A SURVEY OF SURI ALPACA FLEECE CHARACTERISTICS (1997)

A Report to the Australian Suri Breeders Network

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INTRODUCTION

In all textile fibre production the most important property is fibre diameter, followed by specific characteristics relevant to that particular fibre. It is also important that the fibre be as even as possible unless a particular blend is being produced. It therefore is important that an understanding of the fibre diameter variation across the Suri Alpaca fleece be established so the superior regions of the fleece produced be identified for correct preparation prior to processing.

In this project, variation across the animal was identified.
Other fleece parameters to be determined were

- Staple strength
- Medullation %
- Resistance to compression (bulk)
- Fibre type
- Mean micron averages
- Standard deviation averages
- Co efficient of variation averages
- Fibre curvature averages

SURVEY SAMPLE

Animals were sampled on two properties for this study, as well as various Suri and Huacaya samples for the resistance to compression (bulk) comparisons.

The animals selected varied in age (6months to 10 years of age), growth (6 months to 2 years), sex and genetic background (Bolivian and Peruvian). Fleece colour varied with the predominant colour being white.

Due to the variance of length in the samples, only those suitable were used for strength measurements.

The medullation tests were only carried out on white coloured fibre samples.

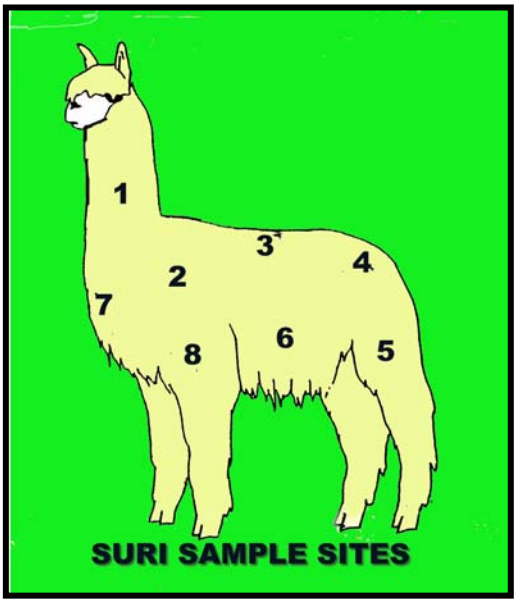
TESTING

To determine the fibre fineness the Optical Fibre Diameter Analyser (OFDA) machine was used. Samples taken from each of the nominated sites were tested by the Melbourne Institute of Textiles Wool and Specialty Fibres testing laboratory. Staple strength, medullation levels, fibre curvature, resistance to compression were also carried out at this laboratory.

FLEECE SAMPLE SELECTION AND COLLECTION

The protocol for this study was to select 8 sites over the animal as shown in diagram 1. The sites are as follows:

1. Neck
2. Shoulder pin bone
3. Mid back
4. Hind pin bone
5. Middle hind leg
6. Midside
7. Apron
8. Middle front leg



(DIA 1)

SAMPLE PREPARATION

Due to the small staple size samples only one sub sample was prepared. The samples were recorded and washed using a 3 bowl system (each bowl of 60 litre capacity) The temperature, time and liquor composition of each bowl was as follows:

Bowl 1	52 degrees for 2.5 min with Lissapol detergent (1 g/l)
Bowl 2	48 degrees for 2 minutes with Lissapol detergent (0.7 g/l)
Bowl 3	Warm water rinse for 2 minutes

The Lissapol detergent (ICI) is described as a 100% active water-soluble nonionic surfactant.

After scouring, the samples were spun-dry and placed in a CSIRO Direct Reading Regain Tester (Rapid Dryer) and dried at 103 degrees to constant weight (i.e. free of all moisture).
The samples were then placed in an atmospherically controlled environment and left to recondition for 12 hours at 20 degrees celsius and 65% relative humidity, prior to measurement.

Samples being used for mean fibre diameter and associated tests were prepared for testing using the mini core machine. This machine cuts the samples into 2 mm snippets for preparation for use in the OFDA.

MEAN FIBRE DIAMETER DETERMINATION

Mean fibre diameter was determined using the Optical Fibre Diameter Analyser (OFDA)

The OFDA is an automatic microscope above a moving set of fibres. The analyser captures the magnified images of the individual fibres with a video camera. The diameter of each fibre identified is measured and recorded by means of computer aided image analysis. The OFDA was checked and calibrated using standard laboratory wool tops. 2000 fibres were measured for each site sample and from these measurements the following data was obtained:

Mean fibre diameter (microns)
Standard Deviation
Coefficient of Variation (%)
Medullation percentage
Fibre curvature

STAPLE STRENGTH MEASUREMENT

The procedure using the Staple Strength Measurement System (Agritest) the samples were measured for staple strength as follows:

The staple thickness (mm) was measured at three locations and average staple density (Ktex) calculated as follows:

The average of tip, middle and base x 3.2 = Mean staple density in Ktex.

Staple strengths were determined by placing the tip and base ends in clamps and exerting a force to break the staple. The applied force was measured in Newtons. The staple strength (Newtons/KTex) was then calculated for each staple according to the following example:

Thickness			Strength (Newtons)
Tip	Mid	Base	
0.45	0.65	0.80	90

Total 1.9 divided by 3 = 0.633

Mean Staple density = 0.633 x 3.2 = 2.02 Ktex
Staple Strength = 90/2.02 = 44.4 N/KTex

The mean of eight staple strengths was calculated from the samples from each of the eight sites to give a measurement for each animal. The position of break (tip, middle, base or random) was also recorded.

RESISTANCE TO COMPRESSION AND BULK

The measurement of fibre resistance to compression was performed on two sub samples of a minimal mass of 150 grams were then scoured,according to standards mentioned earlier, carded and conditioned for six hours prior to measurement. The sub samples were then weighed into 2.5 gram amounts for measurement. The measurements were carried out in the standard laboratory atmosphere of 20 degrees celsius and 65% relative humidity. A reading on the two separate sub samples was recorded and where they did not differ by more than 10 g per sq cm (1kpa) , an average value was calculated. The apparatus used for these measurements is the Agsearch/Agritest Pty Ltd, Resistance to Compression Tester which measures in grams per square centimetre.

GLOSSARY OF TERMS

MEAN or Average fibre diameter of the measured population in microns.

(S.D.): STANDARD DEVIATION is measured in microns. It is a measure of the fibre diameter variation within the tested sample. The lower the S.D. the more evenly sized the fibres are thus giving a more desirable result in terms of processing qualities.

