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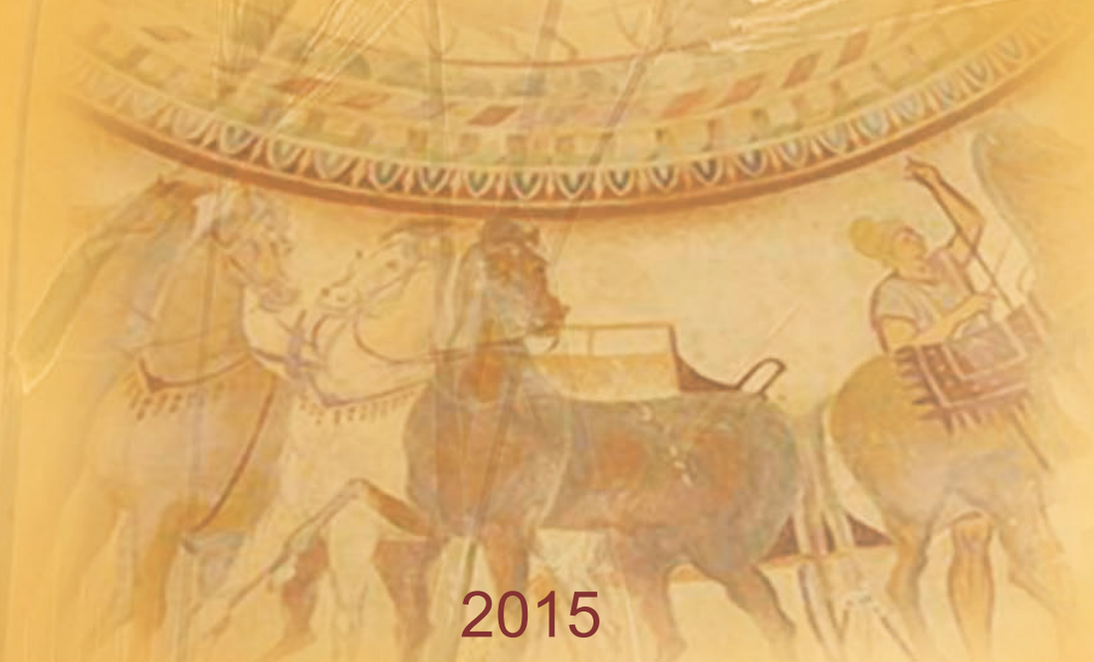

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Investigation on the technological traits of Bulgarian and imported merino wool batches

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Abstract. *The investigation was performed with industrial batches of merino wool originating from Bulgaria (1), Russia (2), Romania (2), Spain (1) and the Czech Republic (1). A total of 16 batches including 7 greasy wool batches, 5 clean wool batches and 4 wool sliver batches. The primary processing of wool batches (classification, washing and carding) was performed using the standard technologies applied at the textile enterprise. After the classification, the relative proportions of types vs the total amount of greasy wool were determined. Washing yields of classified greasy wool batches were established. Clean merino wool batches were submitted to the following laboratory tests: fibre diameter (μm), mean weighted length (mm), short fibre percentage (%), fatness (%), mineral matter content (%), vegetable matter content (%) and moisture (%). The parameters determined on ready wool slivers were as followed: yield (%), fibre diameter (measured with a lanameter, μm), mean weighted length (mm), length B (mm), short fibre percentage (%) and moisture (%).The two Russian wool batches were superior to all other tested batches with respect to high-grade wool content – 96.88% and 96.03%. They consisted exclusively of a single industrial class – grade 64s merino worsted wool (95.94% and 93.95% of batches, respectively). With regard to the relative share of merino worsted wool, the Bulgarian batch (40.98%) came after the Russian (96.88% and 96.03%), Romanian (batch 1) (90.23%) and Spanish wool (57.85%). Russian wool was superior to other batches with respect to washing yield (55.51%), mean weighted length (55.35 mm) and fibre cleanness (it had the lowest mineral (0.99%) and vegetable matter content (1.2%)). There were no considerable differences with respect to yield, mean weighted length and short fibre percentage between Spanish and batch 1 Romanian wool, although the mineral and vegetable matter percentages were significantly higher in Spanish clean wool. The batch from Czech and Bulgarian wool had higher fibre length, lower dustiness and less vegetable matter content than the Spanish batch, but its washing yield was lower. Compared to both Romanian batches, it occupied an intermediate position. The highest yield was established for slivers produced by Russian and Spanish wool – 80.63% and 80.12%. The yields of the other two batches were substantially lower (72.06% for Romanian and 70.54% for the mixed Bulgarian and Czech batch). The highest mean weighted fibre length was determined for slivers made from Russian wool (67.77 mm) whereas the lowest – for slivers produced from mixed Bulgarian and Czech batch (50.83 mm). The studied Russian wool batches were of greatest interest as their technological properties were concerned. Mixed with Bulgarian wool batches, they could be largely used to correct and improve the yield, short fibre length and proportion in clean wool and wool sliver.*

