2012 PBA Fiber Study Report

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Introduction

In 2011, PBA members expressed interest in a second fiber study to see how we are doing (the previous study was in 2004). A committee was formed, and the PBA board approved payment for half of each test for up to six goats per owner/breeder.

In the spring of 2012, fiber samples were collected and submitted to Yocom-McColl in Denver, CO. Statistics for the 2012 fiber test are as follows:

- 134 goats were submitted for the fiber test. Six goats were eliminated from the analysis as they were less than a year old, resulting in 128 goats evaluated as part of the fiber study
- 19 owners and/or breeders – three have spinner's flocks, one has a breeder's flock and 15 have breeder/spinner's herds. Participants were from all over the United States (see Figure 1) and one from Ontario, Canada.
- Farms sent in from 2 to 21 samples each
- Goat ages ranged from 1 to 15 years old. The age breakdown was:
  - (19) 12 to 23 months
  - (21) 2 to 2 yr. 11 m.
  - (28) 3 to 3 yr. 11 m.
  - (15) 4 to 4 yr. 11 m.
  - (13) 5 to 5 yr. 11 m.
  - (11) 6 to 6 yr. 11 m.
  - (8) 7 to 7 yr. 11. m.
  - (6) 8 to 8 yr. 11 m.
  - (2) 9 to 9 yr. 11 m.
  - (4) 10 to 10 yr. 11 m.
  - (1) 15 yr.
- Fiber from bucks, does and wethers was submitted with the gender breakdown as:
  - 19 bucks
  - 95 does
  - 14 wethers
- All three fiber types were represented as follows:
  - 27 type As
  - 85 type Bs
  - 16 type Cs

Figure 1. Location of Fiber Study Participants

Comparison of 2004 and 2012 Fiber Study

	2004	2012
Total goats in study	57	134
Owners/breeders participating		19
Number of bucks	6	20
Number of does	42	92
Number of wethers	9	15
Number of type A goats	7	27
Number of type B goats	35	85
Number of type C goats	15	16

Feeds

Participants were questioned as to what they feed their goats. Answers were varied as you might imagine, but centered around grass hay, orchard grass hay, pasture, grain of some sort, minerals and black oil sunflower seeds. There were a couple of less common feeds, including haylage for one herd and sheep feed for one herd. A couple herds also got kelp as part of their diet. I think for this information to be useful in the study, we would need much more detail. It would be interesting to see how/if feed choices affect fleece production.

Fiber Study Terms

It's difficult to understand a fiber test report without a definition of the terms used in the report. These are some of the terms you will see:

- *Mean Fiber Diameter (MFD)* - the average (mean) diameter of the fibers in the sample. The smaller the MFD number, the finer the fibers in the sample are. The MFD should be high for type-C goats as their fiber and guard hair should have a lot of separation. The following table will gives *average* micron *ranges* for various fiber animals:

Fleece	Micron Ranges[1]
Musk Ox (Quiviut)	11-13
Fine Merino	12-20
Angora Rabbit	13
Cashmere	15-19
Alpaca, Suri and Huacaya	14-40[2]
Pygora	18-28
Mohair, kid	23-30
Llama, Tapada	20-30[3]
Alpaca,	27.7
Llama, Ccara	30-40[3]
Mohair, adult	31-45

[1] British Wool Marketing Board
[2] The Complete Alpaca Book by Eric Hoffman (with contrib. authors), BonnyDoon Press, Santa Cruz, CA, 2003.
[3] Beula Williams (2007-04-17). "Llama Fiber". International Llama Association.

The 2004 fiber study reported all results with the guard hair included in with the 'good' fiber. The 2012 fiber study reports the results both ways: without the guard hairs (dehaired fiber) and with the guard hair. The guard hair information is useful when considering breeding matches. Knowing which buck or doe has fewer guard hairs and/or easily separated guard hair helps you make intelligent choices to continue to improve Pygoras.

- *Standard Deviation (SD)* – this measures the consistency of the sample. In other words, was the sample mostly fine fiber or a mix of fiber and guard hair or mostly guard hair? As the SD number goes up, it indicates a sample that was inconsistent in composition and therefore, less desirable.

- *Coefficient of Variation (CoV)* - this is a statistical measurement that indicates the consistency of the sample. The less consistent the fiber is, the wider the bell curve and the higher the CV will be. The CV should be high for a type-B Pygora as this type of fiber should have two different types of guard hairs.

