
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

Fibre production, shearing procedure and fleece characteristics of alpacas farmed in New Zealand

T. WULIJI, G.H. DAVIS, R.N. ANDREWS, P. TURNER, G.H. MOORE AND K.G. DODDS

AgResearch, Invermay Agricultural Centre, P.O. Box 50034, Mosgiel, New Zealand.

ABSTRACT

Fleece production, fibre characteristics and spring liveweight in adult alpaca, tui and cria farmed in the South Island are reported. The shearing and fibre classing techniques are also described. Liveweight at shearing was 63.9kg, 65.7kg and 67.8kg for 1989, 1990 and 1991 respectively which is markedly increased from the South American records. The latter two years are significantly ($p<0.05$) higher than the initial year (1989) following importation. Clean fleece weight was similar in the latter two years, averaging 1.8 kg, but fibre diameter was significantly ($p<0.05$) coarser from 25.2 μm at importation to 29.8 μm and 31.0 μm at the last two shearings. Machos produced a heavier fleece ($p<0.001$) but coarser fibre than hembras. Tuis and crias produced a heavier and finer fleece than adults.

Keywords Alpaca, tui, cria, shearing, fleece weight, fleece characteristics, coat colour.

INTRODUCTION

Alpaca, llama, guanaco and vicuna form the group known as the South American or New World camelidae. The llama and the alpaca are domesticated and economically important while the guanaco and the vicuna are still in the wild or semi-wild status. There are two breeds of alpacas, huacaya and suri. Huacaya is larger and in some way resembles the llama, having crimpy hair and bulky fleece like that of a Romney sheep, while suri is slightly smaller and grows straight hair, which appears as a slippery and compact fleece like that of an angora goat.

MAF Technology imported a herd of 100 huacaya alpacas from Chile in 1989. These are now farmed as two herds separately at Tara Hills High Country Research Station, Omarama and on a private property at Lowburn near Cromwell. The aim of introducing camelids into New Zealand is to establish a new specialty fibre industry. A programme of management studies on farmed alpacas investigating production, characteristics and seasonality of fibre growth was initiated in 1989. The specific objectives are: to monitor the fleece weight and seasonality of fibre growth in a New Zealand high country grazing environment, to investigate the fleece weight components and their relative importance in animal selection, to monitor follicle and characteristic changes in relation to the fleece weight from young until adult and develop routine techniques of shearing, fleece sampling, classing and laboratory assessments.

Preliminary performance of growth, reproduction and fleece production have been reported (Davis *et al.,* 1991). This paper reports the shearing procedure, fleece weight, fleece characteristics and spring liveweight of adult alpaca, tui and cria herds between 1989 and 1991.

MATERIALS AND METHODS

Animal management

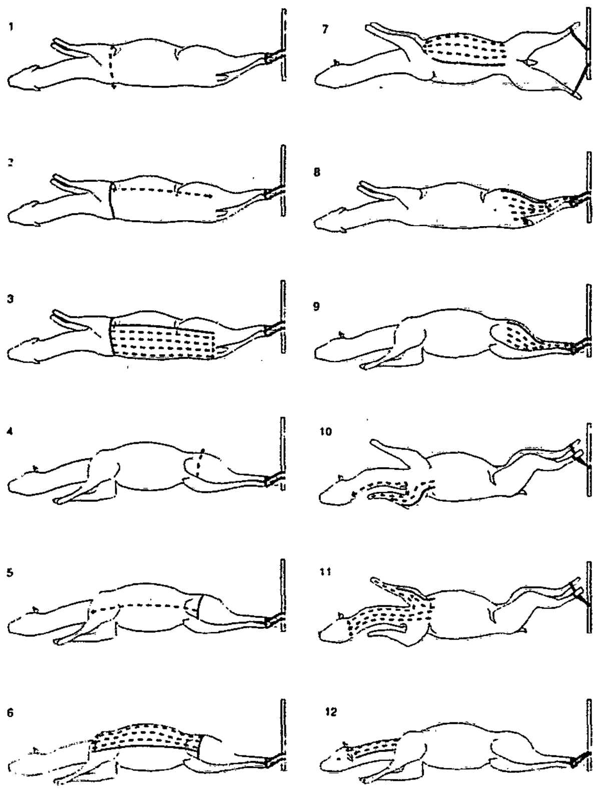
Alpacas were grazed on irrigated ryegrass-white clover pastures at both Tara Hills and the Lowburn property. In winter they were supplemented with either lucerne hay or concentrates. The machos (adult males), hembras (adult females), tuis (1-2 year old) and weaned crias were grazed separately. Parturition occurred in spring or autumn. Adults comprised 2 and 3 year olds at importation in 1989 but actual birth dates and pedigrees were unknown. Shearing was carried out annually in spring (October) prior to parturition. However, the first fleece shorn from the adults in 1989 was mainly grown in Chile and in quarantine, and ranged between 7 and 12 months growth. Crias were first shorn at 8-12 months of age.

