

Evaluation of technological traits of Bulgarian and imported merino wool batches

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Abstract. *The aim of the present study was to perform a comparative evaluation of technological traits of industrial batches of Bulgarian and imported semifine wool. The study was carried out in an industrial setting in cooperation with Kolhida Ltd, Sliven. A total of 18 batches originating from Bulgaria (n=10), Serbia (n=6) and the Netherlands (n=2) among which 4 batches of greasy wool, 7 batches of clean wool and 7 batches of wool sliver were studied. The primary processing of wool batches comprising classification, washing and carding was performed by textile enterprise's standard technology. After the classification, the relative shares of wool types from the total amount of greasy wool in a batch were determined. The washing yield of classified greasy medium wool was calculated. The following laboratory analyses of clean wool were carried out: fibre diameter (μm), mean weighted length (mm), short fibre percentage (%), fatness (%), mineral matter content (dustiness %), vegetable matter content (%) and moisture (%). For slivers, sliver yield (%), fibre diameter (measured with OFDI), mean weighted length (mm), length B (mm), short fibre percentage (%) and moisture (%) were determined. In Bulgarian and Serbian batches, high-grade wool types predominated with highest share of the merino worsted wool (70.54% and 63.70%; 60.66% and 46.64%, respectively). The highest industrial washing yield was that of Dutch wool – 63.89%. Yields of Serbian and Bulgarian batches were similar (53.73%-56.39% and 53.20%-55.89%, respectively). The highest mean weighted length of fibres was determined for Dutch wool – 74.87 mm. Serbian and Bulgarian batches were comparable with respect to this trait: 63.95-65.71 mm and 62.92-65.88 mm respectively. The vegetable matter in studied wool batches was higher than requirements of the standard – from 1.29% to 2.24% vs the reference of 1.2%. The highest vegetable matter content was found in the wool from two Bulgarian batches (1.65% and 2.24%), one Serbian (1.82%), and the Dutch batch (1.92%). Sliver yield varied from 81.31% to 86.91% in studied wool slivers. The highest values of this trait were found out in 3 Bulgarian wool slivers (86.91%; 85.79% and 84.48%) and the Dutch sliver (84.13%).*

Keywords: semifine wool, classification, washing and carding of wool, medium worsted wool, technological properties

Introduction

Regardless of the extensive use of artificial chemical fibres, the advantages of natural wool are indisputable. The high hygroscopicity, elasticity and strength, good heat insulation properties and low electric charge capacity outlines wool an indispensable raw material for textile industry now and in the future.

During the last years, the studies on technological properties of wool produced in Bulgaria are few (Slavov et al., 2005; Panayotov, 2012, 2012a). Raychev et al. (1985) found out that in line with the industrial standard for classification of wool in force in our country, 83.10% of the wool of Mountain Corriedale sheep was classified as medium, including 61.50% worsted. The wool was more homogeneous compared to semifine and local improved wool being classified only in 3 industrial wool types: semifine worsted, medium worsted and medium carded.

Having evaluated the technological properties of Tsigai sheep and Tsigai type wool, Botev et al. (1986) indicated that the main amount of the batch was classified as worsted wool predominantly of grade 50/48s. The wool of lower grades (carded, burr and muddy) comprised 20-30% of the batch. The average industrial yield was 56%, with yield of wool classified as worsted of 57.2-67.5%, and that of low-grade types: 43.9%.

Slavov et al. (2006) investigated the technological properties of merino wool batches from Bulgaria, Serbia, Greece, France, Macedonia and the Netherlands. The results showed that Bulgarian merino wool was substantially superior to imported large amounts of Macedonian, Romanian and Greek wools whose price was comparable. The quality of greasy and clean Bulgarian wool batches varied within a large range: yield from 50.70% to 67.99%, mean length from 55.74mm to 70.30mm and short fibre percentage from 18% to 23.20%, which could be attributed to the rather divergent and changed type of sheep. The authors found out that the imported Dutch and French batches were outlined with the highest quality and excellent technological traits, proportion of high-grade wool types respectively 96.47% and 76.56%, yields 70.60% and 68.80%, mean length – 78.19 mm and 72.34 mm.