- *Comfort Factor (CF)* – this number is used to show soft the fiber is. It is calculated by subtracting the percentage of fibers over 30 microns, (the ones that are stiff and pokey), from 100. The higher the comfort factor, the softer the fiber.

- *Fibers >30 micron (μ)* – this number represents the prickle factor". It is a measurement of fibers greater than 30 microns in the sample. The higher the number, the more guard hairs there, which would result in a prickly yarn.

- *Mean Curvature* - this is related to crimp. The more curvature, the more crimp. Usually the more crimp, the finer the fiber. So a high number is a good thing.

- *SD Curvature* – this is the standard deviation of curvature and is a measurement of how consistent the curvature is - the more consistent the lower the number.

All of the data from a fiber test is useful, but the most important criteria for this study are average fiber diameter (MFD), standard deviation (SD) and comfort factor (CF).

Interpreting a Fiber Test Graph

Each fiber test report also contains a graph that represents the data for the sample (see Figure 1). The numbers up the left side of the graph indicate percentage of fibers. The numbers along the bottom of the graph indicate fiber diameter.

An ideal Pygora fleece has a single peak of fine fiber on the graph with the bulk of the fiber to the left of the 30-micron mark on the bottom line of the graph. Fiber to the right of the 30-micron mark is stiff, undesirable fiber (guard hairs). If a fleece has a lot of fibers over 30μ there is a smaller yield of soft, fine fiber from the fleece. Carefully choosing breeding stock to decrease the amount of guard hair in a fleece will improve this.

Despite a prevailing misconception, all Pygora fleece has some guard hair, even type-A Pygoras.

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Optical Fiber Diameter Analyser (OFDA100)
Micron Test Report

Whistlekick Pygoras/Terri Kistler   10/09/12
136 Fisher Road
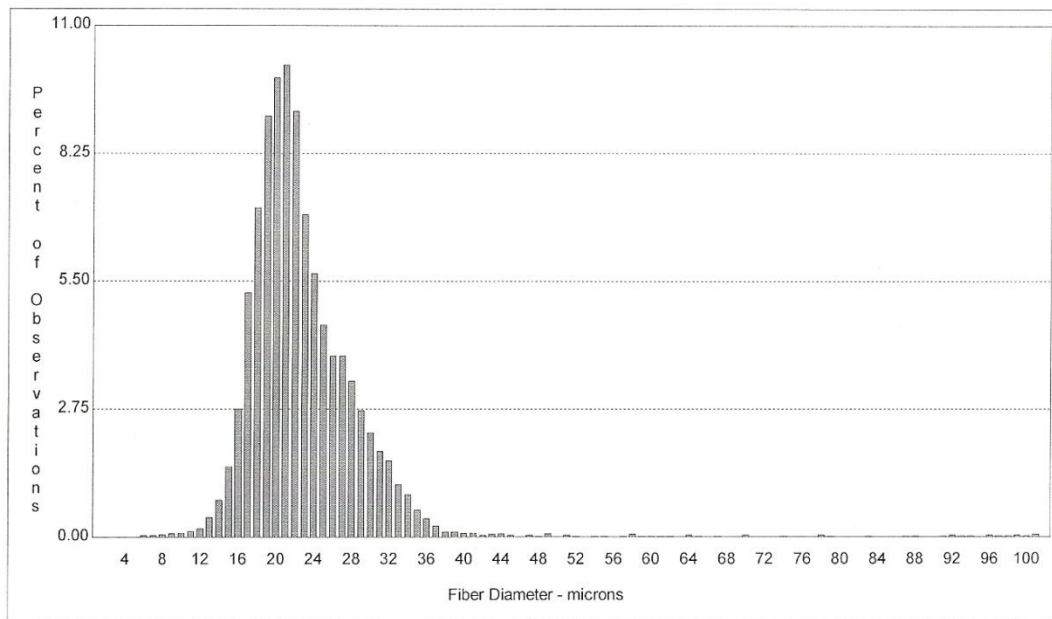Winlock WA 98596 USA   Test No: 446765

Animal and Sample Description

Animal Name:	Ginger	**Animal ID:**	07-95F
Breed:	Pygora	**Sample Location:**	Barrel
Sex:	Doe	**Sample Date:**	03/11/12
Color:	Caramel	**Age:**	04/03/07

Laboratory Data

Mean Fiber Diameter:	25.5 microns	**Spin Fineness:**	44.2 microns
Standard Deviation:	19.3 microns	**Mean Curvature (deg/mm):**	26.8
Coefficient of Variation:	75.7 %	**SD Curvature (deg/mm):**	23.6
Fibers Greater Than 30 microns:	10.1 %	**Comfort Factor:**	89.9 %