All fleeces were sampled prior to shearing, from the left midside region above the 5-6th rear rib by clipping a patch (c. 12x12 cm^2) with small animal clippers.

Shearing procedure

Alpacas have been grouped separately for sex, coat colour and age (ie adult, tui and cria), and shorn in the sequence white, grey, brown, black and mixed colours to minimise colour contamination. Alpaca fleece comprises wool and hair. Wool fibre covers the sides and the loin of the animal while hair fibre covers the chest, belly, head and legs. A machine shearing technique has been developed for alpacas in Peru by R. Dunick, a New Zealand Wool Board shearing instructor. The animals are shorn lying on their side with the two hind legs tied to a wall. Electric clippers with sheep shearing comb and cutters are used. An assistant holds the alpaca by both front legs, stretching and rolling the alpaca to expose the unshorn parts for the shearer. Shearing is initiated on the right side by first running a blow from the belly line, vertically to the shoulder area towards the withers. A second blow is made along the hairy belly line towards the rump, and then repeated blows run lengthwise until the backline is reached. The fleece is collected and the alpaca rolled over to repeat the procedure on the other side in the opposite direction. The fleece from the back and side is collected separately as 'premier fleece' and the rest as 'oddments' including neck (fine, short), chest (or apron) (coarse, long), belly (hairy) legs and pieces (head, shanks and tail). The shearing is carried out in the sequence: body, belly, hind legs, tail, front legs, neck and head (Figure 1).

FIGURE 1 Illustration for alpaca shearing.



1. Shearing is initiated on the right side by first running a blow from the belly line vertically up the shoulder and towards the withers.
2. A second blow is made along the hairy belly line running towards the rump, and thus a separation line is formed between fleece and oddments.
3. The shearing blows are repeated lengthwise until the backline is reached and then completed by running an extra blow over the backbone into the other side.
4. The alpaca is rolled on to the right side to initiate a blow from the lower rump separating the hairy britch towards the back line (lumbar vertebra).
5. A second blow is made along the hairy belly line towards the front shoulder point.
6. The blows are repeated to complete the fleece shearing.
7. The alpaca is rolled onto its back and the belly shorn from the lower abdomen towards the chest.
8. The alpaca is swayed slightly to the left and the right hind leg shorn from the upper to lower parts and the shank cleared.
9. The alpaca is swayed slightly to the right and left hind leg shorn as in 8.
10. The body is stretched and and the right front leg exposed to shear from the upper to lower part and the shank cleared. A blow is run from the shank to the lower neck.
11. Similarly shearing is carried out on the left front leg and continued onto the neck, both underneath and along the side.
12. The back and right side of neck and the head are shorn while rolling and holding the alpaca by the head.

Fleece classing

Shorn fleeces were classed into ten colour categories: white, grey, fawn, light brown, dark brown, black, roan, brown and white, black and white and spotted (or mixed colours). Fleeces were separated into those less than 1 year-old cria (baby), tui (1 - 2 year old) and adult, and sorted into (a) premier fleece (back, side, part of shoulder and rump), (b) neck, (c) oddments (apron, belly, legs) or (d) pieces (head, shankings, tail and other extreme hairy pieces) within each colour and age category. Premier fleeces were graded according to fineness into baby (<22 μm), extra fine (22 - 24.9 μm), medium fine (25.0 - 29.9 μm) and coarse (>30.0 μm) categories. Extremely coarse guard hair and kempy fleeces were also separated from the main lots. Fleeces from tuis unshorn as cria were long, while late born crias had shorter fleeces when shorn with the older crias. Fleeces were therefore also sorted for length into short (<6 cm), medium (6 - 12 cm) and long (>12 cm) grades.

