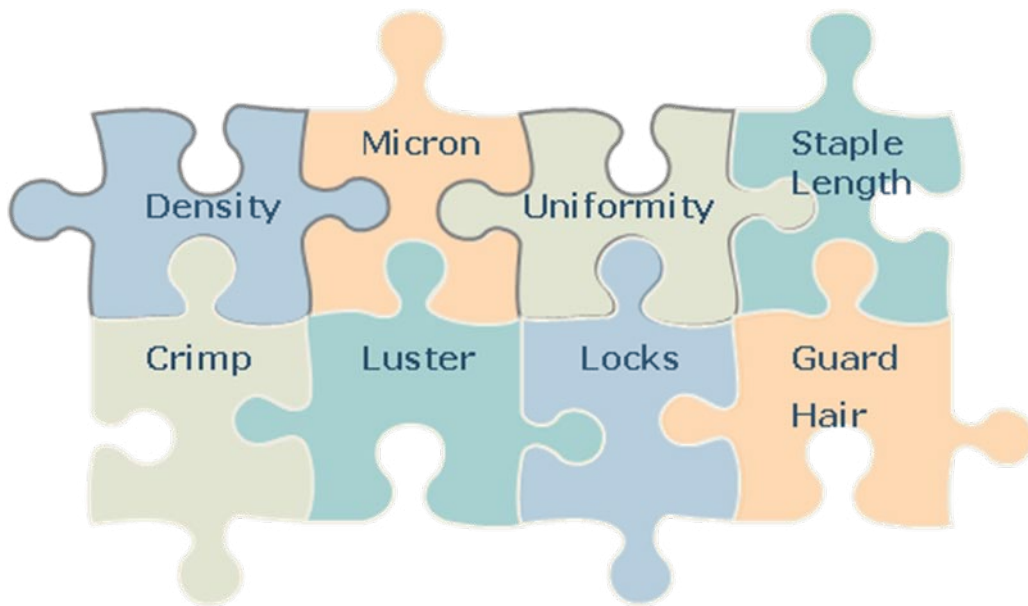


# The North American Alpaca Federation

## Alpaca University

### Alpaca Fiber for Profit Course

#### Module 1: The Current & Potential Value of Alpaca Fiber



Jim Tomaszek

Editorial assistance provided by Pam Welty

Note: This material is presented as a support for the alpaca industry and is not verified by any administrative or authoritative body or by AOBA at present.

# The North American Alpaca Federation

## Alpaca University

### Table of Contents

Introduction: Alpaca Fiber for Profit .....	3
Module 1: Current & Potential Value of Alpaca Fiber.....	5
A. If you don't know where you are going, any road will get you there.....	6
B. Breeding Goals to Achieve Profitable Fiber Production .....	7
C. Alpaca Fiber End Product Strategies .....	8
D. Alpaca Fiber – Form & Function.....	9
1. Fiber – A Textile Building Block .....	9
2. Follicle – A Fiber Building Block .....	9
3. Cuticles/Scales – The Armor .....	10
4. Hair/Fiber/Wool - Definitions.....	11
E. Alpaca Fiber – The Magic & the Myth .....	<del>13</del> <a href="#">12</a>
F. Alpaca Fiber - The Eco-Friendly American Textile Choice. ....	14
G. Alpaca vs. the Competition – Head-to-Head .....	18
1. Alpaca Fiber Compared to Sheep Wool .....	<del>20</del> <a href="#">19</a>
2. Alpaca Fiber Compared to Cashmere .....	24
3. Alpaca Fiber Compared to Cotton .....	26
4. Alpaca Fiber Compared to Silk.....	26
5. Alpaca Fiber Compared to Angora.....	27
6. Alpaca Fiber Compared to Mohair .....	<del>28</del> <a href="#">27</a>
7. Alpaca Fiber Compared to Bamboo .....	28
8. Alpaca Fiber Compared to Linen.....	29
9. Alpaca Fiber Compared to Synthetics .....	<del>30</del> <a href="#">29</a>
10. Suri Fiber compared to Huacaya Fiber .....	<del>31</del> <a href="#">30</a>
H. Module Summary.....	34

# The North American Alpaca Federation

## Alpaca University

### Introduction: Alpaca Fiber for Profit

Question: What do you do to achieve profit with alpaca fiber?

Answer: We selectively breed alpacas to maximize profit realized through the eventual sale of fiber end products and/or fiber-related services.

Question: With a limited fiber supply or demand, how do we sell our fiber for profit?

Answer: As breeders, we come together as partners, rather than competitors, to build appropriate sales & marketing channels for alpaca fiber. In addition, we work in cooperation to educate North American consumers about the value of alpaca fiber in textiles.

Question: Where do we begin?

Answer: We begin with a complete understanding of alpaca fiber, its potential value, realistic market demands (current and potential), and selective breeding goals and strategies.

Question: What is the North American Alpaca Federation's (NAAF) role in this alpaca fiber for profit initiative?

Answer: NAAF is simply an alpaca marketing organization made up of fellow alpaca breeders dedicated to and focused on marketing and sales. NAAF's mission is to promote the North American alpaca and to amplify the demand for the alpaca, its fleece, and related end products through timely education and appropriate related strategies, in support of individual alpaca owners and breeders.

NAAF's goals are to:

Work cooperatively with any and all reputable alpaca industry resources to advance the alpaca industry in North America.

Offer marketing support to Independent Alpaca Businesses for marketing & education.

Develop and implement a comprehensive model for achieving sustainable profit from alpaca fiber.

Continue to attract new customers for sales of alpaca breeding stock.

# The North American Alpaca Federation

## Alpaca University

### ***Course Disclaimer:***

The alpaca is a relatively new and exotic sight in pastures and backyards all over North America. Less is known about alpacas than perhaps any livestock animal in America. As we learn more about our relatively rare alpacas, both through research and experience, our current “facts,” theories, and speculation are sure to adjust accordingly.

Many of the “how’s and whys” of alpaca fiber are still hotly contested issues and some scientific research contradicts previous research. Study contradicts study. It is the intent of this module to attempt to separate pure opinion from responsible research, documented experience, and common sense. It is our sincere hope that this module will evolve into a more refined and accurate knowledge base as you and others question this material, engage in lively discussion, and contribute to improve this workshop.

This module is based on collective breeder experiences, independent university studies, research conducted in Australia (CSIRO), and articles written by Dr. Sumar, Ian Watt, Mike Safely, Dr. Jim Watts (SRS), DVM, Dr. Norm Evans, DVM, Mr. Villarone, Dianna Jordan (AFCNA), Chris Riley (NEAFP), Wini LeBreque, and Robyn Kuhl (NAAFP), along with many other sources.

Every attempt has been made to exclude unsubstantiated claims made by those who might choose to skew facts to favor sales of their own animals, breeding services, or fiber end products. For example, comparing alpaca to other fibers, as in “alpaca is seven times warmer than wool,” still needs to be qualified. Just as a steak cooked to perfection can be a delight to the gourmet’s palate, one burned to a crisp does not reflect a great steak at its best. Similarly, a thick micron and dirty alpaca fleece, mixed with long primaries and guard hair (the proper term is ‘kemp’), which is then poorly processed, can be thought of as the equivalent of a burned steak. It neither represents the standard, nor reflects the potential. As another example, Yokum McCall states that alpaca fiber is 50% stronger (1.5x) than wool, which refers to tensile strength, or the pressure point at which healthy fibers snap. However, we cannot say that an alpaca sweater is necessarily 1.5 times stronger than a wool sweater. What if the alpaca sweater was made with fiber from a sick alpaca? We must be careful not to mix apples and oranges. So, “branding” the North American alpaca (*McDonald’s brands with their Golden Arches logo and slogans like, ‘You deserve a break today.’*) is a must for quality control, customer perception, and the finished product.

The alpaca comes from a diverse genetic background. While DNA studies show the domesticated alpaca to be the closest relative of the undomesticated vicuña, further studies reveal significant breeding history with the llama. As a result, there are many “types” of alpaca, depending on various ancestries. This fact manifests itself in the alpaca’s fiber, which also comes in many varieties. While some styles will be in greater demand than others, dictated more by fashion than true worth, all styles of fiber have value. It is up to owners and breeders to create niche markets. In addition to creating an ever-growing supply and demand for fiber, we must also continue to educate the American public (as well as ourselves) on our harvests’ value.

# The North American Alpaca Federation

## Alpaca University

To accomplish this, we must be sure we fully understand the value of alpaca fiber ourselves. It is in the spirit of this challenge that this module was produced.

Note: NAAF remains neutral on the need for a North American alpaca breed standard.

The Fiber for Profit Workshop consists of four interrelated modules:

Module #1 – The Current & Potential Value of Alpaca Fiber

Module #2 – Alpaca Fiber Evaluation – The Objective & the Subjective

Module #3 - Histograms, Follicular Skin Biopsies, & EPDs

Module #4 – How to Make Money with Alpaca Fiber and the Value Chain

The modules interrelate in order to present a comprehensive understanding of alpaca fiber, its benefits and shortcomings, how it compares to like fibers, and how it can be measured objectively to maximize profit. Module #4 presents case studies showing how it is currently possible to pay for the upkeep of a herd through fiber sales. It is hard work, multi-faceted, and requires that the industry focus on both maintaining open sales and marketing channels to attract an ever-growing population of alpaca breeders, as well as creating breeding and end product standards to ensure the success of an increasing variety of revenue streams for alpaca end products.

## Module 1: Current & Potential Value of Alpaca Fiber

Breeders selectively breed their livestock in order to maximize profit achieved through the sale of end products and/or services. North American alpacas are no longer classified by the US Department of Agriculture (USDA) as an ‘exotic species’ and are defined as “livestock” under federal regulations. This change brings with it both new responsibilities, as well as benefits and opportunities.