(C.V.): CO-EFFICIENT OF VARIATION measures the spread of fibre diameter variation relative to the average. It is calculated by dividing the S.D. by the mean diameter and then multiplying by 100.

(CEM) COARSE EDGE MICRON: Measures the number of microns greater than the average micron where the broadest 5% of fibres lie. Generally the lower the coarse edge percentage the better the quality and the more uniform the fibre diameter distribution.

(PF) % OF FIBRES >30 MICRONS: Refers to the percentage of fibres in the tested sample above 30 microns. Prickle factor (PF) is associated with wools that have 5% of their fibres greater than 30 microns. The wool prickle in apparel garments can cause skin irritation due to the coarser wool fibres irritating the pain receptors of the skin surface.

(SpnF) SPINNING FINENESS: Provides an estimate of the ultimate performance of the sample if it is spun into yarn. This is calculated by combining the measured mean diameter and the measured coefficient of variation. Spinning performance can be improved by either decreasing mean fibre diameter or decreasing the level of fibre diameter variability.

e.g.	Mean 21 microns and C.V.(D) 28%	= SpnF 21.8 microns
	Mean 21 microns and C.V.(D) 24%	= SpnF 21.0 microns
	Mean 21 microns and C.V.(D) 19%	= SpnF 20.1 microns

SAMPLE SIZE: Refers to the number of fibres measured for the tested sample.

FIBRE CURVATURE: The OFDA measures average curvature of fibre snippets. The curvature value is expressed in degrees per mm fibre length. Fibre measurement is the measure of the curve (crimp/crinkle/amplitude) in the individual fibres. There is a reasonable correlation between fibre curvature and staple crimp frequency (HUACAYA) for good styled Alpaca fleece. As the frequency of the crimp increases the curvature value is increased, and conversely the lower the curvature value the lower the staple crimp frequency. Fibre curvature can be measured at all stages of processing e.g. greasy to fabric. The curvature (amplitude) of the fibre influences how the fibre will process, particularly during top making and spinning.

e.g. CURVE = 65.8 [45] deg/mm
65.8 = mean fibre curvature
45 = standard deviation
Curve Number = 2658 number of snippets measured

The standard deviation (or CV if calculated) tends to indicate character (crimp definition). A well defined crimp (good character) usually indicates that the fibres are reasonably even and well aligned. The SD should only be compared to other results of a similar curvature range.
Resistance to compression and bulk can also be calculated using curvature and micron values.

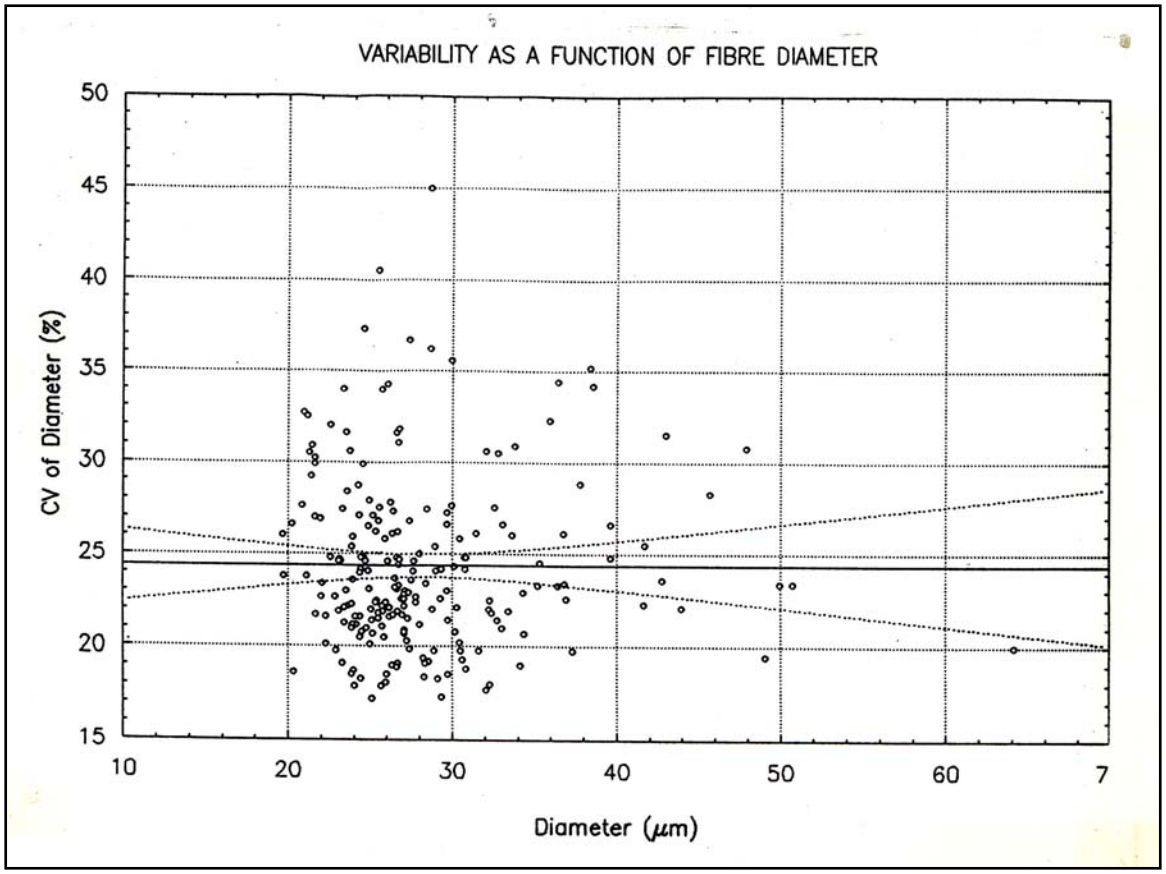
MEDULLATION: Medullation can only be measured on samples that are white/light in colour. Medullated fibres are animal fibres in which the cells within the middle of the fibre (medulla) have collapsed and caused the fibre to become hollow. The medulla of a medullated fibre can be fragmented, interrupted or continuous. The OFDA measures medullation of fibres by their opacity i.e. how well they transmit light. When a fibre is above a certain threshold of opacity it is counted as being medullated. On the printout there is a lot of information regarding the measured medullated fibres. The following is an explanation of the main information.