Recording and Analysis

Greasy fleece weight (GFW) and spring liveweight (SLW) were recorded at shearing. Oven dry yield (105°C, ODY), mean fibre diameter (FD: airflow method, IWTO), staple length (SL) and resistance to compression (RTC) were determined for each mid-side fleece sample. Clean fleece weight (CFW) was calculated from GFW and ODY. The GFW and CFW for adult alpacas in 1989 are not presented as the exact period of fibre growth was unknown. The GFW, CFW and fibre characteristics were compared between tui groups shorn as cria (approximately 8 month fleece) or unshorn (approximately 20 month fleece).

Data were analysed by least-squares analysis of variance separately for each age group. Models included year, sex, location and coat colour. Date of birth was also included in the models for crias and tuis, while the models for the fleece measurements in tuis also included a term to indicate whether or not the animal had been shorn as a cria. The adult models included the individual animal as a random effect with effects not involving year tested against the mean square for this term. Two factor interactions (excluding coat colour interactions with liveweight) were checked, and discarded if not significant.

RESULTS AND DISCUSSION

Least square means for liveweight at shearing, fleece weight and fleece characteristics of adult alpaca are given in Table 1. Animals at Tara Hills were heavier than at Lowburn. There are no other reports of variation in liveweight between colour groups. In this case the multi-coloured brown and white, and black and white were heaviest and the single-coloured black and grey the lightest.

GFW, CFW and SL were similar in production years 1990 and 1991 for the same herds and locations. Machos produced significantly ($P<0.001$) higher GFW (+59%), CFW (+56%) and SL (+ 13%) than hembras. The ODY was significantly ($P<0.05$) higher in 1991 compared to other years with alpacas at Lowburn producing cleaner fleeces ($P<0.01$). There was a significant ($P<0.01$) increase in FD from the first shearing to the second and third shearing by 4.6 μm and 5.8 μm respectively. The overall coarsening of fibre diameter in the herd is likely to be the result of both better nutritional condition in New Zealand and increased animal age. Fleece weight was similar for both years following introduction to New Zealand. RTC was significantly ($P<0.05$) lower in 1990 fleeces and surprisingly, differed between coat colours. As RTC in Merino wool is highly correlated with follicle curvature, fibre crimp and configuration, and diameter (Whiteley *et al.*, 1978) an investigation of these relationships in alpaca is warranted. Neither location nor sex affected RTC. Least square means for liveweight, fleece weight and fibre characteristics of tui and cria are given in Table 2. Tuis were heavier in New Zealand than in South America with males weighing 64.6 kg and females 72.6 kg compared to 32.4 kg and 37.1 kg respectively in South America (Calle-Escobar, 1984).

TABLE 1 Spring liveweight, fleece weight and fleece characteristics of adult alpacas in production years, locations and sexes.

	No of animals	SLW (kg)	GFW (kg)	CFW (kg)	ODY (%)	FD (μm)	SL (cm)	RTC (g/cm^2)[1]
Production years:								
1989	99	63.9^{a}	-	-	78.0^{a}	25.2^{a}	-	53.0^{b}
1990	96	65.7^{ab}	2.28	1.80	78.8^{a}	29.8^{b}	9.5^{b}	46.4^{a}
1991	96	67.8^{b}	2.20	1.81	82.4^{b}	31.0^{c}	9.0^{a}	52.1^{b}
Mean SED		1.3	0.07	0.05	0.4	0.5	0.2	0.7
Locations:								
Tara Hills	74	68.0*	2.27	1.80	78.5	29.3	9.2	49.5
Lowburn	25	63.6	2.21	1.80	80.9***	28.0	9.3	51.1
Mean SED		1.9	0.12	0.09	0.6	0.6	0.3	1.0
Sex:								
Hembra	86	66.2	1.73	1.40	80.3	27.8	8.7	51.1
Macho	13	65.1	2.75***	2.19***	79.2	29.6	9.8***	49.5
Mean SED		1.7	0.11	0.09	0.6	0.6	0.3	1.2
Coat Colours[2,3]:								
W	20	61.3^{a}	2.26	1.82^{b}	80.2^{b}	27.4^{a}	9.1	56.4^{c}
Lbr	7	66.6^{b}	2.37	1.90^{b}	79.6^{b}	28.8^{ab}	8.7	51.8^{b}
Dbr	25	65.5^{b}	2.19	1.76^{ab}	80.0^{b}	28.5^{b}	9.1	48.7^{c}
B	17	62.4^{ab}	1.99	1.57^{a}	88.9^{a}	28.0^{ab}	9.2	44.5^{a}
G	15	62.1^{ab}	2.17	1.74^{ab}	79.5^{b}	27.7^{ab}	9.1	52.2^{d}
R	3	68.3^{bc}	2.08	1.68^{ab}	81.0^{b}	27.6^{ab}	9.8	49.9^{cd}
Br W	4	70.6^{cd}	2.52	2.05^{b}	80.8^{b}	31.4^{c}	9.2	51.7^{cd}
B W	8	69.7^{cd}	2.33	1.86^{ab}	78.9^{ab}	29.9^{bc}	9.7	47.1^{abc}
Mean SED		0.18	0.15	0.9	1.0	0.5	1.6	