This Test Performed According to I.W.T.O Method 47

Figure 2. Sample Fiber Test Report

2012 Fiber Study Results

When the data from the fiber tests was returned to the committee, we analyzed the data in all the ways we could think of that would be useful to a Pygora owner/breeder. Categories include:

- by age
- by fleece type (A, B or C)
- by gender (buck, doe, wether)
- by fleece color
- comparing previous fiber tests to this test for goats who had previous fiber tests

Study Overall

Guard hair data included as a breeding selection resource. Table 1 shows the average values for the fiber test for all goats in the study, both with and without guard hairs included in the data.

Table 1. Fiber Study Average Data

	Guard Hair Included	Without Guard Hair	2004 Study Results	Range
Average Age (years)	4	4	4.4	1 to 15 years old
Average MFD (µ) Lower the better	25.4	20.2	27.02	15.4 to 25.9 w/o guard hairs 17 to 36.8 with guard hairs
Average SD (µ) Lower the better	14.2	4.2		2.7 to 13.5 w/o guard hairs[1] 5.3 to 27.4 with guard hairs
Average CoV (%) Low – more consistency; high – more separation	56	20.8		12.5 to 59 w/o guard hairs[2] 25.6 to 93.7 with guard hairs
Average % of fibers over 30µ	18.4	0		1.3 to 74.4
Average Comfort Factor (%) Higher the better	81.6	100	80.36	
Average Curvature (deg/mm) Higher the better	26.1	29.4		12.4 to 66.9 w/o guard hairs[3] 8.9 to 61.4 with guard hairs
Average Curvature SD (deg/mm) Lower the better	25.3	26.6		11.5 to 44.1 w/o guard hairs 10.6 to 48.1 with guard hairs

[1] Only one individual goat had a 13.5 SD. The range for all other goats was from 2.7 to 5.9
[2] Only one individual goat had a CoV of 59. The range for all other goats was from 12.5 to 34.8
[3] Only one individual goat had an average curve of 66.9. The range for all other goats was from 12.4 to 54.4

As you can see, we have improved a bit on the softness and fineness of Pygora fiber since the 2004 study (25.4µ vs 27.02µ).

We also compare favorably with cashmere (20.2µ for Pygora vs an average of 16.5µ for cashmere). We had 41 goats in this study who tested in the cashmere range (up to 19µ):
- two yearling Type As
- 30 Types Bs from 1-10 years of age
- nine type Cs from 1-9 years of age.
The average MFD of these goats was 17.365µ.

Pygora fiber is very comparable to the other luxury fibers. We have an excellent product, but poor marketing techniques. When someone mentions 'luxury or fine fiber', the first word that pops into most people's minds is 'alpaca'. The alpaca people have perfected their marketing skills and are beating everyone in reaching customers looking for luxury fibers. We need to improve our marketing and PR programs so that 'Pygora' can become a household word.

By Age

One of the selling points for Pygoras is that their fleece does not coarsen significantly as the goat ages. In dual-coated animals, such as Pygoras, Cashmere goats and primitive sheep, the undercoat has one function – to keep the animal warm and alive. Since this function does not change over time, the undercoat tends to remain consistent. The outer coat or guard hairs will change to adapt to the weather conditions to sluff off rain and snow.[1] With Pygoras, the undercoat is what we harvest and use so we can take advantage of that consistency.

The study included goats from 1 to 15 years old with the average age as 4 years old. As you can see from Table 2, Pygora does hold its fineness and softness as the goat grows older (the difference in AFDs between all the age groups is only 2.4µ). This gives us some hard data to provide to consumers to prove what we have been saying about the fiber.

Table 2. Fiber Study Results by Age of Goat (without guard hair)

Age	# of Goats	MFD (w/o guard hair) Lower the better	SD Lower the better	Cof V Low – more consistency; high – more separation	Curvature Higher the better	Curvature SD Lower the better
Study Average		20.2	4.2	20.8	29.4	26.6
1	17	19.9	4.1	21.1	27.6	25.4
2	21	20.4	4.2	20.8	26.7	25.2
3	29	20.0	4.2	21.4	30.3	27.3
4	15	20.6	4.1	20.0	27.3	24.5
5	13	20.9	3.9	19.0	30.3	29.1
6	11	20.4	4.0	19.9	28.7	24.3
7	8	20.5	3.7	18.1	32.1	26.9
8	7	19.6	4.4	23.0	32.1	30.2
9	2	18.5	3.6	19.5	48.2	38.6
10	4	20.2	3.9	19.8	31.3	26.3
15	1	19.2	4.2	22.1	35.7	29.6

An interesting note from the study – it appears that age 5 is when the goats produce their coarsest fleeces on average. I wonder why. What is it about that age? Or is it merely because we had considerably more goats under f5 years old than we did over 5 so the results are a bit skewed?