e.g.	Num med	number of medullated fibres measured
	% med	% of medullated fibres in the measured sample
	mean	mean & SD of diameter for the measured medullated fibres
	Opcty	mean & standard deviation of opacity
	%MdVol	% of medullated fibres by volume
	%MdWt	% of medullated fibres by weight
	Graph	Histogram of medullated fibres

RESULTS

AVERAGE MICRONS

MICRON	mean	sD	cV
19.00	19.69	4.90	24.90
20.00	20.66	5.39	26.05
21.00	21.58	5.72	26.55
22.00	22.40	5.11	22.82
23.00	23.53	5.68	24.14
24.00	24.48	5.92	24.15
25.00	25.50	5.99	23.48
26.00	26.51	6.62	24.97
27.00	27.35	6.39	23.34
28.00	28.62	7.31	25.53
29.00	29.56	6.94	23.44
30.00	30.50	6.95	22.79
31.00	31.33	7.28	23.25
32.00	32.41	7.68	23.70
33.00	33.48	8.62	25.73
34.00	34.32	8.17	23.80
35.00	35.48	9.49	26.70
36.00	36.71	10.01	27.28
37.00	37.57	9.54	25.40
38.00	38.63	11.03	28.58
39.00	39.61	10.19	25.70
41.00	41.50	10.59	25.53
42.00	42.87	11.82	27.55
43.00	43.92	9.73	22.10
45.00	45.67	12.93	28.30
47.00	47.87	14.73	30.80
49.00	49.06	9.55	19.50
50.00	50.72	11.85	23.40
51.00	51.97	10.51	20.20
64.00	64.09	12.79	20.00
Grand Average	**28.37**	**6.92**	**24.38**



(CHART 1)

MEDULLATION / CURVE / MICRON

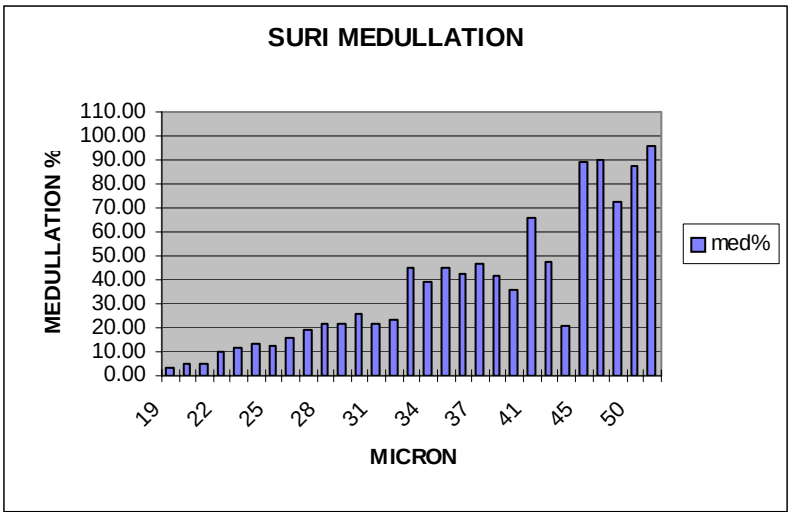
MED%	curve	mean
5	28.51	24.18
10	26.56	24.80
15	28.26	26.30
20	24.57	27.87
25	22.54	28.52
30	22.81	29.13
40	21.38	30.33
50	18.06	34.19
60	17.65	34.27
70	16.05	41.92
90	14.08	52.09
Grand Average	**24.81**	**27.98**

CURVE / MEDULLATION / MICRON

CURVE	med%	micron
15	50.82	40.40
20	31.20	30.83
25	18.41	26.96
30	11.68	24.89
35	10.74	25.06
40	9.03	25.95
Grand Average	**20.38**	**27.98**

MEDULLATION

MICRON	mean micron	MED%
19.00	19.69	3.45
20.00	20.57	4.78
21.00	21.52	4.71
22.00	22.49	9.87
23.00	23.55	11.89
24.00	24.50	13.26
25.00	25.50	12.89
26.00	26.51	16.09
27.00	27.37	18.80
28.00	28.59	21.35
29.00	29.58	21.88
30.00	30.52	25.44
31.00	31.53	21.35
32.00	32.38	23.17
33.00	33.40	45.00
34.00	34.26	39.10
35.00	35.48	44.70
36.00	36.68	42.43
37.00	37.56	46.35
38.00	38.49	41.90
39.00	39.61	35.70
41.00	41.66	66.05
42.00	42.87	47.90
43.00	43.92	20.90
45.00	45.67	89.20
47.00	47.87	90.30
49.00	49.06	72.60
50.00	50.72	87.70
64.00	64.09	95.80



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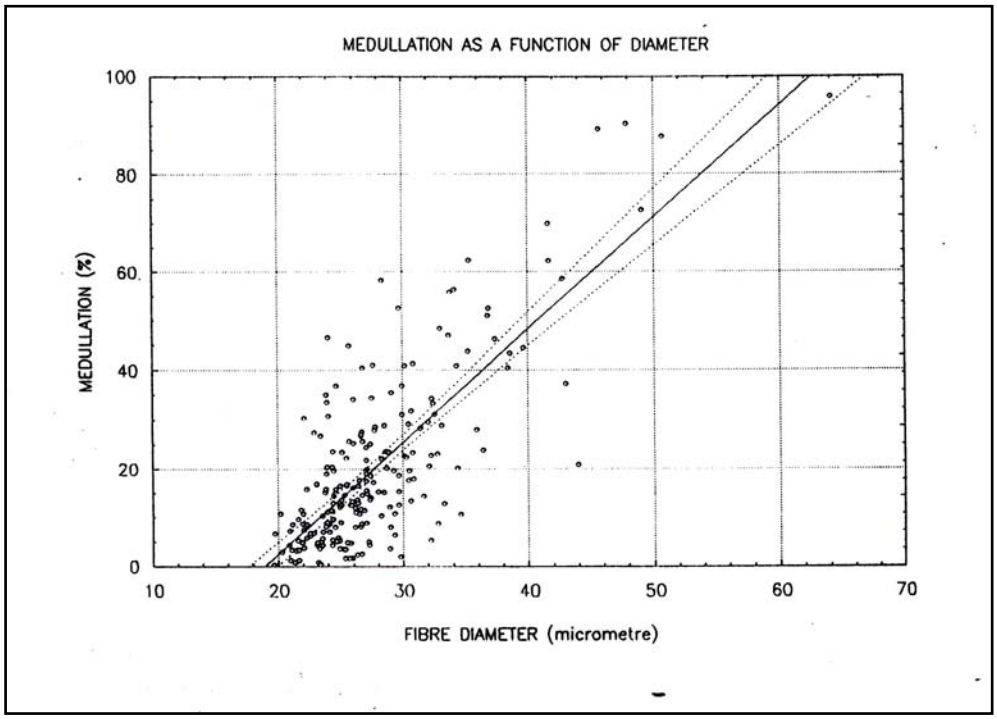

