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Characterization of Non-Angora (´Creole Hairy´) Goat´s Fiber from the Northern Patagonia Area of Argentina. Potential Textile use as Patagonian Cashmere

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Abstract

The fiber produced by the regional Creole goat from the northern area of Patagonia is little known, both within the Country and in the international market. The objective of this work is to characterize the textile quality of this goat fiber in relation to similar fibers coming from other parts of the world, and validate its textile potential use named us Patagonian cashmere. Samples from 4 different zones were analyzed and classified by morphological types such as long cashmere (CA), short cashmere (CC), intermediate cashmere (CI), cashgora (CG) and lustre (L). In turn, the average diameter of the fine fiber was determined and 3 types were classified by fineness: H (<16.5μm), W (16.6-18.6μm) and S (>18.6μm). Frequencies were established and compared by contingency tables. The most significant types are CA with respect to all, CG and CI are not different from each other, but different from the rest and CC and L have the lower frequency. The significantly more frequent fineness is S and there are no significant frequency differences between H and W. The diameter distribution profiles allow us to infer that the fibre examined in this study corresponds to 40% of the type known as cashmere in the international market. The rest of the fibre studied has a diameter slightly coarser than 19μm, but also shows an important textile potential, due to its softness and by being predominantly white in colour.

Keywords: Fiber goats; Patagonian; New process; Dehaired goats fiber; Softness; Fine luxury

Introduction

Although in Argentina, the goat fiber of Angora (Mohair) is widely known, the same information on the production of fiber from the double coated Creole "hairy"goat of northern Patagonia, which could be generically be referred as Cashemere and other names such as Cashgora [1] is not available. However, the name Cashmere results from an arbitrary textile definition and does not correspond to a biological-productive base, although Australian studies confirm that the diameter of cashmere ranges from 13.6 to 19.2μm and cashgora from 17.8 to 22.7μm [2]. In Australia, the fibre produced by the local goat was also characterised by studying the diameter distribution profile comparatively with another fibre commercially known as Cashmere, including different genetic proportions of cashmere goats by mohair-producing goats [3]. In 2002 a local dehairing technology began to be developed to remove mixed fleeces (double-coated) such as goats and others [4,5] which was essential for the subsequent use of these fibers in the textile industry. From the first positive results of this technological development, population structure studies were carried out in the locality of Santa Isabel (La Pampa province) [4] as well as in Las Ovejas, Buta Ranquil, Barrancas, Curi Leucú, Chos Malal, Tricaomalal [6] and Añelo [5] localities, in the province of Neuquén. As part of this study, the quality of fiber produced by these populations and its possible industrialization in the Country was established. The presence of different types of fleeces (long Cashemere, short Cashemere, Intermediate Cashmere, Cashgora and Mohair) was determined as well as degrees of fineness according to different classification criteria and also fiber lengths [1].

As it is a fibre not used by the textile industry in the last 30 years it is not known its behaviour in relation to Chinese cashmere and other fibers of different origins. The objective of this work is to characterize the textile quality of this goat fiber in relation to similar fibers from other origin and to validate its potential textile use with the specific denomination of Patagonian cashmere.

Material and Methods

The study covered several stages that originally included localities in the departments of Minas, Ñorquin, Chos Malal and Pehuenches in the north of the province of Neuquén. As part of this study the quality of fiber produced by these populations and its possible industrialization in the Country, as a replacement of Chinese imported cashmere. The presence of different types of fleeces was determined (long cashmere, short cashmere, intermediate cashmere, cashgora and mohair) degrees of fineness according to different classification criteria, dehairing yields (by removing the bristles) and also fiber length (Figure 1).