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[1] Angus McColl, Yocom-McColl Testing Laboratories Inc., Denver, Colorado

By Fleece Type

As part of the 2004 study, Chris Utterback and Sally McCarrick developed guidelines for typing Pygora fleece:

- Type A must have a cool handle, high luster, consistent style the full length of the lock to the base of the lock and silky guard hair.
- Type B is a blend and does not have style at the *base* of the fiber, but must have luster and two guard hairs: one with good separation and a second one that is fine, silky, and spinnable (it may be so fine it is almost unapparent).
- Type C must have a matte finish (no luster), only one very-obvious guard hair and a creamy, warm handle.

As expected, when comparing the fleece types, Type-A fleeces had the highest MFD and the lowest comfort factor while Type-C goats had the lowest MFD and highest comfort factor (see Table 3). Type-B goats were nicely in the middle. The type C average is even in the cashmere average micron count range.

Table 3. Fiber Study Results by Fleece Type (without guard hair)

	# of Goats	AFD[1] Lower the better	SD Lower the better	Cof V Low – more consistency high – more separation	Curvature Higher the better	Curvature SD Lower the better
Study Average		**20.2**	**4.2**	**20.8**	**29.4**	**26.6**
Type A	29	21.7	4.3	20	23	23.4
Type B	85	20	4	20.5	30.2	26.5
Type C	16	18.7	4	21.6	36.6	32.1

[1] The MFD in this table are with the guard hair data removed.

Table 4 shows a comparison of the 2004 and 2012 fiber study results. It's encouraging to see that Pygora fleeces have become finer and softer since 2004. This hopefully is attributable to successful breeding programs devoted to improving the fleece, but nutrition, climate/weather, etc. must be considered. We also seem to have improved the crimp in type-A and type-B fleeces since the 2004 study.

The downside is that the 'negative' trend we saw in the 2004 study is worse now: the amount of variation (SD) among the samples. This is something we need to address as breeders. It is important to standardize the fleece types so there is less variation. The key is the guard hairs. We should strive to breed for the fewest number of guard hairs possible and for guard hairs that have a good separation from the down. Good separation (a distinct difference between guard hair and good fiber) is essential to successful, complete dehairing. And successful dehairing is essential for sinfully-soft Pygora fiber that spinners love.

Table 4. Comparison of 2012 and 2004 Fiber Studies (with guard hair)

	2102 AFD[1] Lower the better	2004 MFD Lower the better	2012 SD Lower the better	2004 SD Lower the better	2012 Curvature[2] Higher the better	2004 Curvature Higher the better
Type A	27.6	29.4	4.3	3.9	19.4	17.76
Type B	25	27.9	4	3.8	26.9	25.81
Type C	24.2	24.9	4	3.1	33.5	35.78

[1] The AFDs in this table include guard hair data; this is necessary for the comparison as the data in the 2004 study included guard hair.
[2] The curvature in this table includes guard hair data; this is necessary for the comparison as the data in the 2004 study included guard hair.

By Gender

This was something new we looked at in the 2012 fiber study – mostly as a matter of curiosity to see if there were any significant differences in fleece quality between bucks, does and wethers. As you can see in Table 5, there is no significant difference between the genders' fleece quality.

Table 5. Comparison of Data by Gender (without guard hair)

	# of Goats	Aver. Age	MFD w/o guard hair Lower the better	SD Lower the better	Cof V Low – more consistency high – more separation	Curvature Higher the better	Curvature SD Lower the better
Wethers	14	5	20.2	4	20	32.4	28.3
Does	97	4	20.2	4.2	20.9	28.6	26.1
Bucks	19	2.9	20.5	4.3	21.4	30.8	27.7

By Fleece Color

Again, this is a comparison that was not in the original study, but we were curious if there was a difference in fleece quality between the fleece colors (we are not advocating that you breed based on color). I have noticed that white fleeces I spin are not quite as soft as the colored fleeces. Has anyone else has noticed this?

