Argentinian combed cashmere dehairing trial

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Introduction

In an area of 30,000 km^2 in the north of the Neuquén province (Argentine), about 1,500 small stockholders maintain around 390,000 goats (SENASA 2014). In this livestock production system, the *Criolla Neuquina* breed (CCN) is the main resource for the rural population, with meat as a main product and fiber appearing as potential complement of incomes.
Morphologically, the CCN has two ecotypes, differentiated by the fleece type.
Animals with short hair ("pelado") and long hair ("chilludo") are found (Photo Nº1). Fleeces of both ecotypes have a double layer of fibers, fine and soft downy fibers (cashmere or down) mixed with coarse guard hairs (hair). In the fleece there are also different proportions of vegetables, dust, peeling cells and secretions of the skin.
The main attributes that define the quality of the cashmere are diameter and length of the fibers, colour and proportion of down to hair in relation to the total weight of the fleece (yield). In different research from northern Neuquén goats, cashmere diameter of 19.0 microns and length of 39.0 mm has been reported. The predominant colours of these fibers are white, beige and grey.

Photo Nº 1: Two ecotypes of *Criolla Neuquina* goats, *"chilluda"* on the left and "*pelada*" on the rigth.

Cashmere can be harvested by shearing or combing. Combing is done with a special comb once or more times during the shedding season, which allows collecting fibers with high proportion of cashmere, between 65 and 90% (Wang et al 2008). Extracting the fine valuable cashmere fibers from the harvested products is a very delicate process. The textile procedure to separate the coarse guard hair and other impurities from the fibers mixture is called dehairing.
The effect of repeated mechanical action during dehairing is considered to lead to the breakdown of cashmere, shortening the length of the fibers and

conditioning the subsequent spinning. Typical production rates reported for dehairing machines are low and about 2.9 kg/h/m width, and represent about 5 to 10% of the rates for carding (Mc Gregor and Butler, 2008).
Therefore, dehairing process is expensive and complex. Limited objective data is published about dehairing, especially for combed cashmere. A clearer knowledge of this process should lead to improved fiber preparation, processing and cost-effective returns for the combed cashmere.
This work is a reinterpretation of data collected and issued in 2009 on a former technical report of the same authors.

Materials & Methods

In order to evaluate the textile performance of dehairing combed cashmere from northern Neuquén (Minas, Chos Malal, Pehuenches, Ñorquín) batches of cashmere from different colours (white, grey and beige) was processed at a mill in Pico Truncado, Santa Cruz province, Argentina (*Fibras Especiales SA*).
Before dehairing all groups were characterized for fineness, length and Proportion of down, by means of IWTO 12 (Sirolan Laserscan) and IWTO 17 (Almeter) and Wildman-Bray formulae, respectively.
At the mill every batch was reweighed and opened; hardheads of vegetables, thistles, felted fibres and hairy staples were manually separated. The fibres were held in an atmosphere with high humidity (75 %) for one hour approximately for conditioning.
The facilities of the mill were fibres are pass through includes a set of three dehairing machines (Photo Nº 2) with different settings and running in sequence.

Photo 2: Dehairing machines running in sequence.

The figure 1 describes the dehairing process applied on white cashmere batch, beige and grey cashmere are reported together.