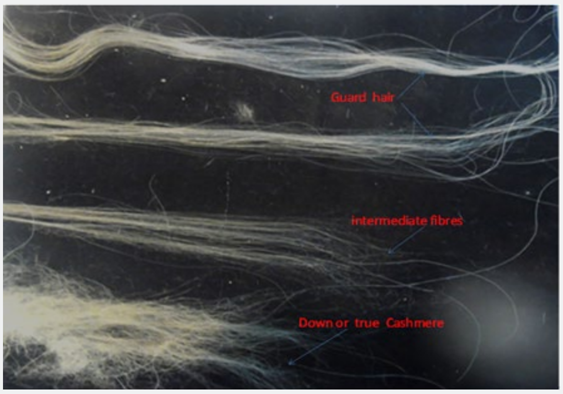

Figure 1: Diagramatical disected patagonian cashmere.

The local textile industry provided samples of fibers called ´cashmere´ that are commercialized in different parts of the world. In the laboratory, the samples were washed and conditioned and chosen staples from each sample were dissected for:

a) To prepare Baer diagrams to identify and classify fiber types, measuring lengths and weighing each type. Fiber types were classified based on wave type (crimp), diameter ratio and length between coarse and fine fibers according to Frank et al, (2009) [5]. They were classified by staple type (styles) based on morphology as : Long Cashmere (CA), Short Cashmere (CC), Intermediate Cashmere (CI), Cashgora (CG) and Lustre or Mohair (M) [1].

b) Using a microprojector (lanameter) the following was determined : fine fiber frequencies (<35µm), average diameter of fine fibers (DMFF), types of medulla where the frequency of the continuous types and the lattice type are considered equivalent to the inverse of the comfort factor (>35µm).

c) Measuring and weighing with a millimeter ruler and a precision scale, the following were determined: length of the fine fibres (LFF), yield to the dehairing (R%) (weight of fine fibres over total fibre weight, w/w).

d) Using the average diameters of the fine fibers, they were classified by quality (fineness) H : <16.5µm; W: between 16.6-18.5 µm; S: >18.6 µm.

e) The fineness grades H (´hosiery´) and W (´weaving´) are suggested by [7] and the class S (´strong´) is added due to the presence of coarser fibers diameter than those provided by the most common related literature, but which are reported in studies of populations similar to those of Neuquén in [8].

f) The samples studied came from the following areas: Zone 0: Department of Ñorquin; Zone 1: Department of Mines; Zone 2: Department of Mines. Chos Malal and Pehuenches, Zone 3: Dept. Pehuenches, from the NW angle of Neuquén, Argentina (between 36° and 39° Lat. S. and between 68° and 71° Long. W) [9].

g) As part of the statistical analysis, contingency tables were designed to establish the frequencies of the classified types and to establish whether the frequency is due or not to randomness by $\chi 2$. The interpretation of the relationship between the frequencies of the variables is performed by calculating the corrected standardized residuals [10]. Z scores greater than +1.96 show boxes figures more frequently than expected and values of -1.96 denote lower frequency than expected by random in 95% of cases.

Results and Discussion

Table 1 shows the frequency distributions of yields to dehairing (potential), distribution of fine fibre lengths (down), distribution of diameters in relation to fleece types and degrees of fineness. These figures coincide to a large extent with the findings of previous similar studies of the same areas [6] of other areas not studied in this work [5] and even considering all the goat fiber producing areas of northern Patagonia [1]. The frequencies were significant ($p<0.05$) to $\chi 2$, demonstrating that the distribution of fineness and type of staple responds to a quality pattern. It can be observed that the combinations: CG-G, CA-S, CA-W and CA-G are the most frequent significative (together: 67.24%). The presence of CG and M demonstrates the influence of the Angora goat in this population, leading to a coarsening of the fibre although with an increase in dehairing yield and fibre lengths. The separation of the lustre types (CG and L) is feasible to be carried out subjectively with which if these are discriminated (31.39%) from the non-lustre types (CA, CC and CI) (68.61%), an equally significant distribution can be obtained ($p<0.05$) to $\chi 2$, being the

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combinations CA-S (22.52%), CA-W (20.02%) and CI-G (15.82%) the most significative frequency (58.36%) within the non-lustre fleece types. Considering the quality of all samples regardless of style, we obtain: mean diameter <18.5 (H+W): 32.76%; mean diameters>18.5 (G+S): 67.24%. If only cashmere styles are considered the result is: (H+W): 36.84% and (G+S): 63.17%. The most significant types ($\chi 2$= 259.76, 4, <0.0001; Cramer test: >0.5) are CA with respect to all, CG and CI are not different from each other, but different from the rest and CC and L were the significative less frequent. The significantly more frequent fineness ($\chi 2$=233.88, 2, <0.0001; Cramer test: >0.5) turns out to be S, and between H and W there are no significant frequency differences (p>0.05).