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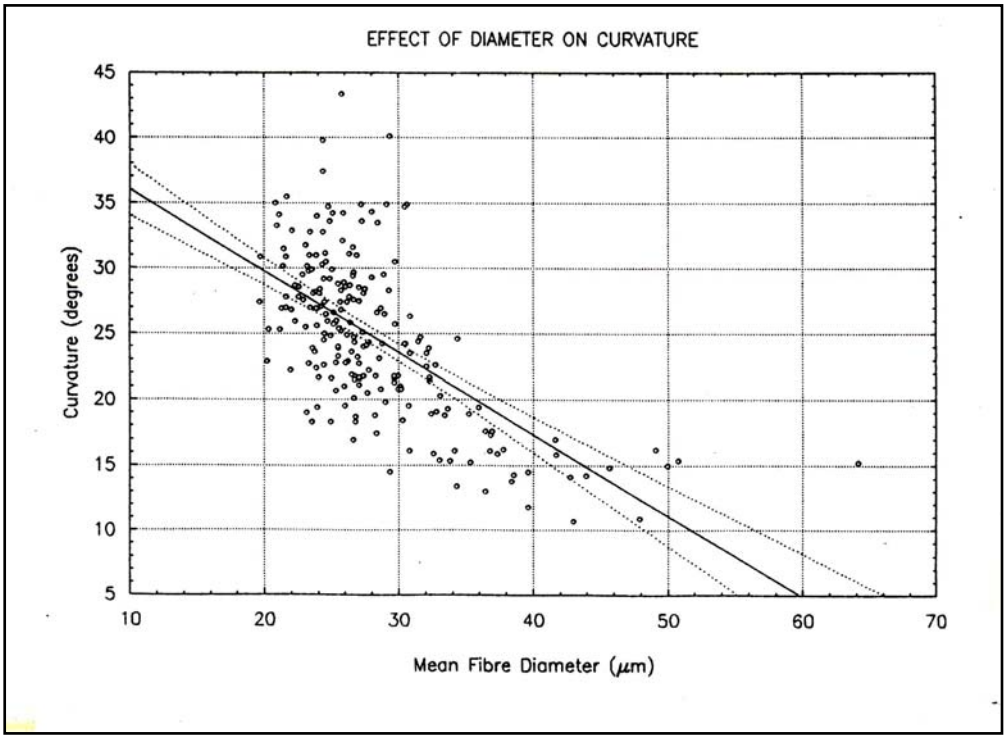
(CHART 4)

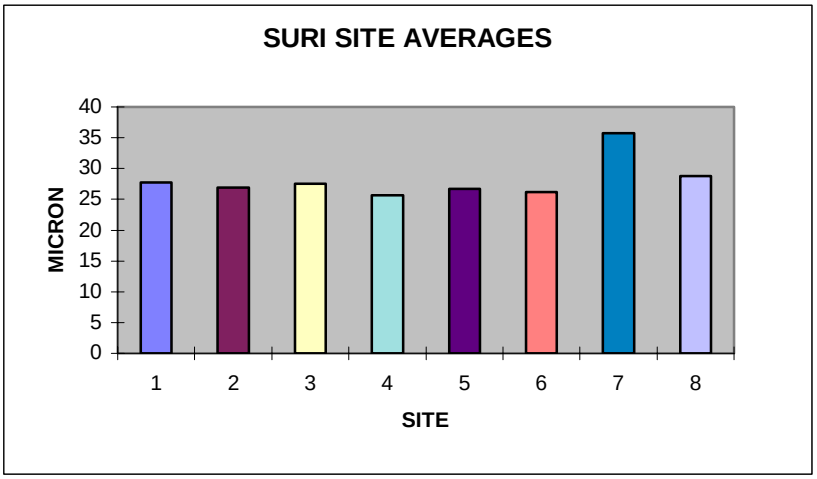


SITE AVERAGES

1 **(MICRON, no medullation / curve)**

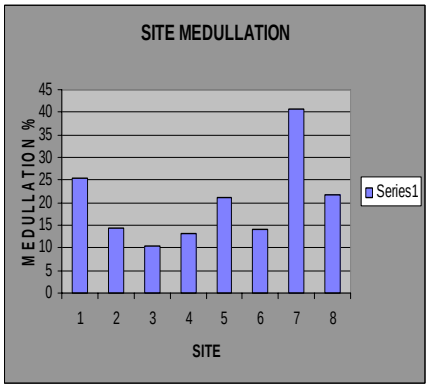
ANIMAL	SITE	mean	sD	cV	d5%AM	%AE30
	1	27.70	6.19	22.51	11.06	33.59
	2	26.96	6.63	24.62	12.75	29.48
	3	27.52	5.87	21.44	10.84	33.54
	4	25.65	5.89	23.08	10.94	23.91
	5	26.67	6.33	23.87	12.00	28.45
	6	26.14	6.33	24.37	11.93	27.34
	7	35.75	9.91	28.40	18.74	61.41
	8	28.81	7.33	25.45	13.97	38.12

site	mean
1	27.70
2	26.96
3	27.52
4	25.65
5	26.67
6	26.14
7	35.75
8	28.81
ave	28.15
sd	3.23
cv	11.5



2 . ALL SITE AVERAGES (coloured removed)

SITE	mean	sD	cV	d5%AM	%AE30	med%	curve
1	27.75	6.25	22.70	11.19	33.20	25.55	22.05
2	26.50	6.61	24.90	12.83	27.49	14.51	26.45
3	27.55	5.88	21.45	10.83	33.50	10.47	30.09
4	25.49	5.93	23.39	11.07	23.03	13.18	26.77
5	26.48	6.30	23.95	11.95	27.30	21.27	25.28
6	25.45	6.15	24.40	11.47	22.96	14.13	26.77
7	35.55	9.96	28.59	18.94	61.25	40.79	18.79
8	28.54	7.34	25.65	14.00	36.59	21.77	22.72