The aim of this study was to perform a comparative evaluation of technological traits of industrial Bulgarian and imported merino wool batches.

Material and methods

The investigation was performed in an industrial setting, in co-operation with Kolhida Ltd. – Sliven on industrial batch-

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es of merino wool submitted to primary processing. A total of 18 batches originating from Bulgaria (n=10), Serbia (n=6) and the Netherlands (n=2) among which 4 batches of greasy wool, 7 batches of clean wool and 7 batches of wool sliver were studied.

The primary processing of wool batches (classification, washing and carding) was performed using the standard procedures adopted at the textile enterprise. After the classification, the relative shares of wool types were determined vs the total greasy wool amount. Washing yields of classified greasy wool batches were calculated.

Clean merino wool batches were submitted to laboratory analyses for determining fibre diameter (μm), mean weighted length (mm), short fibre percentage (%), fatness (%), mineral matter content (dustiness, %), vegetable matter content (%) and moisture (%). The parameters determined on wool slivers comprised sliver yield (%), fibre diameter (measured with OFDI), mean weighted length (mm), length B (mm), short fibre percentage (%) and moisture (%).

Results and discussion

The results from the classification of Bulgarian and Serbian wool batches are shown in Table 1. The Dutch wool purchased as medium wool grade 50s, was not classified and is not included in the table. For Bulgarian batch No 1, the high-grade wool percentage was 64.41%, among which medium worsted 60.66% (grades 50s and 48/50s), semifine worsted 3.58% (grade 56/58s) and an insignificant amount of merino worsted wool (total 0.17%). Among low-grade wool types comprising 35.59% of the batch, the higher proportions were those of merino carded wool (10.05%), medium worsted gray wool (7.33%). In batch No 2, the proportion of high-grade wool types was 71.81%, including medium worsted (grades 50s and 48/50s.) 46.64%, semifine worsted (grade 56/58s) 20.10% and merino worsted (grades 60s and 64s) 5.07%. Among low-grade wool types, the most prevalent was the merino carded type (8.25%), semifine carded type (5.70%) and medium worsted gray type (4.36%). In both batches, the share of felt wool was relatively high – 4.38% and 4.04%, respectively. The lamb wool in batches was respectively 8.18% and 5.38% of the total batch amount.

Table 1. Results from the classification of Bulgarian and imported merino wool batches

Kinds wool, received a classification	Quality of Bradford	Bulgaria, %		Serbia, %	
		Batch No 1	Batch No 2	Batch No 3	Batch No 4
Merino worsted wool	64	0.14	1.01	0.32	
Merino worsted wool	60	0.03	4.06	0.09	1.11
Merino carded wool	60	0.05	8.24		
Semifine worsted wool	56/58	3.59	20.10	6.05	17.37
Semifine carded wool	56	10.05	5.70	7.92	10.31
Medium worsted wool	50	18.52	20.09	33.12	33.81
Medium worsted wool	48/50	42.14	26.55	37.42	29.89
Medium worsted grey wool	48/50	7.33	4.36	3.47	0.91
Medium rough wool	48			0.46	
Coloured medium worsted wool	48/50				
Rough wool		1.69		0.46	
Cut hair and stained with paint		0.35	0.21	0.13	0.10
Medium burr wool	48		0.22		
Lamb wool		8.18	5.38	5.69	4.25
Coloured wool		0.32	0.03	0.06	
Felt wool		4.38	4.04	3.38	0.70
Other low-grade					1.55
White washed wool		3.24		1.89	

The two Serbian batches had the highest relative proportion of medium worsted wool grade 50s and 48/50s (except for the Dutch batch) – 70.54% and 63.7%, respectively. Together with the merino worsted wool (whose share in batches No. 3 and 4 was 0.41% and 1.11%, respectively) and semifine carded wool (7.92% and 10.31%), the percentage of high-grade wools attained 77.46% and 82.18%, respectively. From low-grade wools in both batches, higher proportions were found out for semifine carded wool (7.92% and 10.31%) and lamb wool (5.69% and 4.25%).