[1] 1 g/cm2 = 0.098 Kilo pascals (kpa) [2] Within columns means with different superscript differed at P<0.05.
[3] white, Lbr=light brown; Dbr=dark brown; B=black, G=grey; R=roan; BrW=brown and white; BW=black and white.

TABLE 2 Spring liveweight, fleece weight and fibre characteristics in tui and cria.

	N	SLW (kg)	GFW (kg)	CFW (kg)	ODY (%)	FD (μm)	SL (cm)	RTC (g/cm^2)
Tui								
Shorn as cria	14	69.4	2.85	2.34	82.0	27.3*	14.0	35.6
Unshorn as cria	27	67.8	3.64*	3.05*	84.7*	23.4	21.5***	43.5*
Mean SED		12.2	0.38	0.32	1.2	1.3	1.1	4.3
Sex								
Female	17	72.6*	2.721	2.291	84.3	25.7	17.7	40.5
Male	24	64.6	2.971	2.451	82.4	26.8	17.8	38.6
SED		3.7	0.29	0.24	0.9	1.1	0.8	3.7
Cria Year Born								
1990	58	35.5	1.80	1.44	79.3	24.1	11.2	44.0
1991	42	37.3	1.73	1.44	83.3***	25.4*	12.6***	42.1
Mean SED		2.3	0.13	0.10	0.6	0.6	0.3	1.4
Location								
Tara Hills	75	33.6	1.71	1.38	80.5	24.6	11.7	43.5
Lowburn	22	39.1*	1.82	1.50	82.2*	24.9	12.1	42.6
Mean SED		2.7	0.12	0.10	0.7	0.7	0.4	1.7
Sex								
Female	42	36.5	1.74	1.42	81.2	25.0	11.7	43.2
Male	58	36.3	1.79	1.47	81.5	25.0	12.1	42.9
Mean SED		2.2	0.10	0.09	0.5	0.5	0.3	1.3

[1] fleece weight comparisons in sex were adjusted to 12 month growth.

Fibre characteristics of tuis shorn or unshorn as crias differed significantly, however it appears there is no advantage in delaying first shearing until tuis (ie 1-2 years of age). Although delayed shearing is very common in South America, there were no difference for these traits after adjustment for the period of growth. There was no difference between sexes for these traits measured in tuis. However, for traits measured in crias, born 1991 ODY, FD and SL were higher ($p < 0.05$) than born 1990. There was no difference between locations or sex, except that as for adults, ODY was higher ($P<0.05$) at Lowburn than Tara Hills. Tuis produced about 29.5% more fleece than the adult females in the same period, but cria in 8 - 9 months produced the same weight of fleece that the adults produce in a year.

Bustinza and Gallegos (1970), Gallegos and Avilla (1979) and Condorena (1980) concluded that in general, fibre production was influenced by breed, sex and age. In their studies GFW was recorded highest at second shearing (tuis) and was relatively stable until the eighth shearing. The GFW and CFW of alpacas in New Zealand were similar to those reported in South American literature with tuis having greater GFW, CFW and SL. There were no comparative data for RTC in the literature but it was unlikely to differ greatly from their native population. RTC of adults was higher than that of tuis and crias in our results. The ODY, in equivalence of 87.4% to 93.4% conditioned yield was slightly higher than South American records that ranged from 84.3 to 92% (Pumavalla and Levva, 1988). The alpaca fleece show a higher yield than sheep wool due to its lower moisture and grease content as a result of fewer sebaceous glands in the skin. The major impurities of the fleece were vegetable matter and soil caught up in the fleece through their 'dust bathing' habits. Consequently weathered fleece tips and ultra violet light damage of the fleece can be severe, especially if shearing intervals are extended.