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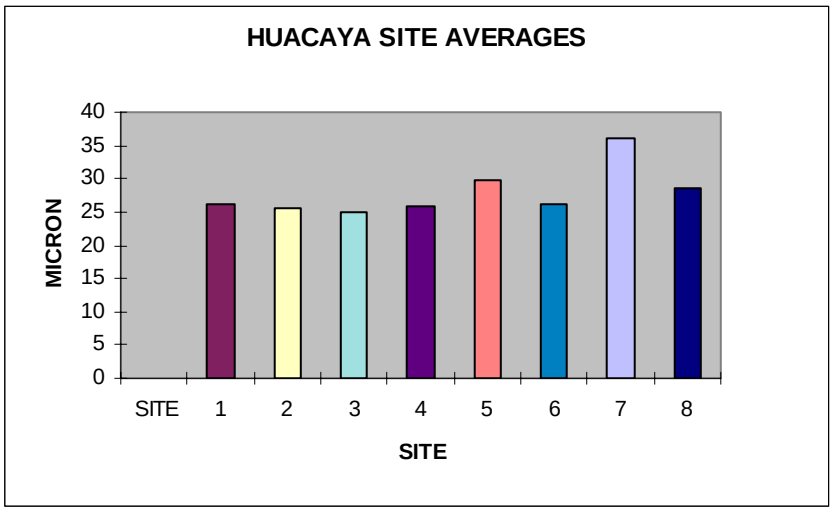
HUACAYA SITE AVERAGES

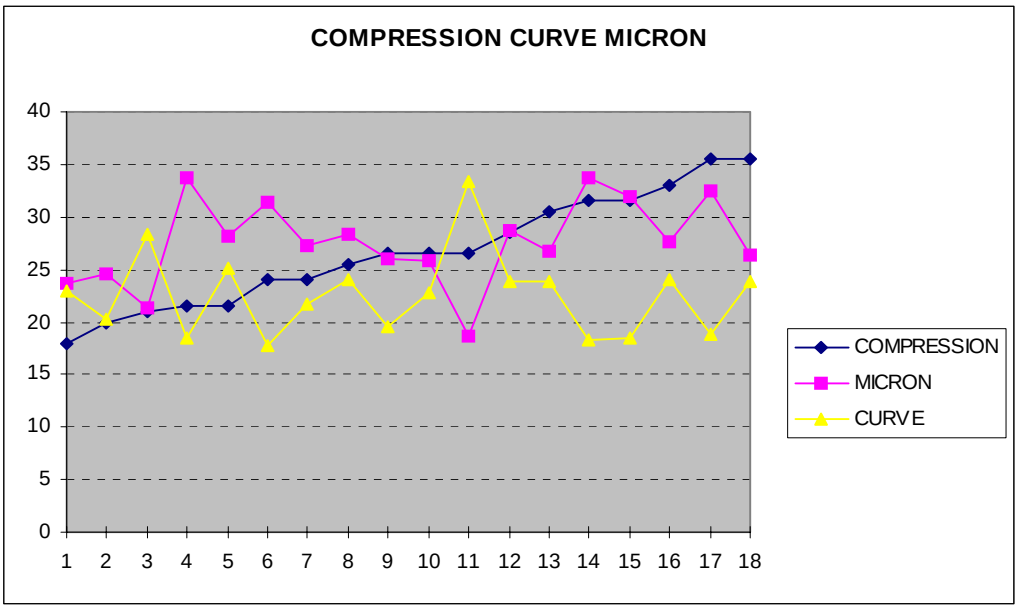
SITE	MICRON
1	26.30
2	25.70
3	25.00
4	25.90
5	29.80
6	26.30
7	36.00
8	28.60
ave	27.95
sd	3.63
cv	12.97



RESISTANCE TO COMPRESSION AND BULK

FIBRE TYPE	AMPLITUDE	COMPRESSION	MICRON	CURVE
SURI	S	18	23.7	23
S	S	20	24.5	20.2
S	S	21	21.4	28.3
S	S	21.5	33.7	18.5
S	S	21.5	28.2	25.2
S	S	24	31.4	17.7
S	S	24	27.2	21.7
HL HUACAYA high luster	L	24.5	24.8	26.7
S	S	25.5	28.4	24.1
S	S	26.5	26	19.6
S	S	26.5	25.9	22.8
S	S	26.5	18.7	33.4
S	S	28.5	28.7	23.8
S	S	30.5	26.8	23.9
HL	M	31	21.7	28.6
S	S	31.5	33.7	18.3
S	S	31.5	31.9	18.5
HL	L	32	27.5	30.5
HL	L	32.5	25.8	24.1
S	S	33	27.6	24.1
HL	L	33	34.5	21.5
HL	M	33.5	22.7	29.4
HL	L	34.5	26	31.1
HUACAYA	M	34.5	27	29.3
HL	M	35	21.1	38.5
S	S	35.5	32.4	18.9
S	S	35.5	26.3	23.8
HL	M	37	18.6	42.7
H	L	37.5	30.8	24