Table 6 shows that there are small differences between the colors' fleece qualities. And it demonstrates that the white samples in this study were indeed not as fine and soft as the colored samples. Is this because the white fleeces have more guard hairs and/or the guard hairs are finer and do not get separated as well or some other reason? It also is interesting that the darker colors have more crimp than the lighter colors.

The findings here do not mean that you should stop breeding white Pygoras or turn to breeding for color. Use fiber test results for individual animals to make your breeding decisions.

Table 6. Fleece Color Data (without guard hair)

Color	# of Goats	MFD w/o guard hair Lower the better	SD Lower the better	Cof V Low – more consistency high – more separation	Curvature Higher the better	Curvature SD Lower the better
Black	16	19.6	3.9	20.0	33.5	26.4
Brown	18	19.2	4.2	21.8	32.9	30.2
Grey	21	19.7	4.4	22.6	30.5	27.2
Caramel	38	20.7	4	19.5	27.6	26.1
White	35	20.9	4.1	19.9	26.4	24.7

Table 7. Percent of Guard Hair by Fleece Color

Fleece Color	% of Guard Hair
Black	15.1
Brown	16
Grey	17.6
White	20.4
Caramel	21.4

Goats With Previous Fiber Tests

We wanted to do a comparison of any previous fiber tests taken for goats in the study. Unfortunately, only 12 goats of the 134 submitted for the study have had their fiber tested previously. And these 12 were owned by only three farms.

The comparison was interesting. You would expect a slight coarsening of the fleece as a goat gets older. However, six of the 12 goats showed improvement in fineness and comfort factor and a decrease in the number of guard hairs in their second fiber sample. This raised questions:
- is it due to the fleece improving (and if so, due to what factors – better/different feed, addition/removal of minerals, new method of harvesting, change of climate, etc.?)
- or is it due to the sampling method (were both samples taken from the same place on the goat? Were they both clean samples with the lock structure intact, etc.)?

Most of the changes were fairly small. However, some changes were quite large. It does demonstrate that a goat should have several fiber samples tested over the course of its life. One fiber test is not accurate enough to base breeding decisions upon.

Table 8. Goats With Previous Fiber Tests

	Time between tests	Change in MFD Lower the better	Change in SD Lower the better	Change in % of Guard Hairs Lower the better	Change in CF Higher the better	Change in Mean Curvature Lower the better
Goat 1	4.5 yr.	inc. 3.6	inc. 0.8	dec. 12.3	inc. 12.5	
Goat 2	17 m.	dec. 1.8	inc. 3.1	inc. 1.6	Dec 1.6	dec. 0.1
Goat 3	4 yr.	dec. 1.4	inc. 3.2	inc. 0.7	dec. 0.7	dec. 5.8
Goat 4	17 m.	dec. 3	inc. 3.3	inc. 13.8	dec 13.8	0
Goat 5	17 m.	inc. 2.5	dec. 4.3	Dec . 5.6	Inc . 5.6	dec. 0.3
Goat 6	2.5 yr.	dec. 4	dec. 4.9	dec. 7.7	inc. 7.7	inc. 13.5
Goat 7	1.5 yr.	inc. 1.9	inc.10.4	dec. 2.3	inc. 2.3	
Goat 8	1.5 yr.	dec. 3.4	dec. 3.4	dec. 8	inc. 8	
Goat 9	1.5 yr.	dec. 0.9	inc. 0.4	dec. 4.2	inc. 4.2	
Goat 10	18 m.	inc. 3.1	inc. 1.6	inc. 9	dec. 9	
Goat 11	18 m.	inc. 4.4	inc. 1.3	inc. 21.5	dec. 21.5	
Goat 12	3 yr. 3 m.	inc. 5	inc. 14.6	inc. 11.8	dec. 11.8	

Conclusions

The first fiber study had two main goals:
- establish information about Pygora fiber that would help us compete in the luxury fiber market, giving buyers data so they could compare Pygora to the other luxury fibers.
- provide a useful tool to help breeders choose breeding pairs. The tests identified deficiencies and strengths in the fiber of each individual animal so a breeder could choose pairings to improve their herd.

The 2012 study provides additional data to help with both of those goals.

Marketing Pygora Fiber

There are a lot of misconceptions out there about Pygora fiber. And there still are a lot of people who do not know what a Pygora is. One way to clear up these misconceptions is education: education of Pygora owners and education of spinners, knitters, etc. The data contained in the fiber studies is a great source of information. You also can use the micron count information to market your fiber – many spinners are knowledgeable about micron counts and they will quote you chapter and verse on how many microns alpaca is or merino is, etc. With your Pygora micron counts firmly in hand, you can show them conclusively how nice, fine and soft Pygora is!