Some of us freely admit we do not breed to sell, but sell to breed. In other words, we have a passion for improving favorable traits and enjoy the associated recognition in the show ring. Whether we breed for improved seed stock, stud fees, alpaca sales, building of large fiber herds, or for breeding the ideal alpacas for the show ring, to be successful we must have a keen understanding of the products and services from which we intend to profit.

This workshop will focus on one aspect of the alpaca livestock business – Alpaca Fiber for Profit. Unlike other “fiber to textile” competitors (wool, cashmere, silk, etc.), the alpaca is relatively rare. As a result, the value of alpaca fiber in the marketplace, both current and potential, is poorly understood in North America. We alpaca breeders are faced not only with creating and nurturing both a supply and demand for alpaca fiber, but with educating the North American public about our end product’s potential value. To do this most effectively, we must hold a collective vision in our hearts and minds. We must map out a future in which we are in basic agreement as to our selective breeding goals and strategies, and how we plan to interface with potential markets.

# The North American Alpaca Federation

## Alpaca University

The most critical factor is that we must intuitively understand that in order to succeed we must partner as breeders for mutual benefit, rather than focus on each other as competitors. Secondly, we need a map or plan as to how we can achieve these mutual goals.

With this in mind, the North American Alpaca Federation (NAAF) has created this workshop, “Alpaca Fiber – Selective Breeding for Quality End Products,” to delve into what we *know*, what we *suspect*, and what we must further *investigate* about breeding alpacas in order to achieve profitable fiber production. This workshop begins with the premise that certain best breeding practices have already been identified and proven by documented historical breeding trials and strategies, and their related successes and failures. There is as much art as science involved in breeding alpacas for profitable fiber production. Our knowledge of our craft is evolving and will continue to grow as we experience, learn, analyze, and share.

The road to success, both financial and spiritual, may well be summed up by the following adage, “Laborers work with their hands; Craftsman work with their hands and their brains; Artisans work with their hands, their brains and their hearts.”

*The following is a work in progress and we hope for your active participation in this effort.*

### ***A. If you don't know where you are going, any road will get you there.***

Picture a luxurious in-ground swimming pool surrounded by a lush landscape. The grass is green, the trees, bushes, and flower gardens well cultivated. The sun is shining, the wind is calm, and it is the perfect day for a swim. Now, picture this enticing scene with one thing missing – there is no water in the pool. The pool has a definite form, but no function. Potential, yes; but, no real function. We have our form - our beautiful Suri and Huacaya, but what is their function?

Question: What should an alpaca livestock breeder breed for?

Answer: Uniform fiber for profit.

Question: What is quality alpaca fiber?

Answer: It depends.

Question: What sort of return on investment can I expect from breeding alpacas for fiber?

Answer: It depends.

NAAF proposes that alpaca breeders understand the following three major benefits of alpaca in North America with regard to the textile industry:

1. Alpaca fiber *feels* about 5 microns softer than sheep's wool of the same micron count. In textile terminology, the term “soft” relates to “handle.” Handle consists of four separate attributes: skin comfort (no itching), stiffness, smoothness, and softness.

# The North American Alpaca Federation

## Alpaca University

2. A demand for fine, luxurious, eco-friendly, carbon-neutral, and naturally lustrous alpaca fiber exists

Alpaca fiber is very strong (1.5x that wool, per Yocum McColl)

*Note: To promote rare is a short-term situation. Alpaca fiber won't always be rare, so build a marketing plan on a short-term concept is short-sighted.*

*Note: Many of us may say, "Have you ever met anyone who didn't like alpaca?" However, this can be a dangerous assumption. There are many substandard alpaca products on the market. A better statement might be, "When presented at its best, everybody loves alpaca."*

### ***B. Breeding Goals to Achieve Profitable Fiber Production***

The goals of this workshop are two-fold:

First, we must understand and evaluate the pros, cons, and ultimate value of producing alpaca fiber for profit.

Second, we must set common goals and strategies to ensure we selectively breed for realistic, potential market demands.

NAAF will put a "stake in the ground" at this point and propose that:

**Breeding a national alpaca herd for profitable fiber production, in order to satisfy commercially viable and lucrative textile markets, will require fiber that averages 25 microns or below, with animals maintaining this average until at least 7 years of age.** We will expand and refine this fiber-breeding goal as we move forward and deeper into our subject.

Note: Drawing a line at 25 microns is assuming a raw fiber market as the only option. This mandate would eliminate socks and duvets from products, with duvets being profitable for farms. The greatest profit from our niche market industry is to control as much of the value chain as possible – from shearing through product sales.

Note: All grades, colors, and micron counts of alpaca fiber have potential value within the scope of both the apparel and alternative use designations (e.g., rugs, duvets, animal coats) and, as a result, breeding for ultra-fine luxurious fiber may or may not produce a greater return on investment for any particular breeder due to individualized overhead costs. Alpacas on "fiber farms," where the animals are bred on pasture with minimal labor and support costs, may return greater profits with higher micron fleeces that are more appropriately used for various non-apparel end products, as well as some styles of socks. It depends upon your niche business model. So, don't throw away higher micron fiber!!

# The North American Alpaca Federation

## Alpaca University

### ***C. Alpaca Fiber End Product Strategies***

Some significant studies, based on experiential evidence, as well as in-depth and long-term laboratory-based studies with sheep, suggest that breeding for follicular density and fast-growing fiber will produce the best results for maximizing profitable fiber production. The reasoning is that a dense fleece will tilt the odds in our favor by producing fleece of superior fineness, length and uniformity.

Note: Alpacas clearly are not sheep. As we research and learn more about alpacas, we will be able to note the differences between sheep and alpacas. But for now, wool can be a useful comparison tool for us.

1. Breeding for fleece uniformity often rewards the breeder with a low average fiber diameter – a consistent fineness. But, this is not a given and uniformity itself carries its own benefit, even though it may not always translate to increased consistency and fineness.
2. Fineness in fiber allows processors to pack more fibers into a strand of yarn, offering increased strength, durability, improved uniformity, and a soft-to-the-touch handle. This fineness allows for a finer yarn and finer weave, which can in turn be used for finer more delicate products. *Note: This would depend on the processing method. Worst processed yarns lose handle because they are tightly twisted and this creates drape at the expense of handle.*
3. Processors may choose to create yarn with fewer fibers per strand of yarn – yielding a lightweight but still strong garment.
4. Fast-growing fibers tend to create fewer, smoother, and longer scales (fiber building blocks), leading to a natural luster unique to alpacas. *Note: More testing is needed here, some of which is currently going on at Gaston Textile College. There are short stapled Huacaya that rival Suri in luster.*
5. Uniform fiber length contributes to a soft, silky feel. It also gives processors a consistent raw product to work with to produce garments of predictable quality.

Note: A lack of or poorly defined crimp makes the weaving process more difficult.

Question: How do we measure uniformity, fineness, fiber growth rate, fiber length, and brightness/luster?

Answer: Objectively, with scientific measurements, and subjectively, with experienced key sensory perceptions. Objective measurements, such as histograms and follicle skin biopsies, will yield valuable metrics. Subjective considerations include preference for crimp style and lock structure, running one's hand along a fleece, and testing the strength

# The North American Alpaca Federation

## Alpaca University

of fibers for weakness (rotten, stress breaks). Evaluating alpaca fiber is both an art and a science.

### ***D. Alpaca Fiber – Form & Function***

#### **1. Fiber – A Textile Building Block**

Fiber is the fundamental component required for making textile yarns and fabrics. There are two types - natural and synthetic. Natural fibers come from animals (sheep, goats, camelids, etc.) or vegetable-based fibers (cotton, flax, linen, and other plant fibers). Mineral fibers (asbestos, etc) are also classified as vegetable-based fiber. Synthetic fibers are man-made and manufactured from synthetic chemicals – (byproducts of the petro-chemical industries) – nylon, polyester, acetates.

#### **2. Follicle – A Fiber Building Block**

One of the unique characteristics of mammals is hair. Hair is made up primarily of the protein keratin, which also produces our own skin, finger and toe nails, animal hooves, and even bird feathers. There are many types of hair, depending on the species, each with its unique architecture to serve a specific purpose. The thousands of follicles present within the skin of man and beast are responsible for growing hair fiber.

Fibers grow from follicles. Follicles are arranged as oval clusters (follicle groups) covering the entire body. Each alpaca hair follicle is a mini-factory lying within the alpaca's skin, which manages the growth and well-being of each individual fiber and fiber type. The more follicles in each cluster, the closer together and, therefore, denser the fleece (i.e., more follicles per square inch or millimeter). The primary follicle consists of a sweat gland (to help manage body temperature), a sebaceous gland (to help protect the fiber. And an erector muscle with allows the primary fiber strength to stand straight for support of the secondary fibers. (Horses are able to use their erector muscles to actually adjust the direction their fibers point depending on wind conditions). We have erector muscles also – as when the hair on the back of your neck stands up.

The primary fiber, which grows from a primary follicle, is usually the longest and thickest of fibers. Its job is to protect both the alpaca and its secondary fibers from the harsh environment. The secondary follicle is generally host to a finer secondary fiber and often also some “secondary derived fibers,” which tend to be finer still. Primary follicles generally form in groups of three (trios), with a number of secondary and derived secondary fibers clustered around each of the primary fibers. A follicle group can be as small as 0.5 mm across. A staple bundle is a number of these follicle groups bundled together. The width of the staple is determined by how densely packed the follicle groups are within the skin.

# The North American Alpaca Federation

## Alpaca University

Note: Just because a skin biopsy may reveal 15 secondary follicles per primary, it does not necessarily follow that all 15 will grow fiber.

### 3. Cuticles/Scales - The Armor

Hair grows outward through the follicle. Each hair is made up of many cylindrical strands of protein. If you think of a thick wire, made up of many thinner individual wires, you can get a feel for the added strength in numbers. This architecture is used for the huge cables that support suspension bridges.