The FD was 31 μm, 27 μm and 25.4 μm in 1991 fleece production for adults, tuis and crias respectively, which were markedly coarser than the corresponding age groups in Peru where 17.7 μm and 27.5 μm were reported for one year and 6 year olds (Flores and Gallegos, 1979). However, alpacas potentially grow fibres over 30 μm when they are older. Calle - Escobar (1984) cited an increase from 27.9 μm up to 38.4 μm for female alpacas with a 13 year age difference under South American conditions.

SL was significantly ($P<0.001$) higher for machos than hembras. A small ($P<0.05$) reduction in the second full fleece shearing of the herd was recorded. FD increases with age but SL decreases (Brioso, 1963). He examined gelded (castrated) alpacas from 5 years up to 15 years old, and found that FD increased from 22 μm to 30 μm and SL decreased from 11 cm to 7 cm, with medullation percentages remaining relatively constant. Variation of fibre diameter over the body regions of alpacas is reported to be small (Von Bergen, 1963).

There was a strong interaction for sex by year born in birth weight (T.Wuliji, unpublished data) where year born 1990 female cria were lighter than year born 1991 male cria, however this effect disappeared at SLW. There was no such interaction found for GFW, CFW and fibre characteristics.

CONCLUSIONS

Our results have shown that the liveweight of adults, tuis and crias were greater than in Chile but fleece weight was similar. Fibre diameter was considerably coarser in New Zealand. Based on the South American experience and the current market trends, breeding should concentrate on: uniform colours in priority of white, fawn, grey, brown and black; improved fleece weight and staple length; reduced fibre diameter and medullation.

The successful farming of camelids in Australia (1850's), the United States (1930's) and recently in New Zealand (1980's) indicates that camelids, especially alpacas, can be reared in areas beyond the Andes. Alpacas' adaptability together with their specialty hair fibre production indicates they may offer an opportunity of diversified farming in New Zealand and Australia.

ACKNOWLEDGEMENTS

The authors thank Misses M. Ramsay, A. Schmack and Ms G.Y. Wang for help with fibre measurements. We are very grateful to Mr R. Dunick for giving shearing instruction and Mr D. Anderson for shearing the alpacas, and also to Messrs J. Rogers, M. Jansen and G. Bruce for technical assistance.

REFERENCES

Briosco, C.D.R. 1963. Un estudio sobre La relacion entre La edad de las alpacas con el diametro de la fibra y la longitud de mecha. *Tesis Universidad Nacional Agraria La Molina - Lima, Peru.*

Bustinza, V.; Gallegos, M. 1970. Algunos datos Biometricos en Las alpacas. I convencion sobre camelidos Sudamevicanos: 175-176. Puno, Peru.

Calle-Escobar, R. 1984. In *Animal breeding and production of American camelids.* Ed. R. Calle-Escobar. Talleres Graficos de Abril, Lima. p.358.

Condorena, A.N. 1980. Algunos Indices de producion de la alpaca bajo el sistema de esquila establecido en la Raya. IVITA. Rev. Inv. Poc. (IVITA). Univ. Nac. M.S.M. 5: 50-54. Lima, Peru.

Davis, G.H.; Wuliji, T.; Moore, G.H.; Bruce, G.D. 1991. Growth, reproduction and fibre production of alpacas imported from Chile. *Proceedings of the New Zealand Society of Animal Production* **51:** 255-258.

Flores, H.; Gallegos, R. 1979. Diametro y longitud de mecha en alpacas Huacaya y Suri, Machos y hembras del Centro de producion La Baya. Tesis Medico Veterinario Zootecnista. UNAA. Puno-Peru.

Gallegos, R.; Avilla, M. 1979. Relacion peso vivo/peso vell¢n en alpacas Huacaya y Suri del centro de producion "La Raya". Tecis MÇdico Veterinario Y Zootecnista UNTA Puno, Peru.

Pumavalla, A.; Levva, C. 1988. Production and technology of the alpaca and vicugna fleeces. Schriftenreihe des deeutschen Wollforschangsinstitutes E.V., 103. p.235-241.

Von Bergen, W. 1963. *In:* Wool handbook. Vol. 1. Interscience publishers, London. p.381-424.

Whitely, K.J.; Watson, N.R.; Wilkins, O.D. 1978. The relationship between the resistance to compression of wool bulks and follicle curvature. *Journal of the Textile Institute* **69:** 41-48.