What Makes a Champion?

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What is Important in the Fleece?
How much attention do we pay to different fiber traits?

Introduction

I want to talk about "the fleece on the alpaca", and should like to start asking, which are those important characteristics in the fleece?, and are those characteristics all equal in economical and technical terms?

According to the present AOBA Rules, judges must pay the same attention to the fiber characteristics as well as to conformation (50% fleece, 50% conformation). However, according to what we know from other alpaca producing countries, the fleece is given a higher importance – 70% – in case of Peru and – 60% – in case of Australia. The reason? In the case of Peru, because they have a very old tradition of alpaca breeding and highly advanced modern textilery. The finer the fiber, the end product will have a higher economical return. Then for the Peruvian breeders the most important trait is fineness, so most of the effort in genetic improvement was done introducing fineness into the alpaca fleece. And strongly I believe that fineness should be also highly important in the American herd of alpaca.

Which are the other important characteristics of the alpaca fleece? How are they correlated or associated with fineness? I will mention some of them:

- Crimp formation
- Staple length
- Density
- Uniformity
- Luster or Brightness

Also, there are other important characteristics for the modern textilery, difficult to measure on the animal, like:

- Medullation
- Resistance to Compression (Newton and Kilotex)
- Washing Yield
- Wax and Suint percentage
- Mean staple length
- Resistance to traction
- Content and type of vegetal material
- Resilience
- Color
- Breakage position, etc.

And I can add many more.

Fiber Fineness

The wool and fiber industry at present, changed completely its system of assessing fineness, from the traditional quality number (counts) to the mean fiber diameter or micron system.

Fineness is the result of the **genetic make-up** of the alpaca, influenced by the **environment conditions**. In sheep the heritability of mean diameter (fineness) is about 0.5 and we can extrapolate this figure to the alpaca fiber heritability. However, we must know that there are no fineness heritability studies in alpacas, so this percentage must be taken with caution.

What means 0.5 of heritability? Heritability describes the strength of inheritance of a character, i.e., whether it is likely to be passed on the next generation or not. According to Professor C. Dalton, heritability is "*For a given trait the amount of the superiority of the parents above their contemporaries which on average is passed on the next offspring."* The notation h^2 is given to heritability and is expressed on a scale from 0 to 10, or 0 to 100% where:

Low weak heritability: 0 – 0.1)0-10%)
Medium or intermediate: 0.1 – 0.3 (10-30%)
High or strong: 0.3 or above (30% or more)

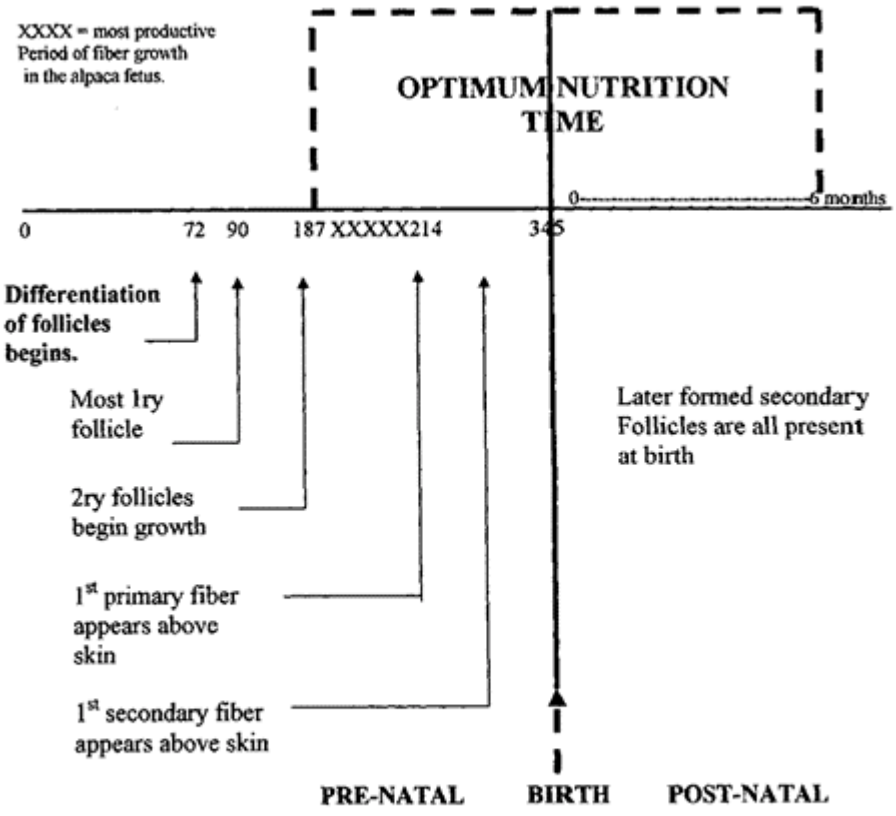
This means that in sheep fiber fineness is highly inheritable. And we can assume with caution, that fiber heritability is also highly inheritable in alpacas.