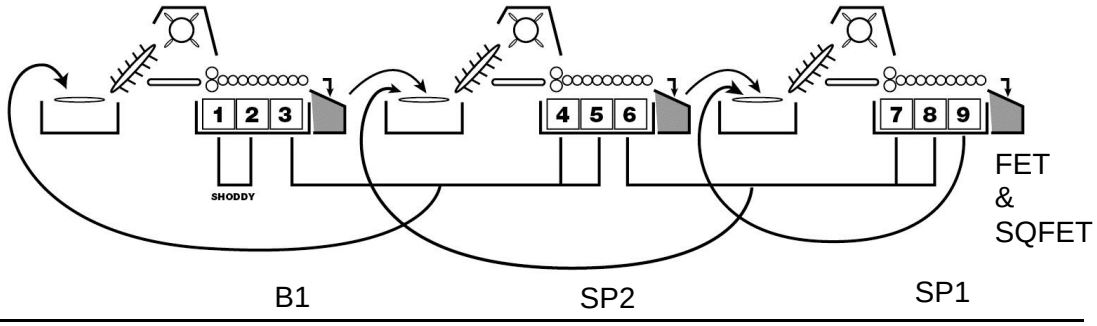

Figure 1: Processing configuration for three dehairing machines showing final product and subproducts. References: FET, product of processing fibers through a set of three dehairing machines; SQFET, products of reprocessing fibers from combing rollers droppings 3 to 9; SP1, discard-droppings from 3rd machine; SP2, discard –droppings from 2nd machine; B1, discard-dropping from 1st machine; Shoody, wastage first and second combing rollers from 1st machine.

Results

White Cashmere processing

First dehairing machine

A total of 5,220 g was spread on the feeding belt in a uniform manner to facilitate the operation of the rollers and avoid stucking.

Droppings weights under combing rollers compartments 1, 2 and 3 was 820, 185 and 320 g, respectively, giving a total of 1,330 g.

It was observed that each wastage have marked differences in the composition of vegetal matter, hair and coarse fibers and soil particles.

Under the 1st and 2nd combing rollers it was observed the highest content of vegetable, coarse fibres and soil dust whilst the 3rd have the highest proportion of down fibre (cashmere). The 1st and 2nd were considered as a shoddy (C1) and the 3rd was kept separate for further processing.

Samples to test fineness and length were obtained at the end of the process. The time required to the process was 1 hour.

Second dehairing machine

A total of 3,450 g of fibers was spread on the feeding belt as in the first dehairing machine.

Droppings weights under combing rollers compartments 4, 5 and 6 was 725, 205 and 265 g, respectively, giving a total of 1,200 kg.

Droppings under combing rollers 4 and 5 were put together with the 3 and returned to the starting point at first dehairing machine. Droppings under 6 combing roller compartment was kept separate for further processing.

Samples to test fineness and length were obtained at the end of the process. The time required to process the fiber was 50 minutes.

Third dehairing machine

A total of 2,230 kg of fibre was spread evenly on the feeding belt.
Droppings weights under combing rollers compartments 7, 8 and 9 was 210, 105 and 145 g, respectively, giving a total of 460 g.
Droppings under combing rollers 7 and 8 were put together with the 6 and returned to the starting point of the process on the second dehairing machine.
Droppings under 9 combing roller compartment was separated and reprocessed in the 3rd dehairing machine.
At the end of the machine were obtained 1685 g of fibre, labelled and named as FET (from the spanish *"Fibra Especial Tratada*"). The time required to process the fibre was 50 minutes.
Reprocessing droppings from combing rollers 3, 4, 5, 6, 7, 8 and 9 was 400 g and termed Second Quality FET.
As a result of this process were obtained 6 materials of different quality:

FET: 32.3%	SP1: 3.3%	B1: 14.8%
SQ FET: 7.7%	SP2: 10.9%	C1: 19.3%

Subproducts SP1, SP2 and B1 have increasing coarse fibre proportions and therefore decreasing quality (Table 2). However length of fibres decreases from B1, SP2 and SP1 probably due to the fact that hair and coarse fibers are longer than downy fine cashmere and because more fibre potentially breaks when process go forward. In all cases the material can be improved through reprocessing but economic efficiency has to be taking into account.
C1 *shoody* wastage is a very low-quality textile material, with a lot of soil dust and coarse hairs, but feasible to be used as horticulture substrate and land filling.
Finally, process losses (soil particles, fibres and vegetables stucked on rollers, etc.) were estimated by difference (615 g) reaching 11.8% and considered as sinkage.

Colour Cashmere processing

A total of 2,795 g of colour combed cashmere was processed and obtained at the end of the process 860 g of FET fibre. The yield of FET was 30.8%.
Beige and grey subproducts were weighed together and represents:

SP1: 5.2%	SP2: 14.7%	C1 + B1: 41.5%

Reprocessing of droppings was not carried out in colour cashmere so there is not SQ FET category available.
Processing losses reached 6.1%.