Table 1: Distribution of yields, lengths, diameters in relation to types of fleece and fineness grading.

Type Finn	n	Fr (%)	Fr/Fin%	FD	FD/Fin	FFL	FFL/Fin	D%	Fineness%
CAH	121	8.69		15.89		6.04		28.82	
CCH	27	1.94		15.56		3.63		11.81	
CIH	7	0.50		16.53		7.07		27.87	
CGH	7	0.50	11.64	16.34	15.88	9.79	5.84	50.41	26.88
CAW	206	14.80		18.01		6.89		34.90	
CCW	15	1.08		17.90		3.92		10.69	
CIW	38	2.73		18.17		7.63		26.42	
CGW	35	2.51	21.12	18.06	18.03	8.93	7.08	46.61	33.96
CAS	355	25.50	32.76	21.56	17.27	7.96	6.64	41.96	31.44
CCS	14	1.01		22.11		6.11		15.49	
CIS	218	15.66		23.30		9.71		38.63	
CGS	319	22.92		24.07		10.51		54.63	
LS	30	2.16	67.24	27.43	23.02	12.23	9.35	64.06	45.81
Total	1392		100.00		21.13		8.46		41.11

References: Tipo: CA: long cashmere, CC: short cashmere, CI: Intermediate cashmere, CG: cashgora; Fineness: H<16.5µm, W: 16.5-18.5µm, S:>18.5µm. Fr(%): Relative frequencies percentage of each type of fineness, FD: fine fiber(down) length, D&: deharing yield fiber base., Fin: Fineness grades : H,W and S.

Underlined figures: represents the frequencies of total or average commercial cashmere(≤18.5µm).

Table 2: Distribution of fiber diameter percentiles (%) in relation to fleece types and fineness grading.

Type-Finn	<10µm	P (05)	P (95)	10-20µm	P (05)	P (95)	20-30µm	P (05)	P (95)	>30µm	P (05)	P (95)
CAH	4.81	0.83	11.85	83.23	67.52	94.79	11.92	2.35	23.47	0.04	0.00	0.24
CCH	5.65	1.26	15.56	83.78	66.15	94.87	10.53	0.65	21.87	0.04	0.00	0.29
CIH	4.70	0.47	7.78	77.52	67.46	87.51	17.72	12.02	25.01	0.07	0.00	0.21
CGH	7.47	1.04	20.13	74.44	45.35	88.70	17.26	10.26	29.75	0.84	0.00	4.78
CAW	2.76	0.56	6.55	66.44	55.92	78.50	30.64	19.95	38.73	0.16	0.00	0.58
CCW	3.60	1.39	8.55	65.16	56.70	80.18	31.07	18.43	38.64	0.16	0.00	0.84
CIW	4.76	0.28	12.18	61.16	47.63	84.06	33.48	15.12	40.51	0.60	0.00	2.80
CGW	3.22	0.29	8.31	64.88	55.65	75.43	31.72	22.74	39.47	0.18	0.00	0.86
CAS	1.73	0.05	4.64	39.04	10.36	56.96	58.52	41.07	86.02	0.71	0.01	2.52
CCS	2.89	0.01	6.48	36.47	2.39	57.49	58.99	40.65	96.77	1.65	0.03	5.36
CIS	1.92	0.02	5.43	30.51	3.15	52.10	66.15	43.36	94.62	1.41	0.07	4.42
CGS	1.57	0.02	4.79	28.07	2.88	51.53	68.85	43.99	95.23	1.51	0.05	4.90
LS	0.00	0.00	7.55	23.43	2.38	56.38	73.42	43.08	99.61	3.15	0.17	10.54

References: Fleece Types: CA: long cashmere, CC: short cashmere, CI: Intermediate cashmere, CG: cashgora; Fineness: H<16.5µm, W: 16.5-18.5µm, S:>18.5µm.