Each group of protein strands cluster and grow together to produce a single hair. For additional protection and support, numerous cuticles (we often call them scales and so we will use the term “scales” from hereon) overlap each other (like roofing shingles) and collectively envelope the entire hair shaft. This structure protects the inner strands of fiber from the environment, yet also allows vital nutrients to seep into the strands for nourishment. These scales vary in hardness, length, and height, depending on the type of hair. The serrated edges of alpaca scales along each hair shaft, coupled with the inner and often twisted structure called fibrils, are the secret of the variability, strength, and elasticity of different types of fiber. The glue that holds the scales together is called elasticum. Try working that into a conversation.

One of the secrets of why alpaca fiber is so strong (resistance to breakage) has to do with its particular architecture. The major difference between Suri and Huacaya fiber has to do with their different fiber architecture. The Huacaya fiber crimps and the Suri fiber does not.

This is due to the ortho- and para-cortical cell structure, as with sheep wool. Using differential scanning calorimetric (DSC) and scanning electron microscopy (SEM) techniques, a recent Ohio State study confirms that *“huacaya have an ortho and para bicortical structure whereas suri fibers mostly consist of paracortical cells.”*

Some believe that it is the arrangement of the ortho and para cortex that determines crimping. Suri fiber has “strands” of ortho around the circumference, which is thought to effectively “balance” the fiber, eliminating crimping. Huacaya fiber, on the other hand, has a top and bottom half of each, resulting in different surface tensions that create the twist which is part of crimp.

The health of the alpaca, its diet, and the weather can and does affect each hair. During processing, how fiber is washed, dyed, and spun will also affect the final product. To compound the complexity, many mammals, including alpacas grow different types of hair for various functions.

# The North American Alpaca Federation

## Alpaca University

One aspect of the American herd that is different from many other countries is that we have a focus on breeding for color. Most other countries focus on breeding white animals. Since we have the most color in the world, this should be an item on which we capitalize. Rather than trying to compete with dyed white fiber, we should consider focusing on the many natural colors available within the North American herd. We have the highest quality colored alpacas in the world. This is a niche advantage!

We will address primary, secondary, and guard hair in a separate section. All three types are needed, per Mother Nature, to comprise the alpaca's natural shield, its fleece. Genetically altering the alpaca to remove guard hair, for example, may seem to benefit textile markets, but it may negatively impact alpaca health. On the other hand, breeding to create primary and secondary fibers that are of similar length and close in micron count will provide comparable textile benefits, but would not be expected to result in harmful health effects. Long fibers is a smart goal also. For those of us who have dams with very short fibers, imagine if we could breed them to be much longer for more years to reap the profits from Fiber for Profit.

### 4. Hair/Fiber/Wool - Definitions

Hair is critical to most mammals' survival. Hair provides insulation from the cold by preventing the loss of body heat and is also able to keep the heat at bay when the body wishes to stay cool by wicking sweat through porous fibers and away from the skin. Animal hair also protects from the negative effects of humidity and rain. Our own human hair does not protect us from the elements as effectively as animal hair does. Scientists still debate and offer theories as to why we human mammals have hair at all. Given our lack of protection from the often-harsh environment, we have learned how to utilize the hair of other mammals and adapt their wonderful thermal properties to our own benefit. We have created and protected ourselves with these mammal-based textiles for thousands of years and will continue to do so.

So, what is the difference between hair and fur? Technically - nothing. Yes, whales are mammals and actually do have very fine hair. But, we do not call that fur! The term "fur" is usually reserved for a thick-coated animal. An otter has fur, as does my Great Pyrenees guard dog. There are no furry whales. The term "wool" presents a special case. While "wool" usually refers to the protective hairy covering of sheep, goat hair, camel hair, and even caterpillar hair can be referred to as "wool." And, of course, alpaca fiber is often called wool fiber, as in, "What do you do with their wool?" (Note that these NAAF modules will give you the knowledge to confidently answer this question to your own and your customer's satisfaction, and establishing a regular revenue stream from the sale of your yearly harvest will further substantiate your reply.) To complicate things a bit more, many mammals are two-coated animals, with thicker outer fibers that function

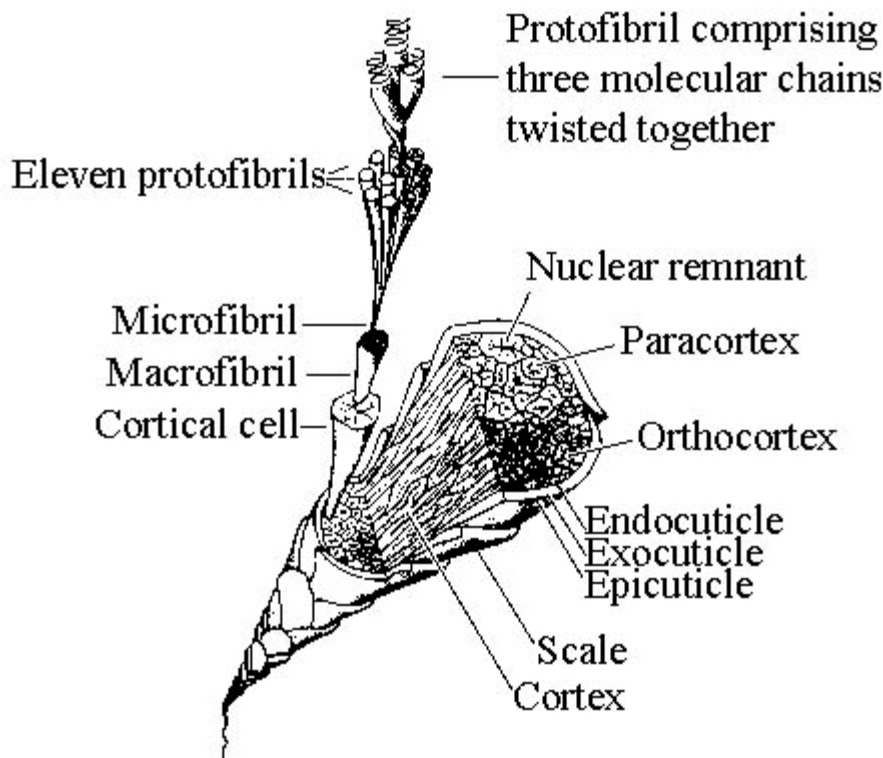
# The North American Alpaca Federation

## Alpaca University

to product the finer, warming inner fibers from harsh environments. The finer coat is typically called down or wool. And, of course, an alpaca is a two-coated animal.

So, for a two-coated mammal, such as the alpaca, the outer, coarser layer, generally consisting of primary fibers, heavily medullated fibers, and guard hair or kemp, is often called “hair,” while the inner, finer, and more delicate secondary fibers are sometimes referred to as “wool.” But, whether we simply call it alpaca fiber or wool, alpacas produce one of the world’s finest and most luxurious fibers. Many say that alpaca is as soft as cashmere. The truth is – it depends. Many say alpaca is warmer, lighter, and stronger than wool. The truth is – it depends. Many say alpaca comes in more natural colors than any other fiber-producing animal. Now, this is definitely true!

If we alpaca breeders intend to maximize profit from our annual harvests, we must understand exactly what we are growing in our back yards and paddocks. If it is our goal to produce the highest quality alpaca products, it will require great genetics, a nurturing environment, expert processing, and an understanding of both market demands and quality control. Let us start by separating fiber fact from fiction.



The above is the profile of a Huacaya fiber. If you take the orthocortex and put each of the cortical cells around the perimeter of the fiber you get a Suri fiber – the placement of the ortho around the perimeter neutralizes the tension difference between para and ortho, resulting in straight Suri fibers.

# The North American Alpaca Federation

## Alpaca University

### *E. Alpaca Fiber – The Magic & the Myth*

Are we able to put a value on alpaca fiber? Is it something a North American consumer would want to wear? Which consumers might want to buy it?

Alpacas and their end products are not well known in North America. There are more than 200,000 animals on North American soil - the supply is minimal (for now!). As a result, there is little demand (yet!). There are many other natural fibers, as well as high-tech synthetic blends, out there to choose from. Given the massive marketing and advertising dollars at play in lucrative established textile markets, why would American consumers choose to wear alpaca?

The need to be clothed is a given – like death and taxes. Cultures and their traditions evolve. Fashion trends play a critical part in textile demand. There are several dynamics in play at any time in the North American textile market place. The value of a diamond is derived from its rarity, its sparkle, and the worldwide tradition of the diamond as a symbol of both an enduring relationship and financial wealth. "Diamonds are forever." In reality, diamonds are very hard crystals. They have industrial value because they can be used for precision cutting of other hard materials. But, we now can manufacture industrial diamonds in the laboratory. Nonetheless, due to tradition and fashion, natural diamonds continue to command high prices and are given high social value. The value of gold is derived from its rarity and the trust the global economy places in gold. Gold does not rust; it is eternal. It is shiny and, like diamonds, is frequently used to symbolize an enduring relationship. Value, therefore, can be based on rarity and perception.

Neither diamonds, nor gold can directly cloth you or keep you warm. Mink, sable, and fox coats, on the other hand, can. These furs were once the rage as rare luxury fashion items. However, their value has been fading due to our new social conscience. The "No Fur" movement exposed the facts that it takes about 200 mink skins to make one mink coat and that baby seals are clubbed to death simply for their fur. The 'No Fur' movement has no qualms about embarrassing the rich and famous over the fur they wear. Fashion and social trends are intertwined. Slaughtering animals for food is considered by most a necessity. Slaughter purely for the sake of fashion, however, has become less and less acceptable for an ever-growing percentage of the population.

As a new awareness about our health and the health of our planet has developed, many of us have begun to pay a premium for select organic foods when we shop. Bombarded on a daily basis with "eat healthy" mantras, we are made aware of the pesticides, herbicides, and related chemicals, which poison the soil and our water supplies in support of maximized food production techniques. Similarly, we are becoming ever more aware of the consequences of our heavy dependency on petroleum-based products.