The higher number of industrial wool types in investigated

batches (except for the Dutch batch) in our opinion was due to the lack of a preliminary processing of wool.

Laboratory tests of clean wool parameters and classified medium worsted wool sliver

Using instrumental methods, several technological indices of classified wool batches are determined at each stage of wool processing (Table 2). The highest industrial washing yield was obtained for the Dutch wool batch – 63.89%. In Serbian batches it was 53.73% and 56.39% (difference by 2.66%). Washing yield of Bulgarian wools ranged with-

in 53.20% and 55.89% (inter-batch variation from 0.46% to 2.69%). While the values of this trait were comparable among Bulgarian and Serbian batches with variations from 0.5%-

3.19%, substantial differences were demonstrated between Dutch vs Bulgarian and Dutch vs Serbian batches, by 8.00% to 10.69%, respectively.

Table 2. Technological properties of clean medium carded wool

Origin	Yield, %	Fibre diameter, µm	CV, %	Quality of Bradford	*Weighted average length, mm	Short fibres, %	Fat, %	Dustiness, %	Vegetable matter, %	Moisture, %
Bulgaria	55.29	32.05	29.84	48	69.30	19.17	0.71	1.34	1.65	17.35
Bulgaria	53.66	30.78	28.23	50	62.92	20.57	0.50	1.05	1.40	16.72
Bulgaria	53.20	30.90	26.99	50	65.88	21.08	0.42	1.66	2.24	18.23
Bulgaria	55.89	32.83	29.30	48	63.95	23.10	0.43	1.08	1.29	17.77
Serbia	53.73	32.60	28.02	48	65.71	20.68	0.54	1.07	1.38	16.34
Serbia	56.39	32.09	28.15	48	63.91	22.15	0.44	1.40	1.82	17.58
Netherl.	63.89	33.95	27.32	48	74.87	17.29	0.59	1.40	1.92	20.39

*The length was determined by means of comb wool fibre length analyzer

The average fibre diameter in most of studied batches ranged within 31.62-33.95 µm, corresponding to Bradford grade 48s. In two Bulgarian batches, wool fineness was from grade 50s (30.78 µm and 30.90 µm).

The highest mean weighted length of fibres was established for Dutch wool – 74.87 mm. For Serbian wool, it was 63.95-65.71 mm, with insignificant difference between the two batches (1.8 mm). In Bulgarian batches, weighted fibre length varied from 62.92 to 65.88 mm, except for one batch with length of 69.3 mm.

Short fibre percentage in Dutch wool was the lowest recorded – 17.29%. In Serbian batches, the values of the trait ranged from 20.68 to 22.15%, with difference of 1.47%. The relative short fibre proportion in Bulgarian batches varied from 19.17% and 23.10%, and the differences among batches – from 0.51% to 3.93%.

The washing of wool removes a part of mineral vegetable matter and wool grease. The wool fat of clean wool (its content should be from 0.4% to 1.5%) is necessary for maintenance of fibre properties – strength, elasticity, flexibility, lustre. The residual fat percentage in studied batches was within the allowances (0.42% - 0.71%), permitting the preservation of wool technological properties.

The dustiness of all batches was considerably below the allowances for medium wool types (norm 2.2%) and varied from 1.05% to 1.66%. A higher mineral content was established in 4 batches – two originating from Bulgaria (1.66% and 1.34%), one Serbian (1.4%) and the Dutch batch (1.4%).

With respect to vegetable matter, their content in studied batches exceeded the amount stipulated by the standard (1.2%) – it ranged from 1.29% to 2.24%. The highest amount of vegetable matter in wool was found out in two Bulgarian (1.65%; 2.24%), one Serbian (1.82%) batch and the Dutch batch (1.92%).

Robinson affirms (Rogachev et al., 2000) that the moisture of clean wool should not be below 15%. The critical threshold is 12%. The lower moisture content of wool has

an adverse effect on wool fibres – they lose their elasticity and become brittle. According to the requirements, clean wool moisture is 17% with deviations within 5%. For studied batches, moisture content varied from 16.34% to 20.39% and complied with norms.