Length and yield of dehairing are clearly influenced by fibre diameter and partly by the styles (Table 1). These results have a very interesting relationship with those obtained in Faure Island in Australia with feral goats and also cross with Angora goats [8]. They also differ slightly from the results obtained when samples from the Añelo department are also included [5]. Table 2 shows

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the mean diameter distributions of fibres grouped in percentiles assuming an empirical distribution that does not depart much from the normal one. For the finest samples (H) the highest fibre frequency are those of the 10 - 20µm, something similar happens with the W, but in this case the 20-30µm frequency increases a lot, being this group the most frequent for the coarse fibre class(S). The frequency comparisons between fleece types within each fineness do not show significant differences at χ2 (p>0.05), which indicates that morphological differences do not affect the diameter distribution, which coincides with what was obtained in Australia [3]. The frequency of fibres >30µm is affected by the quality of the dissection, as the total fleece fibres present here are not considered. However, in the coarsest group the fibres >30µm are significantly more frequent (χ2=16.3, 3, p<0.05), which indicates that they are more difficult to differentiate from non-objectionable fibres due to the smaller diameter difference between them. When comparing the frequencies of fiber samples between Zones, the following results were obtained as the most outstanding: in Zone 0, Type CA and Fineness S are significantly more frequent (χ2=53.52, 8, p<0.0001). In Zone 1, Type CA and Fineness S are significantly more frequent (χ2=45.87, 6, p<0.0001). In Zone 2, Type CA and Fineness S are significantly more frequent (χ2=29, 64, 6, p<0.0001) Type CA and Fineness S. In Zone 3, Types CA and CI and Fineness S are significantly more frequent (χ2=13.26, 4, p<0.01).

Table 3: Distribution (%) of fiber diameters from different sources.

Sources	<10µm	10-20µm	20-30µm	>30µm
China, Short brown	9.2	70.42	20.21	0.14
Russia Cashmere	2.8	15.09	35	47.11
China white I	1.07	98.74	0.19	0.001
China white II	4.17	76.88	18.92	0.024
China white III	0.2	95.81	3.9	0.097
Scottish brown	6.63	72.87	20.42	0.08
Scottish white	9.32	76.99	13.67	0.02

In principle, a fairly homogeneous distribution of types and finenesses between the studied areas can be expected, which could have been different if the department Añelo had been included in the survey [5], as it was the result obtained in a later paper [1]. Table 3 shows average diameter distributions of goat fibre samples named ´cashmere´ from different geographical origins around the world. The Chinese cashmere I and II samples (13.93 and 13.86µm respectively) show similar diameter distributions to the CAH and CCH from Patagonian cashmere, but with a higher frequency of 10 - 20µm than CIH and CGH. The Chinese sample III despite its larger diameter (16.3µm) shows a higher frequency of 10 -20µm and lower frequency of >10µm. Samples of Scottish origin despite having similar average diameter as Chinese III (16.46 and 15.47µm respectively) are more similar to Patagonian CIH and CGH types in terms of diameter distribution. The Chinese pigmented sample (brown) despite having a diameter similar to Chinese III shows a significant deviation of fiber frequencies towards >10µm and similar to CAH, CCH in the range of 10 - 20µm. The types classified in this work adjust in their diameter distribution to that reported in Australian fibre and the intermediate CI and CG types seem to correspond to distant crosses with Angora goats in different genetic proportions, when compared with the distributions obtained in [3].

Conclusion

It can be concluded that, in general, the fibre examined in this study corresponds to approximately 40% of the type known as cashmere in the international market, showing a significant resemblance with fibres of another origin, mainly China. On the other hand, the rest of the fibre studied has a coarser diameter but also shows an important textile potential due to its softness to the touch and because it matches mainly the white colour. Given the great variability detected, a future genetic improvement can be consider.

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