The differences found in different strains of alpacas coming from different countries and breeders, are very marked as a result of generations of selection for fineness.

Breeders must take into consideration that there is a tendency for fine fleeces to be light in weight, because the genetic correlation between fleece weight and fineness is negative. In other words, **more fine less weight**. This sometimes means lower returns to breeders (sometimes fleece buyers do not pay for fineness, but for weight).

However, many other genetic factors are involved in the expression of the heritability. The number of Primary and Secondary follicles in the skin of the newborn alpaca have a major influence on determining fineness, and the fleeces produced by sheep with high follicle numbers in the skin tend to be both fineness and heavier. However, here is where nutrition plays a very important role. Nutrients, particularly amino-acids are needed for the growth of individual fibers and are supplied to the follicles through an extensive network of blood vessels and capillaries.

It has been found in sheep that follicle maturation, i.e. from development to maturation has ceased by the time the lamb is 6 months old and the most effective period of follicle maturation (as shown in the next diagram) is from 80 days after conception to 70 days after birth. *Therefore, a high plane nutrition during this period is vital to ensure optimum follicle development*. If the pregnant ewes in this critical period do not receive a very good plane of nutrition, the growing and maturation of Primary and Secondary follicles, will be low, in spite of the high genetic make-up of the mother for high follicle numbers. As I said before **fineness is the result of the genetic make-up of the alpaca, influenced by the environment conditions**. (Food intake in this case.)



Most productive follicular/fiber growth is from 187 – 214 days in head and neck area.
Pedro Yi (1995 – Peru)

Effects of Nutrition and Photoperiodicity on Fiber Production

In sheep, research has shown that there is an important relationship between nutrition and fiber production. It is worth noting that wool grows continuously throughout the life of the sheep. However, the quantity and quality of the fiber produced each year will vary according to seasonal conditions and the nutrition available to the sheep. This concept can be extrapolated and the knowledge applied to the alpaca.

Sheep maintained under natural conditions of feeding and climate, showed a minimum wool growth-rate in winter and a maximum in summer, regardless of temperature changes. Many studies support the evidence that wool growth rate depends mostly on photoperiodicity. Growing differences were more marked in animals under natural feeding (natural pastures). This is the wool growth rate during the different seasons of the year:

- Winter 14%
- Spring 20%
- Summer 34%
- Autumn 32%

In Peru the shearing time is during the spring because the natural environmental conditions improve especially food availability and temperature. In the USA in spite of the excellent feeding strategies all the year round, shearing should be done also in spring in order to take advantage of the longer photoperiod of the summer months.

In periods of prolonged drought the fiber produced in the highland of Peru is usually much finer, as alpacas often lack adequate nutrition to enable them to maintain maximum fiber production, and such wool

is often termed "**Hungerfine**". If the drought is particularly severe the fiber will become so thin that the tensile strength is reduced significantly.

In the last 10 years I read some studies done is the USA by some American breeders showing the great increase in fiber diameter of alpacas fed at the quarantine stations of Peru after being bought from the highland breeders and moved down from high altitude.

These studies show us the changes in the level of nutrition from minimum levels to overfeeding and the consequences on the fiber diameter. From "hungerfine" fleeces to overfed alpaca fleeces. Nevertheless, other important information has been neglected, such as range of variation of fineness, the percentage of animals that showed minor changes, the nutritional status of the animals, the quantified level of nutrition in both places (highland and quarantine), the geographical area from where they come and the season of the year when studies were done (photoperiod). These types of studies with erroneous conclusions only confuse the evidence of the few bonafide scientific reports done elsewhere.

I want to mention one of the most important pieces of scientific work done by Angus Russel, who reached the following conclusions:

"The alpaca fiber production is influenced by nutrition, but the effect is proportionately greater on fiber length than on diameter. This offers opportunities for increasing fiber weight with only a minimal penalty in terms of fiber quality."

Thus the relative contributions of length and diameter to the increased fiber weight resulting from the higher level of nutrition are of the order of 80% and 20% respectively.