Vegetable and mineral matters of clean wool are removed mechanically when the wool passes through a system of comber machines. The resulting slivers have a higher short fibre percentage, vegetable matter and neps, so they are submitted to subsequent processing in order to remove short fibres <25mm, neps and remaining vegetable matter from comber sliver, to make fibres straight and parallelly oriented.

The parameters controlled by laboratory analyses of slivers and obtained results are presented in Table 3.

The sliver yield varied from 81.31% to 86.91% in studied wool slivers. The highest yield was obtained in 3 Bulgarian sliver lots (86.91%; 85.79% and 84.48%) and in the Dutch lot (84.13%). In the other lots (Lot 1, Lot 5 and Lot 6), it ranged from 81.31 to 83.3%.

The mean fibre diameter of slivers varied from 33.10 µm to 36.42 µm, corresponding to grade 46s with the exception of two Bulgarian wool slivers (lots 2 and 3) with wool grade 48s.

In the different lots, fibre mean weighted length varied from 76.46 mm to 83.27 mm. The highest value of this parameter (determined by both methods) was that of Serbian wool slivers – 83.27 mm and 85.80 mm; 83.10 mm and 83.93 mm, respectively. The variation of the trait for Bulgarian slivers was within 76.46-80.08 mm.

Residual fat in wool slivers of different origin ranged within the allowances for medium worsted wool slivers: 0.6-1.2% (except from Bulgarian lot 3 that had a fat content of 0.54%). With respect to vegetable matter, there were no substantial differences among the slivers. In all studied slivers, vegetable matter % was below the upper limit of minimum allowance set by the standard (0.1%), confirming that all slivers complied with normative requirements with respect to this parameter.

Table 3. Technological indices of medium worsted wool sliver lots

Origin	Yield, %	Fibre diameter		Length				Fat, %	Vegetable mater, %	Moisture, %
		µm	CV, %	mm	Short fibres, %	mm	Short fibres, %			
Bulgaria										
Lot 1 Bulgaria	81.31	34.75	27.74	78.49	19.12	80.20	14.96	0.62	0.04	18.71
Lot 2 Bulgaria	86.79	33.31	25.30	76.46	21.23	81.90	14.10	0.58	0.02	19.07
Lot 3 Bulgaria	85.79	33.10	26.53	77.67	17.59	79.47	14.10	0.54	0.025	20.57
Lot 4 Serbia	84.48	35.68	29.40	80.08	18.30	81.30	15.90	0.60	0.025	20.83
Lot 5 Serbia	81.94	34.44	26.70	83.27	14.87	5.80	13.00	0.62	0.03	17.08
Lot 6 Netherl.	82.28	36.42	29.90	83.10	17.10	83.93	14.90	0.60	0.030	20.28
Lot 7	84.13	34.85	28.08	78.60	17.81	79.85	15.45	0.64	0.030	19.80

Conclusion

High-grade wool prevailed in Serbian and Bulgarian batches, with highest share to medium worsted wool (70.54% and 63.70%; 60.66% and 46.64%, respectively). The quality of clean worsted wool batches corresponded to Bradford grade 48s, except for two Bulgarian medium wool batches. The highest industrial washing yield was found out in the Dutch wool – 63.89%. Values of Serbian and Bulgarian batches were similar (respectively 53.73%-56.39% and 53.20%-55.89%). The highest mean weighted length of fibres was demonstrated for Dutch wool – 74.87 mm. For Serbian and Bulgarian batches, the values were comparable: 63.95-65.71 mm and 62.92-65.88 mm. Vegetable matter contents in studied batches exceeded the amount stipulated by the standard (1.2%) and ranged from 1.29% to 2.24%. The highest vegetable matter was found out in two Bulgarian wool batches (1.65%; 2.24%), one Serbian (1.82%) batch and the Dutch batch (1.92%). The studied wool slivers' yield varied from 81.31% to 86.91%. The highest yield was obtained in 3 Bulgarian sliver lots (86.91%; 85.79% and 84.48%) and for the Dutch one (84.13%).

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