Selective Breeding

The 2004 study pointed out that 'Pygora fiber is not very consistent yet'. This 2012 study shows that is still the case. In fact, the variability has increased since the 2004 study. This is a step backwards. To become a breed that is taken seriously and valued for what Pygoras are, we must focus on breeding selectively to standardize and improve our goats and their fiber. To do so:
- fiber test all breeding stock, especially bucks.
- do not breed any animals that do not conform to the Pygora standards and/or that have high micron counts (over 26.7) and/or low comfort factors.
- examine the fiber test results of the previous generations of your proposed breeding animals to make sure they meet the criteria as well.

Thoughts to Consider

Breed to Obtain Only Type-B Fleeces

This is a big suggestion, but I believe it has merit and deserves to be evaluated and discussed: consider moving to a single fleece type in Pygoras. Breed to strictly type-B Pygora goats and eliminate the type As and Cs as they age out of the breeding pool. There are several factors in the study results that prompt this suggestion:
- There is a big range of guard hair percentages among type-A goats from 15.4 to 50.1%. There also appears to be a separation problem between guard hairs and good fiber in type As. The guard hairs are becoming softer and therefore hard to remove during dehairing.
- Most of the higher AFDs (and therefore coarser fibers) are in the type As
- The type-C Pygoras simply do not produce much fiber; they have one harvest a year and it usually is quite a bit smaller than type-A or type-B goats Pygoras.
- Type-C fleece is matte finish and doesn't have many crimps. Most consumers are looking for that sheen and curl that puts Pygora in a special category.

This leads us to question if Pygora breeders still should breed type As when they are coarser and less soft than the type Bs or type Cs when the yield is so low and they lack luster and crimp? After all, we are trying to capture a fine-fleece market and competing against kid mohair, alpaca and cashmere goats. Shouldn't we be concentrating on breeding our very softest, finest-fleeced goats?

Yes, type-A Pygoras are gorgeous with those long, curly, shiny locks, but when the fleece is made into a 'cloud' or roving and spun, does that really provide a spinner with the best experience?

Most spinners we've consulted who have spun Pygora, including myself (and I have all three types of Pygoras) prefer type B to spin and as finished yarn. Type-B fleeces have the best of all worlds - great handle, softness and volume.

Conduct a Lifetime Fiber Study

I would love to see the PBA conduct a study where breeders/owners nominate specific Pygora kids and fiber test them every year throughout their life to see how much change there actually is in the fleece. I'd like to hear from Pygora folks who would be willing to designate a kid or two and do the fiber tests every year. I am willing to write the proposal for the PBA if there is enough interest in such a study.

Fiber Test!

The saddest statistic I saw from this fiber study was how few Pygora owners and breeders fiber test their goats. This is a wonderful tool to improve the breed and market our fleece. A fiber test is quite inexpensive: $9. It provides a wealth of information that can be used to show consumers how wonderful our fiber is and to make sound breeding decisions. If you are serious about producing a consistent supply of fiber for the fiber markets, you should be fiber testing!

I'd also like to recommend that we do a fiber study at least every 5 years or so to keep tabs on how our breed is doing and to make sure we don't veer off into any bad habits.

Do Not Sell 'Raw' Pygora Fiber

As you can see from the various tables, the percentage of guard hair in a fleece may be quite high (up to 74.4% in one instance with an average of 18.4%). And for some fleeces, the separation between guard hairs and 'good' fiber can be quite low, making it difficult to dehair it completely. These factors mean that if a consumer buys 'raw' Pygora fiber and tries to dehair it themselves, chances are high that they will be dissatisfied with the results and form a negative opinion of Pygora fiber. And negative opinions are something we want to avoid! The recommendation is to strongly discourage the selling of un-dehaired Pygora fiber to consumers.

Thank Yous

I want to thank my two committee members, Kari Schroeder who developed the test form and who bravely did a lot of the Excel analyses (we both had to learn how to use Excel) and Chris Utterback who conducted the first study and who refused to let me quit on this one. It's an amazing amount of work to put a fiber study together, and I thank you both very much!

I also want to thank everyone who took the time and made the effort to submit samples for this fiber study. It was a remarkable undertaking, and I am proud to have been a part of it.