In the next figure you will see the changes in body weight in adult alpacas, the fetal weight increment and the percentage of natural forage production in the highland of Peru:

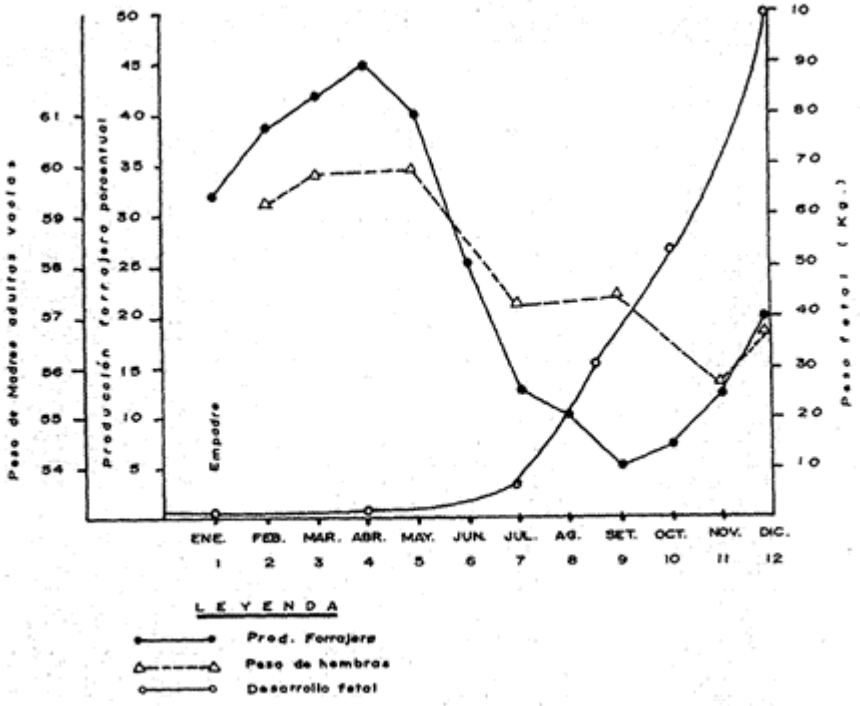


FIG. 3 CURVAS OF PRODUCCION FORRAJERA (PURCENTUAL), ANNUAL, PESOS DE MADRES ADULTAS VACIAS Y DE INCREMENTO DE PESO FETAL.

Relationship between Crimp and Fiber Fineness

Crimp also called "character" is the waviness you see along the fiber and the staple. One way to measure crimpness is the number of waves per inch or centimeter. A caliper is used to compare the scale with the natural ondulations of the staple. Crimps per inch show high values on the back (saddle) and neck, and less pronounced in other parts of the body. The suggested Grades for fine wool, based on length of crimp/depth of crimp ratio, are the following.

Good: Very deep crimp in relation to crimp length, good character, usually high number of crimp per inch.

Average: Average crimp depth in relation to crimp length, fair character, usually average numbers of crimp per inch.

Some researchers working with different breeds and strains of sheep found that there is not a strong correlation of crimp with fineness. However, when dealing with individual breeds and also some strains, the relationship is positive, and one can predict the diameter with a probable error of about two microns.

According to Wickham, crimp is not strongly inherited and is controlled by a variety of environmental factors including nutrition and internal and external parasites (that indirectly influence nutrition). A high clover component of the diet has been shown to have a beneficial effect while copper and zinc deficiencies are very detrimental.

In the Peruvian conditions of alpaca breeding crimpness is highly appreciated for the breeders. They used to say, "In 90% of the cases a crimped fiber is a visual indicator of fineness." When I visited an alpaca textile factory in Peru, where the fleece sorting is carried out entirely by woman's hands, the highly crimped fleeces end up in the very fine fleece section.

In a very recent study, 20 fine fleeces were selected for 4 trained people (10 with good crimp and 10 without crimp). Results showed that the crimped fleeces were in the range of 17.5 – 22.0 microns, and in the other non-crimped fleeces the range were of 18.0 – 27.0 microns (one was 18 microns and the average was 24.0 microns.)

What we can extract from this little piece of work?

1. Hand fineness evaluation was very good.
2. Good correlation between fineness and crimp
3. The number of fleeces was not enough to have statistical results.

I myself would like to investigate with a large number of Huacaya fleeces, from different age, sex, color, and strain, the widespread opinion that crimp is related positively with fineness.

However, the presence of crimp is not only a probable indicator of fineness, but also has some other qualities:

1. Highly appreciated for the hand spinners.
2. High crimp frequently inhibits the felting that results in cotting.
3. Hand spinning of crimped fleeces produce a more regular and uniform yarn.
4. Some textile researchers found some good textile qualities.
5. Crimp is related with dense fleeces. High crimp tends to form very dense lock or staples.
6. Crimped wool is more circular (transversal sections) and therefore less elliptic, less medullated fibers,

All these important characteristics deserve a "must." Must be taken into consideration among the important traits of the alpaca fiber. And also, deserve a careful study in the field with trained people in fleece studies, experimental design and appropriate statistical analysis.