Our current socio-economic conscience rings with dozens of "buzz words:" natural, organic, eco-friendly, carbon-neutral, no kill clothing, conservation, and green, to name a few. This social consciousness presents a unique opportunity for alpaca producers and for the marketing of alpaca fiber in these newly evolving markets. Americans have already evidenced a willingness to pay a

# The North American Alpaca Federation

## Alpaca University

premium for organic food. Most Americans also readily accept that we need to wean ourselves off ever diminishing oil products. This will translate into higher prices for petroleum-based synthetics like nylon and Gore-Tex. This ever-growing socially conscious American movement toward “Going Green” provides a perfect niche for the American alpaca grower.

Alpacas are easily established as eco-friendly, green, and carbon-neutral, along with any number of other “organic” or “natural” adjectives we wish to employ. Given the facts about alpacas and their minimal impact on the earth, it seems likely that many Americans will be willing to pay a premium for “Made in America,” “green” alpaca clothing. Alpaca fiber, therefore, presents a unique combination of benefits for textile producers. Alpaca fiber has the ability to meet the demands for both warmth and fashion, while dovetailing beautifully with the consumer’s increased awareness of and appreciation for “green” products. Integrating the concept of “green” alpaca fiber into America’s consciousness will bolster fiber marketing initiatives, add perceived value to alpaca products, and, ultimately, raise producer profits as demand continues to grow.

In the name of serving fashion and responsible global conservation, let’s investigate how “green” alpacas really are. In a nutshell, alpaca fiber hits the bull’s eye in its ability to help meet the growing demand for environmentally responsible textiles.

### ***F. Alpaca Fiber - The Eco-Friendly American Textile Choice.***

“Agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach.” *NGO Sustainable Agriculture Treaty*

As alpaca breeders we can tie into the socially conscious, “green” movement, because alpaca and its fiber satisfy many of the requirements for eco-friendly, carbon-neutral, and socially responsible agriculture.

**The “Green Strategy” for alpaca:** Why waste yet more fossil fuels manufacturing petroleum-based synthetic fibers when the natural solution is in our own backyards? We must promote all of the following environmentally-friendly attributes of alpaca fiber.

#### **1. Sustainable**

An ever-growing American herd provides a continuous source of fiber for textiles and other eco-friendly byproducts. Alpaca can be efficiently and effectively grown on thousands of small independent family farms across North America. Alpaca is both sustainable and fashion-ready!

# The North American Alpaca Federation

## Alpaca University

### 2. Natural

Alpaca fiber is not synthetic or petroleum-based like polyesters, acetates, acrylics, nylon, rayon (a wood pulp product which requires dry-cleaning!), or Gore-Tex. Cotton, while a natural fiber, uses 25% of all insecticides applied to crops worldwide. The Environmental Protection Agency (EPA) deems seven of the top 15 pesticides used on U.S. cotton crops to be potential or known human carcinogens. Cotton now comes in several natural colors, but not the wide array of alpaca.

### 3. Animal-Friendly

Unlike mink or baby seal, which are killed to harvest their pelts, alpacas are not harmed when their fleece is harvested. Alpacas are shorn once a year and shearing not only provides producers with wonderful fiber, it benefits the alpaca by removing fleece that would otherwise render them susceptible to unhealthy heat stress during the warm summer months.

### 4. Durable

Alpaca fiber is one of the strongest (tensile strength) natural fibers in existence. This translates into durability and the ability to spin fabric that is very lightweight, yet strong. Archeologists have found remnants of Peruvian Inca alpaca textiles from centuries ago. No forced obsolescence here.

Note: Research (Holt, Stapleton 1993) alpacas have a tensile strength range of 22-104 N/KTex. 35N/KTex is considered sound on conventional machinery. 40N.KTex is not considered minimum for sound wool.

Note: Though widely believed to be ‘abrasion resistant’ due to the fiber’s great strength, this has not been shown to be the case in day-to-day wear. Alpaca does not seem to be any more or less abrasion resistant than sheep’s wool.

According to the International Alpaca Association, “it is important to point out that [alpaca’s] thermal characteristics widely surpass the ones of wool and that they are also better than the standard characteristics of mohair and cashmere. The resistance of alpaca fibers is also higher than the resistance of the other above mentioned fibers.” (International Alpaca Association 2010, <http://www.aia.org.pe/aia.html?32>).

### 5. Environmentally-Friendly – “Going Green”

1. Alpacas are the most environmentally friendly of agricultural grazing animals – they live lightly on the earth.
  - a. Alpacas have soft, padded feet that do not cut into the topsoil. Sheep and goats are much harder on the earth because of the impact of their hooves, which are more likely to tear up and damage plant life and soils.

# The North American Alpaca Federation

## Alpaca University

- b. Damage to topsoil decreases long-term soil fertility, increases soil erosion, and encourages the proliferation of weeds.  
Alpacas are generally kinder to pasture than sheep, preferring to browse on a variety of plants and grasses, without disrupting root systems.
  - c. This allows faster pasture recovery and minimizes soil erosion.
  - d. Where cattle (leather) pull up grass by the roots and compress the soil, alpacas do not. Rather, alpacas use their front incisor teeth to cut grasses off while grazing.
  - e. Alpacas, as browser-grazers, enjoy eating brush, fallen leaves, and other vegetation that is often undesirable to other species.
  - f. Alpacas' fur, referred to as fleece, grows quickly and is lighter, warmer (meaning it takes fewer strands than wool to insulate), and softer than most sheep wool.
  - g. Alpacas consume lower amounts of both water and forage relative to other livestock, and their efficient three-stomach digestive system metabolizes most of what they eat.
  - h. Their pellet-like droppings are pH-balanced and are an excellent, natural, slow-release, low odor fertilizer, that may also be used as bio-fuel.
2. Alpacas, due to the architecture and qualities of their fiber require few, if any, chemicals to grow their fleece or to have it processed into yarns, felt, and other specialty fiber products.

Note: At this time, alpaca owners residing in white-tail deer territory must administer monthly injections of ivermectin to safeguard their herd from meningeal worm. Ivermectin is considered to be highly toxic and remains in manure, and presumably soil, for some period of time, the extent of which is not yet known. More research is needed to determine the long-term effects of this practice and breeders must decide how it may affect the labeling of alpaca as a "green" livestock. Similar considerations may apply to many of the medications or de-wormers often routinely used to maintain herd health.

- a. Sheep fleece contains lanolin. As a result, a multi-step detergent wash is needed to remove most of the lanolin prior to processing. Although alpaca also needs to go through a fiber-scouring phase, the chemicals required are fewer and less harsh. Ultimately, alpaca fleeces are relatively easy to process due to this absence of lanolin. The lack of lanolin also gives alpaca a higher yield of end-product by weight, often yielding twice the finished weight of sheep wool when comparing equal pre-processing fleece weights.
- b. Alpacas come in wide array of natural colors, offering far more choices for naturally colored yarn and products, as opposed to colors produced using chemical dyes.

# The North American Alpaca Federation

## Alpaca University

- c. Manufacturing synthetic fibers is energy-intensive and can release lung-damaging pollutants such as nitrogen and sulfur oxides, particulates, carbon monoxide, and heavy metals into the air, as well as climate-warming carbon dioxide.
- 3 Alpaca fleece may naturally resist intense solar radiation in rarified mountainous atmosphere. (Research is needed here – this bullet comes from retailers of alpaca products and is unsubstantiated to our knowledge).
4. All parts of the alpaca fleece are useful; the higher micron or “hairier” portions (lower legs, britch, etc) may be used as natural weed mats around trees, heavy felt for boot liners, or for indoors rugs, to cite just a few examples.
5. Alpaca clothing is considered to “breathe naturally,” as it tends to wick moisture and perspiration away from the skin.
6. Alpaca fiber is very strong, but this feature does not translate into resistance to abrasion.
7. Alpaca fiber may require de-hairing if it contains a significant percentage of coarse primaries (guard hair or kemp) and especially if it is intended for finished products that will be worn next to the skin. The de-hairing process removes the thicker primary fibers, but retains the softer secondary fibers in the fleece. Duvets in Australia are made exclusively from de-haired alpaca fleeces. In general, however, overly hairy alpaca fleeces, with numerous thick and long primary fibers, are not ideal for processing into high-end products.

## 6. Fiber isn't just for breakfast anymore!

Alpaca end products and blends are beginning to turn up everywhere. Today, you can buy alpaca quilts, blankets, duvets, pillows, throw rugs, carpets, cushions, knitting yarn, scarves, shawls, toys, gloves, hats, ponchos, jackets, socks, coats, sweaters, horse blankets, saddle pads . . . and the list continues to grow. We can purchase alpaca products from farm stores, co-ops, through catalogs, and over the Internet, as well as from shops in our local malls.

There are two principle methods of processing used to produce alpaca yarns and fabric. The worsted method processes the fleeces into product by “combing” (not carding) fibers to coax them into a highly parallel configuration. This method allows for fewer twists per yard, and these fewer twists produce less tension allowing for a smooth feel and a soft fabric. The worsted process also results in a wonderful draping quality. Suri fiber, being crimpless, offers no loft to a product. Loft is required in the

# The North American Alpaca Federation

## Alpaca University

woolen process, where fibers are “carded” rather than combed. The carding process encourages loft and is used to produce yarns for bulky sweaters noted for their warmth. Note that Suri and Huacaya fiber share both differences and similarities in terms of their beneficial uses. The alpaca, therefore, offers us multiple choices for production fabric qualities. Suri and Huacaya breeders are not in competition, but rather provide a synergy of choices and possible combinations of traits that increase the overall potential for profitability within the industry.