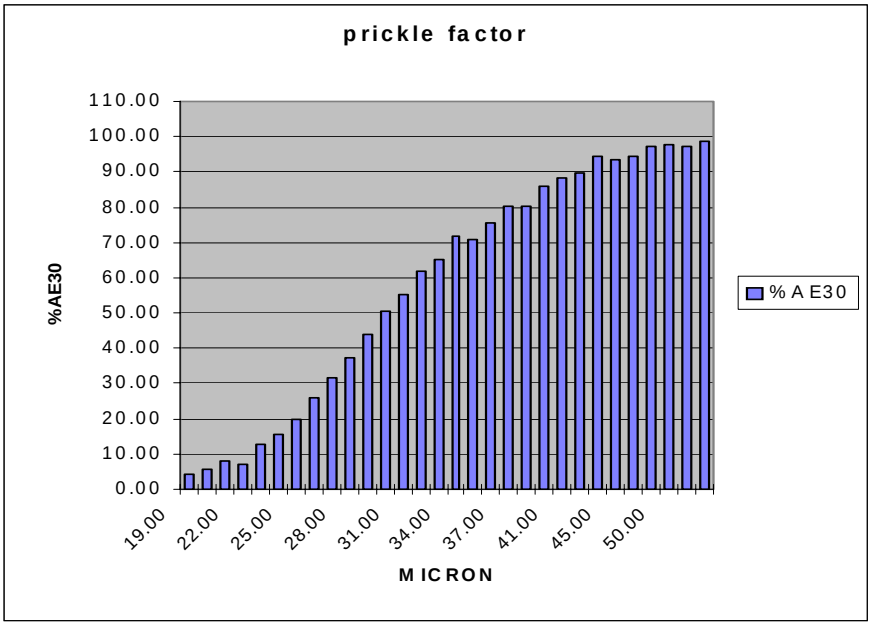
HL	L	38	27	27.3
HL	H	38.5	22	40
H	M	38.5	30.1	29.7
HP	H	40	21.5	43.1
H	M	40.5	27.8	34
HP	H	41	20.9	40.9
H	M	41	31.2	27.4
HL	M	42.5	25	30.8
H	L	42.5	35.8	24.1
HP	H	43.5	23	36.4
HL	M	44.5	29.7	33.9
HP	H	45	23	40.9
H	M	45	33.4	28.8
H	M	45	24.4	40.2
HP	M	45.5	23.8	41.2
HP	M	45.5	20.7	44.3
HL	M	45.5	22.7	39.8
H	M	46	39.9	24.1
H	H	46	26	39.2
H	H	46.5	23.1	41.8
H	H	47.5	27.3	37.9
H	H	48	26.7	33
H	M	48	29.9	35.9
HP	H	48.5	24.4	41.3
H	H	48.5	21.1	52.3
HL	M	49	37.5	20
H	H	49.5	33.9	29.4
HL	H	51	26.4	32.4
H	H	53	35.4	33
H	H	55	26.3	41.7



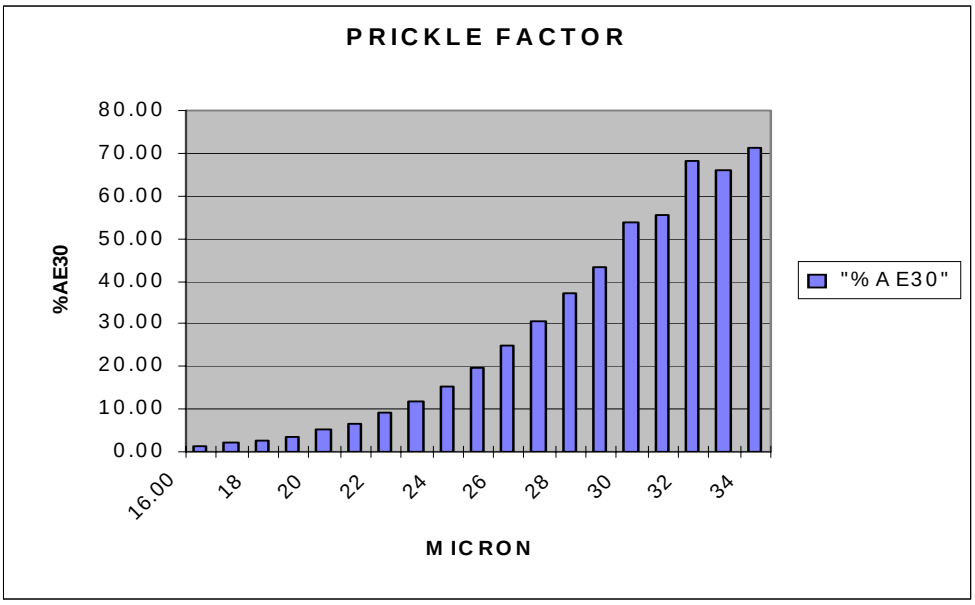
PRICKLE FACTOR
(Suri)

MICRON	mean micron	%AE30
19.00	19.69	4.15
20.00	20.64	5.62
21.00	21.58	7.98
22.00	22.40	7.25
23.00	23.53	12.59
24.00	24.48	15.73
25.00	25.50	20.06
26.00	26.51	25.80
27.00	27.35	31.41
28.00	28.62	37.22
29.00	29.56	44.05
30.00	30.50	50.69
31.00	31.33	55.35
32.00	32.41	61.91
33.00	33.48	65.37
34.00	34.32	71.70
35.00	35.48	70.90
36.00	36.71	75.58
37.00	37.57	80.40
38.00	38.63	80.40
39.00	39.61	86.00
41.00	41.50	88.43
42.00	42.87	89.75
43.00	43.92	94.30
45.00	45.67	93.50
47.00	47.87	94.50
49.00	49.06	97.20
50.00	50.72	97.60
51.00	51.97	97.20
64.00	64.09	98.90
Grand Average	28.40	35.49

(SURI)



(HUACAYA)



ALL AVERAGES

(Due to some sample sizes, not all animals could be recorded in these figures)

MICRON	mean micron	sD	cV	d5%AM	%AE30	med%	curve
19.00	19.69	4.90	24.90	9.65	4.15	3.45	29.15
20.00	20.57	5.44	26.38	10.30	6.03	4.78	29.13
21.00	21.52	5.97	27.74	11.29	8.71	4.71	28.88
22.00	22.49	5.28	23.49	9.54	8.09	9.87	28.71
23.00	23.55	5.69	24.19	10.88	12.68	11.89	26.73
24.00	24.50	5.91	24.12	11.21	15.80	13.26	28.29
25.00	25.50	5.99	23.48	11.21	20.06	12.89	27.49
26.00	26.51	6.54	24.67	12.48	25.83	16.09	25.15
27.00	27.37	6.36	23.24	11.98	31.61	18.80	25.77
28.00	28.59	7.27	25.40	14.29	37.24	21.35	23.81
29.00	29.58	7.06	23.85	13.52	43.75	21.88	25.57
30.00	30.52	6.80	22.26	12.55	51.30	25.44	23.96
31.00	31.53	7.22	22.95	14.10	57.00	21.35	24.55
32.00	32.38	7.64	23.59	14.17	61.82	23.17	21.06
33.00	33.40	8.74	26.15	17.05	64.13	45.00	17.58
34.00	34.26	7.15	20.87	13.00	75.03	39.10	18.03
35.00	35.48	9.49	26.70	18.27	70.90	44.70	17.83
36.00	36.68	9.58	26.13	18.30	77.33	42.43	15.47