Fiber diameter, age and length of the staple

In Peru between 40% and 50% of the alpacas are shorn annually and the other 50% are shorn between 1 ½ and 2 years. It has been shown experimentally that under fair to good nutritional levels in natural pastures, alpacas can be shorn annually, and the staple length will be superior to the 7cm requested by the textile industry.

Shearing each year, rather than every two years, the breeders gain about 30 – 35% more in fleece weight. That means a higher economical return. With an annual regime of shearing it is expected an increase of the fiber diameter around 0.30 microns yearly, and also that the length of the staple diminish in about 0.36cm per year.

Also, here is a Table of the staple length (cm) in relation to age and breed.

Age in Years	Breed	
	Huacaya	Suri
1	12.30	16.80
2	12.10	16.20
3	11.30	15.50
4	10.90	13.40
5	10.50	12.90
6	10.60	12.10
7	9.60	11.60
8	9.20	11.20
9	8.70	11.00
10	8.50	10.50

However, in this study, the number of shearings can not be separated from age. In other words, is the shortening of the length of staple due to the aging of the alpaca or the number of shearings it has undergone in its lifetime? Shearing could possibly have an indirect effect through nutrition, since on a constant ration more food might be required to maintain body temperature immediately after shearing and therefore less food might be available for fiber growth.

Factors that affect Fiber Length

In the context of processing alpaca fleece the next most important characteristic to fineness is Fiber/or Staple Length. The length of the grease wool is usually expressed in terms of Staple Length, and is the length of each lock from root to the tip of the fiber. The mean fiber length, of the raw fiber or wool tends to be greater than the staple length, and is the total length of a group of single fibers fully stretched. You will note that the fiber length of a crimpy lock is longer than the staple length. For breeding purposes staple length is widely used.

In sheep wool fibers longer than 100 – 125 mm are highly priced. The same is the case with alpaca fiber, however, alpacas under natural pasture conditions (highland of Peru) produce the following staple length from the first shearing at 10 months of age to more than 8 years.

Huacaya females: from 123 to 89 mm.
Huacaya males: from 126 to 104 mm.
Suri females: from 160 to 114 mm.
Suri males: from 168 to 117 mm.

Fiber growth is governed, as is fineness, by the genes, and influenced by environmental factors.

We know that around 30% of the fibers break in the early stages of processing when the fiber is sound and untangled,, but 60% or more of the fibers may break when they are tender and/or tangled. This is the result of a temporary reduction in the growth rate of the fibers, which in turn is associated with a thinning and shedding of some fibers from the follicle. Thus tenderness and cotting of fiber must be regarded as factors leading to shorter lengths.

There are four main factors that lead to the thinning, shedding and cotting of fibers:

1. Winter reduction in fiber growth.
2. Pregnancy: According to studies done in Peru, lactating mothers will produce 5% less fleece weight, and those lactating and gestating will produce 8% less fleece weight.
3. Poor nutrition.
4. Parasitism.

Improving winter nutrition is the solution, as well as good nutrition in the last third of gestation and during the first six month of a cria's life. Drenching the alpacas is good management practice to avoid the effect of parasites on the quality of the fiber. However susceptibility to cotting is reasonably heritable and selection for fleece weight will produce alpacas that are more resistant to both unsoundness and cotting.

Luster and/or Brightness

Wools differ in the quality and quantity of luster. Luster is defined as the sheen, gloss or shine of the fleece. However, it is not only a visual observation; it also incorporates the silky feeling of touching the fleece. Luster characteristics depend on not only the outer cells of the fiber (cuticle cells) but also the size and straightness of the fiber. It is not easily perceptible on isolated fibers, but mostly in fleece locks, thread, yarns and fabric.

The Peruvian breeders refer to "Brightness" when Huacaya fleece shows sheen or luster. Luster is an important characteristic in the Suri fleece but is not very common in the Huacaya breed. The wool industry describes three types of luster: silvery, silky and vitreous. The silvery luster is found in the finest Merino wools with high degree of crimp; the silky luster is present in the long staples of British breeds, like Lincoln and Leicester; and the vitreous, in the Mohair and other goat fibers. Von Vergen studies in the alpaca fleece mentioned that Suri shows a silky luster and Huacaya has a silvery luster. Most of the softness of handling is due to fiber fineness and luster.

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