### ***G. Alpaca vs. the Competition – Head-to-Head***

Much can be learned from comparison, whether in ideas, points-of-view, products, or alpaca fiber. Let us look at our alpaca fiber harvest from the point of view of a manufacturer of fine textiles. Of what value is alpaca fiber to such a manufacturer?

Alpaca fiber is rare – like diamonds or gold. But, rarity is not necessarily indicative of perfection. Take Cabbage Patch Dolls, for example. Prices soared as consumers struggled to find these rare gifts for children and collectors. A lack of supply, coupled with high demand, drove prices (and profits) through the roof. But, the novelty soon wore off. What are these dolls worth now? Certainly not what we who jumped on that bandwagon paid for them at the time.

Note: Rarity may serve us well now, but it will not continue to do so, as the American alpaca fiber supply slowly grows. Rarity, for alpaca producers, is likely to function only as a short-term marketing strategy.

Alpaca breeders rightly worry about the alpaca fiber supply. If a wild demand for alpaca fiber suddenly emerged among North American consumers, American fiber producers would likely be unable to deliver an adequate and sustained supply of product. In that event, the mania for North American-grown alpaca would likely soon fizzle. Current producers, therefore, need to work to ensure there is sustainable method for attracting new breeders to the industry. Furthermore, it is critical for breeders to not only build a continuous supply of marketable fiber, but to also ensure *consistency* in that supply by establishing widespread use of standardized methods for shearing, harvesting, grading, sorting, classing, and quality control.

In order to attract new breeders, and thus grow the North American herd, current producers must work to demonstrate to potential new breeders the viability of additional revenue streams – an annuity, if you like, - by means of a consistent yearly harvest. We must understand our fiber, the textile markets, and fashion trends. Although we need not be experts in all of these fields, but must be aware of potential avenues to create and market our unique, luxurious, elegant, and socially-conscious end product.

What *is* the value or potential value of what is growing on the backs of our alpacas in our pastures, paddocks, and back yards? To appreciate that value, we must compare our harvest to our competition’s harvest – in the spirit of “not better, but different.” There is no “golden fleece” that is perfect in every way. Alpaca, however, sure has a lot going for it!

# The North American Alpaca Federation

## Alpaca University

### 2008 Alpaca Fiber Production vs. Its Competition By Weight:

Fiber	Major Producers	Production
Alpaca	Peru	5000 tons
Cashmere	China-Iran	6000 tons
Angora	China-France-Chile	10,000 tons
Llama	Bolivia	600 tons
Vicuna	Peru	3 tons
Mohair	South Africa-USA-Turkey	29,000 tons
Wool	New Zealand-Australia-South Africa	2,000,000 tons

Above table from Australian Commonwealth Scientific and Research Organization (CSIRO) From the above table it should be clear that production of alpaca fiber would surpass that of wool just after the Chicago Cubs win the World Series two years running. We are and will be a niche market product, at least for the foreseeable future. However, we have the ability to make that market both very lucrative and socially responsible.

### Comparing Alpaca Based on Fiber Qualities:

Making any “blanket” or absolute statement that broadly compares one fiber to another can be problematic. For example, statements that, “Cashmere is prettier than alpaca,” or that, “Silk has more luster than Suri,” are subjective and highly dependent upon the specific products or fiber samples being compared. Although it is a fact that it generally takes fewer alpaca fibers to produce the same insulative effects as wool, this does not translate into a statement that alpaca is warmer across the board. Rather, it is just that, often, less alpaca is required to provide a given level of insulating protection. Actually, the most important variable in the statement is that the degree of insulation achieved is highly dependant upon the construction of the garment.

In fire retardancy testing, the level of retardancy achieved is similarly dependant on the construction of the garment, not just the type of fiber. The form of the fiber, whether it be raw, knitted, woven, tightly woven, and even the type of weave in a fabric, greatly affects a product’s flammability. These same factors similarly affect insulative attributes, tensile strength, water resistance, water absorbency, durability, and hypoallergenic characteristics, among many others.

Broad statements comparing fiber types should not be made unless they are based on verified studies that substantiate the characteristics being propounded. As alpaca products become more mainstream, it will become ever more important that breeders not present unsubstantiated claims. We must have testing results on which to rely.

# The North American Alpaca Federation

## Alpaca University

### 1. Alpaca Fiber Compared to Sheep Wool

While there are many varieties of sheep in the world, each bred for a specific purpose, this comparison is limited to evaluating alpaca fiber against “Merino” wool. Merino wool is associated with the ultimate in fine, soft, low-itch sheep wool. Merino sheep are bred for their fiber and not their meat. Merinos are bred all over the world, but primarily in Argentina, Australia, New Zealand, South Africa, and the western United States.

Note 1: There are many kinds of sheep wool, just as there are many kinds of alpaca fiber. All have value. At this time, NAAF sees no reason to attempt to force a breed standard on the North American alpaca. A “cookie cutter” approach would limit the numerous possibilities open to us for selective breeding for the great variety of fleece characteristics available. The emerging market for alpaca fiber should dictate value, just as the market for sheep wool has resulted in a wide variety of end-uses and products, each dependant upon unique fiber characteristics. Different breeds of sheep thrive in different geographic regions and produce widely varying end products. The same may hold true for alpacas.

Note 2: The evaluation of alpaca fiber vis-à-vis sheep wool will be the most extensive comparison we will make, as alpaca fiber and wool share a number of characteristics. The two are also natural companions for blending and, when done in the proper percentages, result in truly wonderful end products.

#### Class-One Wool

Merino sheep produce the “best” wool, in terms of fineness, softness, durability, memory, and strength. Wool is known for its “memory,” which is the ability of fiber processed into textiles to bounce back to its original shape. Alpaca is often criticized for having inadequate memory and, as a result, is often blended with 6% to 20% wool to increase memory.

Merino fiber is know for its high frequency of crimp. This high crimp frequency gives merino its “loft” and resultant insulating properties, making it very warm. Merino is also noted for its large number of cuticles (scales), which affect its spinning properties because the numerous scales grab each other easily. Merino frequently measures in the 16-22 micron range, with upwards of 30 crimps per inch.

Elasticity and memory, although related, are not interchangeable terms. Elasticity is “give” – the ability to expand. Elasticity is a comparative measure of how far a fiber stretches. Memory is how well the fiber returns to its normal length. A rubber band has both elasticity and memory, while pulled taffy has elasticity, but little memory. Elasticity is partially affected by Huacaya crimp style. Crimp will provide some “give” in a yarn, but elasticity also depends on the twist of the yarn (1 ply, 2 ply, 3 ply, etc). Nylon, in the form of spandex, is sometimes added to alpaca to give it additional elasticity. Numerous options are available to create new fiber combinations and, therefore, new synergistic products.

# The North American Alpaca Federation

## Alpaca University

Studies show that wool is 80% elastic, whereas alpaca is only 10% elastic. Alpaca, therefore, is not considered an elastic fiber. As a result, alpaca is often combined with wool, in amounts varying from 6% to 60 % of finished product, to give alpaca fabric added elasticity. According to one Australian Commonwealth Scientific and Research Organization (CSIRO) study, “Crimp in alpaca increases the ease of manufacture and can partially substitute for memory.” In finished fabric or products, memory refers to a fabric’s ability to return to its original state after being stretched. Sweaters that become baggy with wear or upon washing and that do not easily return to their original shape lack memory.

Suri and Huacaya fiber are not considered to have either significant elasticity or memory. While crimp structure from some highly crimped alpaca may remain in a woolen fabric, a significant percentage of the crimp will disappear in the manufacturing process. Nonetheless, in general, the more well defined the crimp going into the woolen process, the better for ease of processing and more loft in the end product.

### **Class-Two Wool**

Class-two wool is somewhat inferior to Merino wool from a textile perspective. It is good wool but less expensive than Merino. It has a large number of scales, so it spins well. Unlike Merino, its scales have a sharper point on the three edges of the scale. This type of wool is often used for traditional Scottish and English sweaters.

### **Class-Three Wool**

These fibers have fewer scales and less crimp than the above two classes. Fewer scales make this fiber smoother and brighter. The smoother fiber reflects light better than fiber with numerous scales, which diffuse light.

The lower number of scales and the fewer crimps per inch in Class-three Wool decrease softness. It is also known that Suri fibers have fewer scales than Huacaya fiber, as well as little or no crimp. The smoother nature of Suri fiber lends itself to evaluation by breeders according to “luster,” while the equivalent term used to evaluate Huacaya fleece is “brightness.”

Note 3: The fiber industry in general uses the term “brightness” when referring to the various reflecting abilities of fiber. The term “luster” is a breeder term applied exclusively to the Suri.

While luster appears as a deep “glow,” brightness is the result of light reflecting off irregular surfaces (crimp, for example). If you look at Suri fabric it does not have brightness like Huacaya, but something much more subtle and soft, which is what we call luster. Some studies state that Suri has been shown to have an oval hair shaft, which reflects more light than a cylindrical shape. Not true – fleeces with high SD’s exhibit

# The North American Alpaca Federation

## Alpaca University

more ovoid fibers but as density and fineness improve, the more cylindrical the fibers become. Oval fibers are reflective of a more unimproved or primitive fleece in either type of alpaca.

Note 4 – Class 3 wool is known to be less elastic and less resilient than Class-one or Class-two wool

Note 5: Suri does have larger scales that lay flatter than Huacaya fiber. The result is very similar to a mirror effect. Some Huacaya, however, can have just as much luster. It seems unfair to distinguish one from the other based on luster. In textiles, it doesn't make that much difference. Most Suri will be processed in a worsted method, with tighter twist and weave that reduces handle, but adds drape. Therefore, loss of handle from larger Suri scales becomes a moot point. The luster of Suri, however, stays with the fabric, giving a completely unique and exotic 'glow' to the finished product.

### **Class-Four Wool**

Class 4 fibers are long and coarse, with few scales and little crimp. They are, therefore, smooth and bright, but with very little elasticity, memory, or tensile strength.