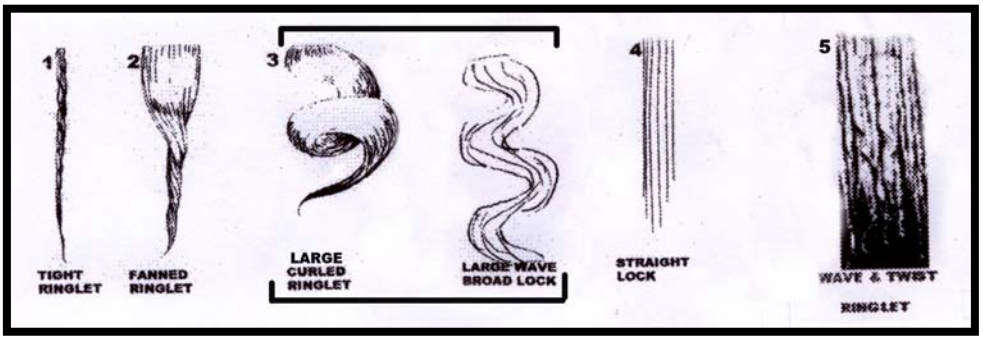
37.00	37.56	9.14	24.30	16.80	81.80	46.35	16.05
38.00	38.49	13.36	34.70	26.25	73.65	41.90	14.05
39.00	39.61	10.19	25.70	17.30	86.00	35.70	13.15
41.00	41.66	9.96	23.90	17.50	90.40	66.05	16.40
42.00	42.87	11.82	27.55	20.90	89.75	47.90	12.40
43.00	43.92	9.73	22.10	14.60	94.30	20.90	14.20
45.00	45.67	12.93	28.30	25.10	93.50	89.20	14.80
47.00	47.87	14.73	30.80	31.50	94.50	90.30	10.90
49.00	49.06	9.55	19.50	12.90	97.20	72.60	16.20
50.00	50.72	11.85	23.40	20.00	97.60	87.70	15.40
64.00	64.09	12.79	20.00	17.80	98.90	95.80	15.20
Grand Average	27.98	6.82	24.38	12.82	33.46	20.38	24.81

HUACAYA AVERAGES (no medullation or curve results available)

MICRON	**mean micron**	**sD**	**"cV"**	**d5%AM**	**"%AE30"**
16	16.72	4.04	24.20	7.87	1.32
17	17.59	4.41	25.06	8.73	2.09
18	18.65	4.70	25.16	8.94	2.75
19	19.62	4.80	24.47	9.02	3.61
20	20.51	5.18	25.23	9.65	5.16
21	21.48	5.32	24.74	9.73	6.53
22	22.49	5.56	24.73	10.12	8.96
23	23.50	5.75	24.48	10.32	11.75
24	24.48	6.03	24.62	10.80	15.21
25	25.52	6.22	24.38	11.18	19.57
26	26.55	6.38	24.05	11.29	25.05
27	27.47	6.46	23.52	11.35	30.81
28	28.45	6.65	23.38	11.71	37.36
29	29.40	6.93	23.59	12.02	43.17
30	30.57	6.75	22.10	12.04	53.76
31	31.33	8.29	26.50	15.85	55.33
32	32.91	8.16	24.80	13.80	68.00
33	33.56	9.01	26.85	18.50	65.80
34	34.19	8.78	25.70	14.60	71.40
Grand Average	**23.48**	**5.75**	**24.53**	**10.41**	**14.11**

LOCK TYPE and MICRON (no number “3 styles”)

LOCK TYPE	micron	sD	cV	%AE30	curve	AVE age
1	24.52	6.50	26.53	18.84	24.20	1
2	26.46	6.10	23.17	27.26	26.18	3
4	31.18	7.96	25.54	47.05	21.58	5
5	26.45	6.17	23.39	28.82	28.13	3



(DIA 2)

STAPLE STRENGTH

Sample No	Newtons Kilotex	Newtons Kilotex without back	diff	Postion %Tip	of %Middle	Break %Butt
111	45.77	50.62	4.85	74.3		25.7
652	31.43	33.65	2.22	100		
106	40.98	43.88	2.90	52.8		47.2
103	39.80	44.03	4.23	65.6	12.5	21.9
768	54.84	59.51	4.67	38.89	11.11	50
R43	20.15	21.22	1.07	100		
754	45.84	50.34	4.50	100		
105	33.42	36.32	2.90	100		
255	42.76	47.44	4.68	100		
R38	10.35	11.05	0.70	100		
109	29.23	31.83	2.60	87.5	0	12.5
363	41.90	45.24	3.34	71.4	28.6	
110	29.31	32.15	2.84	87.5	12.5	
R33	18.25	19.38	1.13	100		
107	34.61	36.74	2.13	0	0	0
100	46.70	50.03	3.33	0.0	0	0.0
112	37.42	41.19	3.77	0.0	0	0.0
113	50.77	56.08	5.31	0	0	0
104	22.53	24.83	2.30	0	0	0
P51	57.50	63.71	6.21	62.5	0	37.5
13702	42.04	43.58	1.54	100	0	0
355	49.87	56.19	6.32	96.4	0	3.6

9252	54.31	59.57	5.26	71.4	0	28.6
10236	39.05	43.12	4.07	100	0	0
102	32.83	36.97	4.14	100	0	0
32	47.22	48.64	1.42	85.7	0	14.3
10230	43.50	47.54	4.04	68.8	0	31.3
R39	12.48	13.42	0.94	100.0	0	0.0
363	43.81	46.44	2.63	100.0	0	0.0
10232	54.89	64.47	9.58	91.7	0	8.3

average	38.45	41.97	3.52
sd	12.52	14.04	1.93
cv	32.54	33.45	54.82
median	41.44	43.96	3.33

CONCLUSIONS

CORRELATIONS

Diameter, CV	**.01**
Diameter, Curve	**-.63**
Diameter, Medullation	**.77**
CV, Diameter, Curve	**-.17**
CV, Diameter,Medullation	**.04**
Curve, Medullation	**-.57**

Minimum significance correlation = + or - .2

Summary of Correlations

Diameter/CV CV is independent of Diameter

SD/Diameter SD is proportional to the Diameter

Diameter/Medullation As the fibre becomes stronger in micron there is an increase in medullation

Diameter/Curve The higher the micron the lower the curvature

CV/Diameter/Curve The more variable the diameter (CV) the less the curvature

Curve/Medullation Where an increase in medullation was evident the curvature was less

STAPLE STRENGTH

The staple strength findings were considered not conclusive. Variation of age, type and growth pattern (some animals were in quarantine) made a definitive outcome hard to establish. The average N/KT of 38.45 was less than found in the study of staple strength in Huacayas (Holt/Stapleton 1993). This average was still above the minimum of 35 N/KT required for sound wool. When the back site was removed from the data, an average of 3.52 N/KT was added to the strength result making it 41.97 N/KT.