<u>Concluding remarks</u>

The yield of combed Argentinian cashmere was slightly higher than 30% for both white and colour cashmere. White cashmere showed a little difference to colour cashmere but less quality, as is described below. White cashmere could reach a total yield of 40% if consider adding SQ FET to FET but some quality parameters would decrease (Table 1 and 2).

Results in Tables 1 and 2 shown that values of Mean Fiber Diameter (MFD; µ), Percentage of Fiber < 30 microns (Hair Content; %) and Coarse Fraction Fiber Diameter (Coarse FD; µ) decreases as the fibre go through the process of dehairing as results of separation of the coarse fibres fraction.
The whole process allowed:

- Reducing the MFD on 1.0 micron and 1.4 microns for white and colouring cashmere, respectively.
- Reduction on the amount of coarse fibers (Hair Content) to 56.4% and 33.3% for white cashmere and colour cashmere, respectively.
- Reduction on mean diameter of coarse fraction of 6.3 microns and 8.5 microns for white and colouring cashmere, respectively.

The variability of the dehairing efficiency between white and colour cashmere could be explained by the ability to separate long and short coarse fibers, since white cashmere came predominantly from "*chilluda*" goats (long staples) and colour cashmere are predominantly from "*pelada* " goats (short staples).
Additionally, the variability of the separation efficiency of the coarse fibre fraction could be due to the existence of an intermediate fraction between 25 and 35 microns, has been reported in llamas. This fraction results more difficult to separate during the dehairing process but the presence has not been confirmed in this ecotype of goats.
For Fibre length (Figure 1) the greatest change was observed in the 1st dehairing machine. No effect on fiber length was shows in successive runs on the others two dehairing machines. The decrease on length was 10.5 mm on white cashmere but 4.9 mm on colour cashmere. The values obtained in these fibres conditions its use in woollen yarns and blends.
As expected the Pdown (Table 1) was increased in every passing as a result of the sequence of dehairing applied to fibers.

The whole process could be improved by changes in clearance setting between rollers, working speed, feed rate, etc.

Table 1: Fiber quality of combed cashmere from different colours before and after dehairing.

Batch	Processing Stage	MFD	Hair content	Coarse FD	FL	Pdown
White	PreDH	20,7	6,2	41,3	39,5	77,4
	1DH	20,6	5,4	39,6	29,0	80,7
	2DH	20,3	4,4	36,9	28,4	85,9
	FET	19,7	3,5	35,0	29,0	89,3
Colour	PreDH	19,8	4,8	42,5	32,0	79,5
	1DH	19,2	3,0	36,8	25,6	89,3
	2DH	18,5	2,0	34,7	26,6	93,4
	FET	18,4	1,6	34,0	27,1	94,9

References: MFD, Mean Fibre Diameter; Hair content, Percentage of Fibers >30 microns; Coarse FD, Mean Diameter of the fraction >30 microns; FL, fibre length; Pdown, proportion of down to total fiber weight; PreDH, previous to dehairing; 1DH, product of the first dehairing machine; 2DH, product of the second dehairing machines; FET, product at the third dehairing machine.

Table 2: Quality of subproduct obtained on the dehairing process of combed cashmere

Droppings labelling	Batch	MFD	Hair content	Coarse FD	FL	Pdown
SQ FET	white	20.3	4.2	34.7	29.8	88.3
SP1	white	21.9	8.6	36.7	26.4	77.1
SP2	white	23.3	13.0	38.3	28.6	66.8
B1	white	24.8	17.9	41.7	29.7	54.0
C1	white	25.7	20.6	46.5	-	42.8
SP1	colour	20.5	5.4	36.2	25.7	83.8
SP2	colour	20.8	6.0	37.2	30.5	81.5
C1 + B1	colour	23.4	13.7	49.2	-	49.7

References: MFD, Mean Fibre Diameter; Hair content, Percentage of Fibers >30 microns; Coarse FD, Mean Diameter of the fraction >30 microns; FL, fibre length; Pdown, proportion of down to total fiber weight; SQ FET, reprocessing droppings from combing rollers 3-to 9; SP1, discard-droppings from 3rd machine; SP2, discard –droppings from machine 2nd; B1, discard- dropping from at 1st machine; C1, wastage under first combing roll from 1st machine.

Bibliography

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