Note 6: Wool's characteristics have been studied for centuries. It appears from the above classifications that fewer scales give wool fiber its brightness. Fewer scales also result in diminished memory. More scales contribute to greater strength and better memory. These facts should be kept in mind when investigating Huacaya and Suri fiber architectures.

### **Wool compared with alpaca:**

- A major difference between alpaca and sheep wool is that wool contains lanolin, whereas alpaca does not. Lanolin is a wool grease that protects sheep fiber from the environment and that imparts a unique "odor." Alpaca has no lanolin, making it odor-free. Generally, not all the lanolin is removed from wool during the scouring /washing process. Alpaca tends to stay cleaner than wool, because of this lack of lanolin; lanolin tends to attract and retain dust and small particles. While some people are allergic to lanolin, the skin rashes many people experience are from wearing inferior wool due to the "prickle factor" effect of 30-plus micron fiber, as it jabs into the skin (a direct result of the hooks from the scales on wool fibers). The prickle factor can also be caused from coarser hairs sticking out of fabric, interacting with the skin, and triggering pain receptors, resulting in irritation and itching. Lanolin is used in some cosmetics, salves, and other beneficial skin products.
- Because of its superior fiber tensile strength (its naturally strong internal structure), alpaca stands up to daily wear better than wool. Better tensile strength helps a garment resist holes, but tensile strength alone cannot prevent holes altogether. Fiber strength has two characteristic measurable functions: tensile strength and shear strength. Holes in socks are caused by failure of shear strength, due to repeated pressure perpendicular to the fiber. The principal reason for holes developing in the toes and heels of socks is the use of the wrong grade of fiber. Holes will develop both in poorly made alpaca socks and poorly made woolen socks. Holes in suits and dresses are caused by failures in tensile

# The North American Alpaca Federation

## Alpaca University

strength, where the force is parallel to the fiber. Again, properly processed alpaca fiber (no short or damaged fibers *or second cuts*) will resist these wear and tear issues better than most other fibers. Durability results from the use of the proper grade and length of fiber for the specific application. Quality control, therefore, is important to ensure that end products meet consumer expectations.

- When running your hand over fiber, alpaca will generally feel softer than wool of the same micron count. This softness is partly a result of the fact that the overlapping “scales” along the shafts of alpaca fibers protrude less (lie closer to the shaft) than on wool fibers. There are also *fewer* scales on alpaca fibers than on wool fiber and wool scales have “hooks” on them, while alpaca scales are soft, rounded, and leaf-like scale. Suri can feel even softer than Huacaya of the same micron count because Suri fibers have about 30% fewer scales than Huacaya fibers. The unilateral cortex and fewer scales of Suri fibers make them smoother to the touch and more lustrous, but a little harder to spin.

It has been reported by Phan that the mean scale height of alpaca fibers that have fiber diameter greater than 19  $\mu\text{m}$  is approximately 0.4  $\mu\text{m}$ , while that of wool fiber of similar fineness is around 0.8  $\mu\text{m}$ . Obviously such a scale profile will result in a smaller difference between the friction coefficients against-scale and with-scale for alpaca fibers than the corresponding difference for wool fibers. It has been reported that the DFE (a technical term for friction metrics) is, on average, 0.20 for Huacaya alpaca, 0.16 for Suri alpaca, and 0.40 for sheep wool. In addition, as the cuticle cell thickness reduces, the bending rigidity of the fiber may reduce. For alpaca fiber, the mean scale frequency is greater than nine scale edges per 100  $\mu\text{m}$  while wool fiber has four per 100  $\mu\text{m}$ . This would result in a smoother surface for alpaca fiber than wool. Compared with the scale of wool, cashmere and alpaca fiber scales are thinner and denser.

- Wool is more likely to become heavy and saturated when wet, as it can absorb up to 35% of its weight in liquid. According to the Gaston Fiber College, alpaca wicks, but *does not absorb* water.
- Some manufactures advertise that alpaca resists matting and pilling, and that only the finest alpaca fibers will pill. To our knowledge, however, this has not been substantiated and the quality of the fiber used, as well as the method of manufacturing, will have a substantial impact on whether or not a finished product has a tendency to pill or matt.
- Alpaca is absolutely unique among fiber-producing animals in that it comes in the widest array of colors naturally available. The exact number of colors, however, is a matter of some debate. Peru cites 52 natural colors and Australia 12, while the United States identifies 22 individual colors. Research done at the University of Ohio suggests there are probably an infinite number of colors that appear to be expressed in alpaca fiber. However, the study identifies only three basic colors of alpaca fiber: black, white, and red (brownish/yellowish/reddish). These three basic colors combine in a wide variety of ways to visually create the many colors generally found on an alpaca color chart. One of

# The North American Alpaca Federation

## Alpaca University

the interesting implications of this study is that, if there are only three basic alpaca colors, then there are no true “gray” fibers. Silver gray and rose gray alpacas are a mixture of the three primary alpaca fiber colors.

- The key advantage to all this color choice in alpaca is that dyes are not needed to achieve a wide variety of color options for the consumer. Although alpaca, like wool, takes dye beautifully, most dyed colors are achieved through the use of chemical dyes that require the disposal of chemical waste, often toxic. These dyes add expense, an extra processing step, and a significant chemical waste stream, with its attendant environment impact. While natural, earth-friendly, non-toxic dyes can be used on alpaca, the addition of a dye step, particularly with the more expensive “natural” dyes, will increase final product costs. The alpaca, with its wide, natural array of color is a perfect fit for the growing interest in “living green” and this aspect of alpacas should be a marketing focus for North American breeders, who already possess the global edge in producing quality colored alpaca.
- Compared to sheep wool of comparable fineness and yield weight at shearing time, alpaca has been shown to produce a higher yield, and a greater percentage of fiber is retained after basic processing.
- Alpaca is, in general, more medullated (a distinctive feature of alpaca), generally grows a longer staple length, and is considerably stronger (tensile strength) than wool.
- Both alpaca and wool are susceptible to felting when agitated in water. Wool is sometimes pre-shrunk during processing.
- Wool scales are more hook-like than alpaca scales. This makes wool easier to felt (the hooks catch and hold on to each other), but also harsher to the hand than alpaca fiber of the same micron count.

## 2. Alpaca Fiber Compared to Cashmere

Cashmere fiber comes from goats. There are no “purebred” Cashmere; rather goats that produce a downy undercoat of 19 microns or less qualify as Cashmere goats. Some breeds of goats tend to produce naturally finer fiber and it is those goats that often are selectively bred to produce cashmere. Goats are a two-coated animals and, whether the fiber is harvested by shearing or combing, a large number of thick primary fibers will necessarily be harvested together with the soft, fine undercoat. As a result, these fleeces must be dehaired during processing in order to meet the 19-micron standard required for cashmere.

Note: Recently, the American Cashmere growers raised the standard for fineness from 19 microns to 17 microns! They are committed to marketing a better product for a better price. We alpaca breeders should take note of this. Quality and consistency, in our niche market, is everything.

# The North American Alpaca Federation

## Alpaca University

Note: The American cashmere industry no longer has industrial mills to dehair and process its fiber. The big mills are all offshore now. American cashmere breeders are forced to use mini mills for processing. While the American cashmere industry was once an important part of the American market, that is not the case today. Foreign competition has eroded profits. This can serve as a lesson for alpaca breeders – where are our North American industrial mills, our co-ops, and, most importantly, the active and assertive support of our breeders. What do you do with your fiber?

Cashmere is a very silky, soft fiber that is either combed or shorn from the Cashmere goat. It insulates well, drapes well, and resists wrinkling. American cashmere has been very costly, due to its limited supply. Recently, however, cashmere products have become much more affordable to the average consumer as a result of the large amount of cashmere being harvested and processed in China for sale in the world market. Environmentalists and scientists, however, have begun sounding the alarm about the impact of large herds of Cashmere goats in China, as lands are being overgrazed, increasing desertification of the area.

- Cashmere is softer than most alpaca (for now!).
- Cashmere must be less than 19 microns (with only 3% > 30 microns) to be called cashmere. Baby alpaca approaches this level.
- Cashmere is an established industry with a long history and experience in marketing and manufacturing,. Unfortunately, many cashmere customers have never heard of alpaca.
- Cashmere is available in far fewer natural colors than alpaca, requiring dyeing for added choices. Some say dye damages fiber. It certainly diminishes the natural brightness of alpaca fiber. Although cashmere is easily dyed, adding chemical dyes to the process eliminates the ability to label the product as “natural or green.”
- Cashmere’s thermal insulation abilities are not thought to be any different than alpaca. Rather, insulating qualities depend on the application and a variety of manufacturing factors.
- Cashmere is not as wrinkle resistant as alpaca.
- Given like quality fiber and processing techniques, alpaca pills less than cashmere, even at the lowest micron counts. Pilling is a function of the number of hair ends in a length of yarn and is not related to fineness. Wool products from China, with high micron counts, pilled and matted very quickly, which created a huge PR problem for the wool industry back in the 80’s and 90’s. Pilling is closely related to the minimum and maximum lengths of fibers used in a process.
- Cashmere, like alpaca, absorbs almost no moisture.

# The North American Alpaca Federation

## Alpaca University

- It is not clear whether cashmere is more susceptible to shrinking than alpaca. Shrinkage of alpaca in a product is more a function of spinning tension than anything else. So, alpaca may or may not shrink less than cashmere. It will depend on the application.
- It is generally recommended that cashmere be dry cleaned only. Alpaca, on the other hand, may be hand-washed (and sometimes machine-washed), making it easier to care for than cashmere.
- Cashmere tends to lose its luster after a couple of years, while alpaca (especially Suri) seem to glow forever.
- Cashmere does have crimp and is compared to alpaca in this respect as well as for fineness.
- Cashmere fibers, like Vicuna fiber, are relatively short, averaging 1.5 inches in length.
- Cashmere wool is ideal for wearing in all types of climates because it has a high moisture content, which allows its insulating properties to change along with the relative humidity in the air.
- Cashmere does not hold up as well as alpaca to hard wear because of its extremely soft, downy finish.
- Cashmere is not only soft and silky, but also very lightweight. It results in a luxurious fabric, both in terms of appearance and feel.