It is recommended that a controlled group of Suris be tested to obtain a more conclusive result

LOCK TYPE

Lock type (1) showed a finer average result (24.5 mic) but was mostly from the younger animals. Lock type (2) (26.4 mic) and lock type (5) (26.4 mic) come from 2/3 year old animals on average. Although the fibres grew in a different lock structure their statistics were similar. The straight lock (4) came mostly from the older animals and was coarse in micron (31.1)

There were insufficient numbers and variation of lock types to make a definitive finding.
A larger number of varying lock types should be tested to make a better conclusion.

PRICKLE FACTOR

Little difference between Huacaya and Suri fibre could be found for this characteristic.

Micron	Huacaya %AE30	Suri %AE30
20	5.16	6.03
25	19.57	20.06
30	53.76	51.30

MEDULLATION

The Suri results for medullation appear to be lower than that of similar microns for Huacayas. There was limited data available for the Huacaya fibre for this comparison.

Micron	Huacaya	Suri
20	12.9%	4.7%
26	36%	16%
36	60%	42.4%

Diameter/Medullation for Suri fibre had a correlation of .77. As the fibre became coarser in micron, there was an increase in medullation.

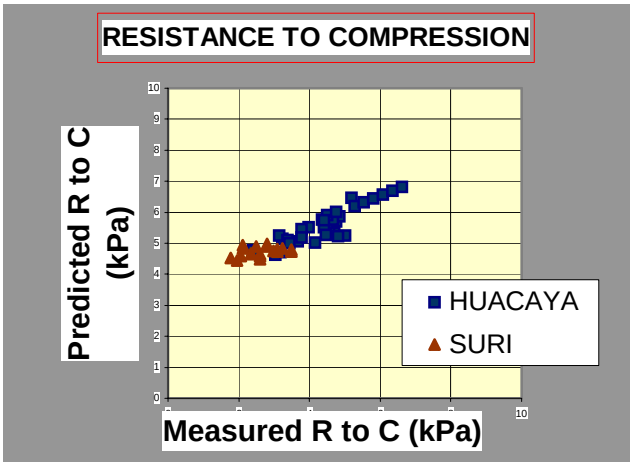
CURVATURE

Curvature in the Suri ranged from a value of 15 (40 mic) to 40 (25 mic) showing a negative correlation of -.56 (the greater the micron the lower the curvature value). It was also noticed that when the C of V was higher the curvature value was lower.

Within both groups (Huacaya and Suri) the greater the micron the lower the curvature value.

RESISTANCE TO COMPRESSION (Separate Data for Huacaya and Suri)

The Suri fibre was shown to have the lowest reading of compression when compared to the more crimpy fibred Huacaya.
Suri (range 18 g.sq.cm - 35.5 g.sq.cm) (curvature range was 17.7 - 33.4)
Huacaya ranged for compression from 24.5 g.sq.cm - 55 g.sq.cm. (Curvature range was 20 - 52.3). It was also evident that those lustrous Huacaya fibres with the lower fibre amplitude tended to have a lower resistance to compression to those of the more crimpy Huacayas.

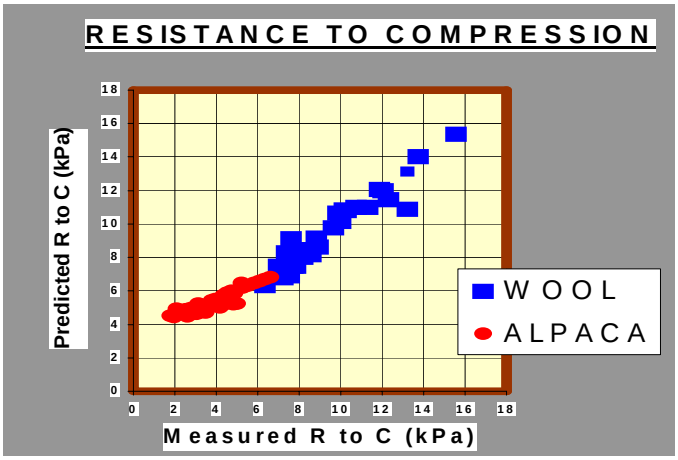


Dr Swan compared the alpaca curvature/compression results with those he had tested on wool. He used the simple mathematic relationship between diameter, curvature and resistance to compression (compressibility equals mean diameter -power 2 x mean curvature -power 1.5). The data was expressed in kilopascals.

This can be seen in the graph showing predicted resistance to compression (using curvature data input) compared to known measures resistance to compression of both the suri and huacaya samples.

Dr Swan, when he compared results of alpaca resistance to compression and curvature readings (Holt/Scott) to similar data that he had from merino sheeps wool said "that the alpaca adheres to the same basic relationship between compressibility, diameter and curvature as does wool".

(Holt/Swan1995)



Although when graphed, the slope of the relationship for alpaca differed slightly to that of merino wool. This may have been because of the different curvature measurement systems being used between the two sets of data or there may have been a difference between the keratin of the alpaca and wool fibre. The physical laws governing the compressibility of alpaca and wool fibres appear the same.

CO-EFFICIENT OF VARIATION

The average C of V for Suris in this trial was 24.38%. The range was between 19.5% and 30.8% with the majority being within plus or minus 2% of the mean (24.38%)
Co-efficient of variation was seen to be independent of diameter.

SITE VARIATION

Within each breed of Alpacas (Suri/Huacaya) there was a variation between sites on the individual breed, but there was no significant variability between the Suri and Huacaya in variability between sites.

The true analysis of variance removing residual variation was

SURI

between animals	**15.3%**	**variance**
between sites	**11.8%**	**variance**
interaction & residual	**11.8%**	**variance**

HUACAYA

between animals	**10.9%**	**variance**
between sites	**10.4%**	**variance**
interaction & residual	**10.8%**	**variance**

Formula used for variance between site means (averages)

$S^2_{ms} = S^2_r + A S^2_s$

S	=	Site
r	=	Residual variance
A	=	Number of animals each site
m	=	Mean

Minimum significant difference between sites for Suris was 6.4%

The site number 7 (apron) was significantly coarser in micron and coefficient of variation in both Suri and Huacaya groups.

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