*Information from: [swicofil.com](http://swicofil.com) and [ezinearticles.com](http://ezinearticles.com)*

### 3. Alpaca Fiber Compared to Cotton

The cotton shrub is native to tropical and semi-tropical environments of America, India, and Africa. It produces breathable, wearable textiles, with good strength and durability. Cotton is often blended into other fibers to provide strength and softness. Cotton is lightweight, relatively soft, inexpensive, and widely available. However, pesticides and herbicides are generally needed in substantial quantities to competitively grow cotton crops. While organic cotton is now on the scene, it is both rare and expensive.

### 4. Alpaca Fiber Compared to Silk

Silk is a fiber produced by the larvae of various insects during the construction of cocoons. Silks used for textile manufacture come principally from cocoons spun by moth caterpillars called silkworms. Most of the world supply of silk is produced in Japan and China. Silk is resilient, has excellent memory, excellent strength, and is both warm in winter and cool in summer. When blended with other fibers, silk enhances the overall

# The North American Alpaca Federation

## Alpaca University

strength and comfort of its partner fiber. The signature brightness of silk comes from the unique triangular shape of each fiber. Silk fibers are able to refract light, like a prism, at many angles. Most protein fibers, including alpaca, are cylindrical in shape.

- Silk is versatile and very comfortable, cool in summer and warm in winter.
- Silk absorbs moisture up to 11% of its weight.
- Silk is naturally hypoallergenic.
- Silk is easily dyed.
- Silk has only a moderate ability to resist abrasion, yet it is the strongest natural fiber – considered to be as strong as steel.

*Information from: fabrics.net*

Note: The silkworms are killed before the moth can emerge from the cocoon. Alpacas are no kill!

## 5. Alpaca Fiber Compared to Angora

Angora fiber is shorn or plucked from Angora rabbits. The fiber is very slippery and the textile industry often takes advantage of this property by blending angora with wool to make spinning easier and to reduce production costs.

- Angora fiber is finer than either Cashmere or Merino.
- Angora fiber is hollow, giving it insulating properties. It is usually blended with other fibers, such as wool or silk.
- To achieve the finest quality angora yarn, it should be handspun with high twist, to ensure minimum shedding.
- When angora is blended with silk, its strength is enhanced.
- Angora fiber length varies by rabbit breed.
- Angora felts easily.
- Angora is easily dyed and retains dye longer than wool.
- Angora is considered a luxury fabric in terms of both appearance and feel.

# The North American Alpaca Federation

## Alpaca University

*Information from: Angora.cl*

### 6. Alpaca Fiber Compared to Mohair

Mohair is produced by Angora goats and closely resembles Suri fiber.

- Mohair locks tend to be twisting, long, bright, and silky.
- The vast majority of mohair is white. Although colored mohair has recently become available, it is produced in very small quantities at this time.
- Mohair is said to be stronger and more resilient than wool, and was frequently used for commercial grade upholstery for trains and the like, in years gone by.
- White mohair takes dye very well and, therefore, is frequently available in strong, brilliant colors.
- Mohair has no crimp and is commonly blended with wool to add loft. Mohair is often processed into worsted fabrics, due to the long length of its fiber. Since mohair has no crimp, it is not well-suited for the woolen process, unless a crimp machine is used. .
- Angora goats grow approximately one inch of fiber per month and are, therefore, shorn twice each year, with each fleece tending to carry staples up to six inches in length.

### 7. Alpaca Fiber Compared to Bamboo

Bamboo is classified as a grass and, unlike trees which can take decades to grow to maturity, bamboo is very fast-growing, reaching harvestable size within four to five years. To make fiber from bamboo, the bamboo is heavily “pulped” until it separates into long, thin component threads, that can then be spun and dyed.

- Bamboo fiber is exceptionally soft and light, with a silky feel. This makes it breathable and cool to wear, and it absorbs more moisture than other more conventional fibers, such as cotton and polyester.
- Bamboo is very sustainable to grow, as it does not require the use of pesticides and grows very quickly under favorable conditions.

# The North American Alpaca Federation

## Alpaca University

- Bamboo fiber is more anti-static than other types of fabric and also tends to perform better when it comes to odor control, as it has a natural deodorizing property.
- Bamboo is similar to finely bleached viscose with respect to the fineness and “whiteness” of its fibers. It is also very strong and durable, with excellent ability to withstand abrasion. Bamboo possesses many qualities that make it perfect to spin.

*Information from: Bamboofabricstore.com*

## 8. Alpaca Fiber Compared to Linen

Linen textiles are made from flax plants, which are grown in many parts of the world, although Western Europe is historically known for growing and producing the highest quality linens. Linen has long been renowned for its durability and long life. Silica present in the flax fiber protects linen against rotting. The mummies of Egyptian Pharaohs, preserved to the present day, are wrapped in the finest linen cloth. The tensile strength of linen thread is twice as high as that of cotton and three times that of wool. Linen possesses rare bacteriological properties, making it resistant to fungus and bacteria and, as a result, it is found to be an effective barrier to some diseases. For example, according to medical studies conducted by Japanese researchers, bed-ridden patients do not develop bedsores where linen bed sheets are used.

- Linen fibers are very long, with the finest fibers measuring 12 to 20 inches in length. Linen fibers, however, have poor elasticity and linen fabrics wrinkle easily.
- Linen is hypoallergenic and is helpful in actually treating a number of allergic disorders.
- Linen is highly “hygroscopic.” as it is capable of rapidly absorbing and also yielding moisture. Linen can absorb as much as 20% of its dry weight in moisture, which explains why linen clothing tends to feel fresh and cool.
- Linen scores high in air permeability and heat conductivity properties. The heat conductivity of linen is five times that of wool and 19 times that of silk. As a result, in hot weather, those dressed in linen clothes tend to have skin temperatures that are 3°- 4°C lower than those of their cotton-wearing friends. According to some studies, a person wearing linen clothing perspires 1.5 times less than when dressed in comparable cotton clothing and two times less than when dressed in viscose clothes. In cold weather linen is an ideal insulator.

# The North American Alpaca Federation

## Alpaca University

- Linen's smooth surface and luster is pleasant to the touch and naturally rejects dirt. With repeated washings linen becomes softer and smoother.

*Information from Vintagecompany.com and Answers.com/topic/linen.*

### 9. Alpaca Fiber Compared to Synthetics

Synthetic fibers became very popular among consumers during the last fifty or so years, as they were affordably produced on a mass scale. According to "Natural Fibers Online – 2009:"

[O]ver the past half century, natural fibers have been displaced in our clothing, household furnishings, industries and agriculture by man-made fibers with names like acrylic, nylon, polyester and polypropylene. The success of synthetics is due mainly to cost. Unlike natural fibers harvested by farmers, commonly used synthetic fibers are mass-produced from petrochemicals to uniform strengths, lengths, and colors, easily customized to specific applications.

More recently, however, consumers have become more aware that oil reserves are not without limit and that as oil becomes more scarce prices per barrel will continue to rise and fluctuate wildly. These fluctuations tend to wreak worldwide economic havoc. Fortunately, America is "going green" and alpaca, unlike nylon and its oil-based relatives, is sustainable, renewable, and earth-friendly. Our alpaca herds, and their fleece, can provide an ever-growing supply of natural, ecologically sound, multi-use fiber. Many people feel that oil-based textiles and clothing will soon be considered politically incorrect and, ultimately, become obsolete. As oil reserves dwindle or become more difficult to harvest, the price of synthetics is likely to rise.

- **Rayon** is a generic term for man-made fibers composed of regenerated cellulose derived from trees, cotton, and woody plants. Characteristics include high absorbency, bright or dull luster, pleasant feel or hand, good draping qualities, ability to be dyed into brilliant colors, and superior strength.
- **Tencel** is a relatively new fiber created from the wood pulp of specially selected trees, processed in a high-chemical, but environmentally safe way. Tencel was introduced to the world of apparel in 1992 and was the first new fiber introduction in over thirty years. Tencel's fiber characteristics include a subtle luster, high-wash stability, extremely low shrinkage, and good tear resistance.
- **Nylon** is the generic term for man-made fibers composed of polyamides derived from coal and petroleum. Characteristics include high strength, elasticity, low

# The North American Alpaca Federation

## Alpaca University

water absorption, and quick drying time. Nylon does not “breathe” the way natural fibers, like alpaca, do; rather it creates a “sweat suit” environment for the wearer.

### 10. Suri Fiber compared to Huacaya Fiber

Suri alpacas and Huacaya alpacas are different both in physical appearance and in the specific characteristics of their fiber. Suri alpacas appear more angular and slender due to their long, lustrous fibers that hang down against their bodies, as opposed to growing perpendicular to the skin the way Huacaya fiber does.

According to Cameron Holt:

Suri fiber is basically a straight fiber and is used like mohair for specialized fiber production. One of the main difficulties when processing Suri (like Mohair) is the requirement for some twist in the sliver so it will not pull apart during the drawing process. This is due to the lack of cohesion when spinning caused by the low, smooth cuticle scale structure. Processors have suggested that they prefer a fiber with a slight wave in preference to a straight fiber. From a breeding perspective, Dr. Julio Sumar would prefer the ringlet type, followed by the lock and twist and wave.

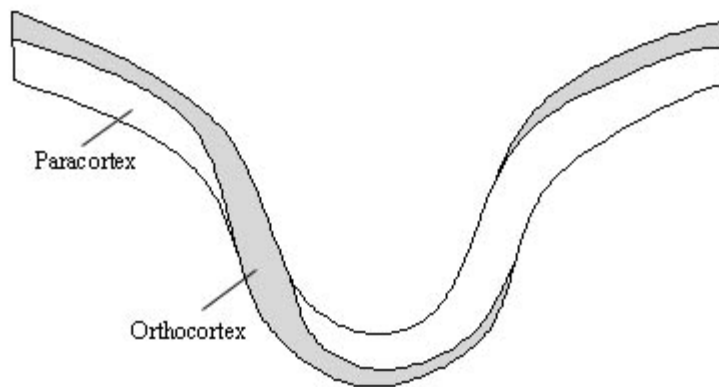
Suri fiber can grow in tight ringlets, wave and twist ringlets, corkscrew ringlets, large wave, broad lock, and straight lock formats. Locks can twist almost to the skin and locks can be large or small, thick or thin. Thickness does not necessarily equate to density (paraphrasing Cameron Holt). Suri is relatively rare, making up only 20% of the world’s alpaca population. The Suri is thought to be rarer, possibly because it is less hardy and less able to thrive in the harsh South American mountain climates. The Suri’s fleece offers less insulation against the cold.

- Suri fiber, like Huacaya, can be very fine and silky, but has no crimp (or rather, should not) and thus Suri is best suited for woven goods. Its tight scale structure makes Suri difficult to dye and Suri fiber is more difficult to work with, as it is relatively heavy when compared to similar animal fibers..
- Huacaya fiber shares more similarities with sheep wool than Suri, as Huacaya fleece is soft, fluffy, and crimped. This natural crimp provides greater elasticity in Huacaya yarn, making it a good choice for knits. The Huacaya’s scale structure allows it to accept dyes more readily.
- The average annual staple length of Suri fiber is 4 to 6 inches, whereas the average annual staple length of Huacaya fiber is 3 to 5 inches.

# The North American Alpaca Federation

## Alpaca University

- Suri fiber often feels cool to the touch, which may be due to the fact that more of its straight fibers make direct contact with our skin, thereby absorbing more heat from our hands. It is thought that the denser the Suri, the cooler its fiber lock will feel.
- Whereas the Suri has coiled locks of fiber that hang downward, the Huacaya has crimped fiber, which act like small springs, and grow perpendicularly to the body giving Huacayas their rounded, fluffy appearance.
- Huacaya fiber is more abundant and enjoys greater popularity in the world market. Only a small fraction of the world's alpaca population is Suri.
- Suri and Huacaya have different scale structures. The Huacaya has a balanced ortho- and para-cortical structure, which makes its fiber curl. The Suri fiber contains an abundance of para-cortical cells, which keeps its fiber straight. The Suri fibers have different scale shape, height, and distribution than the Huacaya. This straight fiber with long, few, and smooth scales give the Suri its signature luster. The bolder, deeper crimp in Huacaya with fast growing fiber is indicative of longer scales, which in turn create its signature brightness.



### Alpaca Fiber Benefits Summary

- **Alpaca fiber is stronger than many other animal fibers**, even at the finer grades. Yocum McColl studies reveal alpaca to have a tensile strength of 1.5x of similar wool fibers. This trait allows manufacturers to create lightweight, sculpted, and fashionable garments, since a bulky sweater format is not required to provide equivalent warmth. Alpaca can deliver warmth in light, delicate and elegant fashions. Alpaca's natural strength also provides durability. The options for alpaca are numerous, from worsted to woolen, bulky sweater to form-fitting

# The North American Alpaca Federation

## Alpaca University

delicate knit, next to the skin sweater to a fine gabardine coat. The possibilities are almost endless.

- **Alpaca wicks moisture.** Up to 30% of its weight. This means an alpaca fabric will allow moisture to move to the outside of the garment where it can evaporate. Cotton and wool products, on the other hand, absorb moisture. This is why a wool sweater can feel very heavy if you are caught in the rain – wool can hold up to 50%.. A water-soaked wool sweater can also bring out the smell of lanolin residue that was trapped within the fiber scales. When a fiber absorbs moisture, the moisture diffuses into the fiber, causing the molecules to separate and fiber volume to increase, which is called swelling (or hygral expansion). Wool and cotton socks tend to make your feet sweat because they are absorbing moisture. Alpaca does not tend to absorb moisture, rather it transports moisture away from the foot where it can evaporate at the outside of the sock.
- **Huacaya alpaca “blooms,” contributing to its insulating qualities.** Scale structure has a significant effect on the characteristics exhibited by a finished textile. For example, the scales on fibers in newly-made alpaca fabric will generally be tightly packed. Once washed, or “fulled,” the scales will relax, easing the tension within the fabric. The term for this is “bloom.” You can try this at home with two like skeins of Huacaya alpaca fiber. Wash one and let it dry; then put it side-by-side with the other. The washed skein will be a bit fuller and less scratchy. The washed skein will also be brighter, because more surface area will be available as the scales relax, creating more reflective surfaces. Bloom contributes to the insulating properties of Huacaya fiber. Since Suri fiber has a longer and smoother scale structure, Suri fiber does not bloom.

Note: brightness does stay with alpaca fiber as it is processed into fabric. With wool, especially in the unwashed fleece, the lanolin grease is highly reflective. When the fleece is scoured to remove the majority of the lanolin, the fleece frequently appears duller.

- **Although inconclusive, alpaca may exhibit hypoallergenic qualities.** We know about the “prickle factor,” where thick and/or hollow fibers of around 30 microns can prick the skin, causing rashes, discomfort, and other reactions, thereby making some wools very uncomfortable to wear. AllergyNursing.com reports that some people who were believed to be allergic to lanolin, were instead reacting to the “prickle factor.” Although some people who feel they cannot wear wool find that they can wear alpaca comfortably, there is not enough evidence to substantiate a claim that alpaca is hypoallergenic. Alpaca has an open scale structure, which creates spaces that may be susceptible to filling with dust, mold, and pollen. So, while alpaca may appear to exhibit some hypoallergenic characteristics, more research is needed before it can be claimed to in fact be “hypoallergenic,” and to what degree. Alpaca is low-allergenic.

# The North American Alpaca Federation

## Alpaca University

- **At its best, alpaca fiber is extremely fine, with a good balance in size and length of primary and secondary fibers.**
  - **Alpaca fiber has a higher tensile strength than wool (1.5x per Yocom-McColl).**
  - **Alpaca fiber is relatively easily processed, as it contains little grease, oil, or lanolin, and is compatible with processing by either the woolen or worsted systems, depending on fiber length.** The lack of lanolin also makes alpaca odor-free.
  - **Alpaca fiber can be carded, combed, and blended with other natural and/or synthetic fibers, for a wide variety of finished blends.**
  - **Alpaca exhibits natural brightness and luster.** Due to the unique structure of alpaca fiber, it tends to reflect light very well, contributing a natural brightness or luster to finished products.
  - **The lasting brightness found in the wide array of natural alpaca colors adds to its value.** Although alpaca fiber, in particular Huacaya, can be easily dyed any color, it will lose some of its natural brightness.
  - **Alpaca is fire retardant. More studies are needed, but alpaca will not melt and stick to your skin in a fire.**
  - **Alpaca is warm. Studies show that the medullation (full or partial) helps insulate against both heat and cold. While crimp adds some insulation (loft) up to 80% of crimp can be lost in processing. It is the medullation that insulates.**

### *H. Module Summary*

Hopefully, the information presented above has helped clarify how valuable alpaca fiber is and will continue to be in the marketplace. A choice to wear cotton contributes to the herbicide and pesticide use that adversely impacts our earth every hour of every day. A choice to wear nylon or most other synthetics contributes to the ongoing use and depletion of petroleum-based products. A choice to wear mink, fox, sable, baby seal, beaver, and even leather, contributes to the slaughter of these animals for their hides and pelts. Further, these hides and pelts require the use of petroleum products during the tanning process. A choice to wear wool also has environmental impact by virtue of the fact that wool requires repeated scouring with harsh detergents to prepare it for processing. In sharp contrast, alpacas are shorn once a year, after which their lanolin-free fleeces can be easily processed with minimal washing, and the alpacas

# The North American Alpaca Federation

## Alpaca University

themselves go on their merry way grazing and working on growing the next season's fleece. If we are to live lightly on the earth, if we are to think globally and act locally, then we can look to alpaca fiber, as it satisfies all the criteria for a "Green Movement."

More than 200,000 alpacas are on the ground in America, as of this writing (2010). While Peru is often cited as having more than 90% of the world's alpacas, there is little arable land left in the Andes for future growth. The size of Peru's alpaca herds will likely remain relatively constant over the next 50 years. America's potential for growth in the alpaca industry, on the other hand, is virtually unlimited. We can create the largest herds of high quality alpacas right here in America. The North American herd already has the most diversity in terms of rich, naturally colored alpacas. North American alpaca needs no dyes to provide consumers with a wide array of natural, eco-friendly color choices.

In the Modules that follow, we will investigate alpaca fiber in greater depth, examining its internal structure and the qualities that make it unique. We will discuss quantifiable measurements, of which breeders must be intimately aware, for these measures are inextricably related to our ability to manage our herds effectively. We will help breeders define and understand the qualities for which they should be breeding and help breeders learn to accurately judge the quality in their own barns, paddocks, and pastures, without the need of an opinion from a show judge. We breeders must develop the ability to assess our own product and we must learn how best to generate income from that product. The Modules that follow will examine how breeders can make the best choices to maximize income and will provide guidance on how to create sales and marketing channels, and how to attract an ever-growing customer-base to create a thriving industry of "Alpaca Fiber for Profit."

**NAAF is a donation driven, nonprofit organization. If you found value in this learning module please consider a donation. Every dollar helps us keep working for you; there is no donation to small. Your dollars keep our learning modules free and NAAF working for you. Please visit [NAAlpaca.org](http://NAAlpaca.org).**