Keywords: merino wool, classification, washing and carding of wool, worsted wool, carded wool, technological traits

Introduction

From 1999 to 2010, the amount of produced wool has decreased by 13% on a global scale. In 2011 – 2012, the production increased by 2.45%, with expectations for a moderate increase in consumption and production of wool and wool products in the near future (FAOSTAT). The main task to wool producers and processing enterprises is to provide wool of high physico-mechanical and technological quality and its processing into high-quality products. This could be achieved only through an integral approach to sheep breeding, wool preparation and marketing, wool primary treatment and its processing at textile enterprises **(**Sidortsov, 1974).

The traditional classification of wool is not compliant to industrial standards. Detailed studies conducted in the 1980s in Australia and in the 1990s in Russia on variations in fibre diameter and length resulted in development of new technologies for preparation and instrumental methods for wool testing. They permitted to establish functional relationships between the principal properties and spinning traits as well as to predict the outcome of processing. The preparation consists of creating uniform industrial batches of wool with the same physical, mechanical and technological characteristics, requiring a uniform spinning technology (Rogachev, 2000). The two most important features of wool fibres – diameter and length, are essential for wool spinning quality and its price (Ward, 1998; Adams and Oldham, 1998; Rogachev, 2000; Pepper et al., 2000). Earlier research on technological properties of merino wool produced in Bulgaria were carried out by Hinkovski et al. (1984), Stoyanov et al. (1986), Panayotov and Lukarski (1988).

In a comparative study of technological features of Bulgarian, Russian, Australian and Romanian merino wool Slavov et al. (2005) established that the main technological properties of Australian and Russian wool were superior to those of Bulgarian and Romanian batches. Panayotov (2012) reported the main technological properties of 17 stock batches of merino wool. Out of the total amount of 118.191 t greasy wool, one-third (24.52%) was worsted and two-thirds (75.48%) – carded wool. Among worsted wool, that of grade 64s was predominant (84.31%), whereas grade 60s (83.49%) prevailed among carded wool samples. The mean weighted lengths were 59.12 and 47.65 mm, respectively. The washing yield of batches varied from 44.64% to 53.65%. The vegetable matter content in all wool types exceeded substantially the standards (from 2.03 to 2.86%).

The aim of the present study was to perform a comparative evaluation of technological features of industrial batches of Bulgarian and imported merino wool.

Material and methods

The investigation was performed in an industrial environment in co-operation with Kolhida Ltd – Sliven and comprised industrial batches of merino wool originating from Bulgaria (1), Russia (2),

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Romania (2), Spain (1) and the Czech Republic (1). A total of 16 batches including 7 greasy wool batches, 5 clean wool batches and 4 wool sliver batches. The primary processing of wool batches (classification, washing and carding) was performed using the standard technologies applied at the textile enterprise. After the classification, the relative proportions of types vs the total amount of greasy wool were determined. Washing yields of classified greasy wool batches were established.

Clean merino wool batches were submitted to the following laboratory tests: fibre diameter (μm), mean weighted length (mm), short fibre percentage (%), fatness (%), mineral matter content (dustiness, %), vegetable matter content (%) and moisture (%). The parameters determined on ready wool rovings were as follows: yield (%), fibre diameter (measured with a lanameter, μm), mean weighted length (mm), length B (mm), short fibre percentage (%) and moisture (%).

After individual classification of the studied batches, the Czech and Bulgarian merino wool batches were joined together and then submitted to washing and carding as a new mixed batch, whereas one of Romanian wool batches was sold as clean wool.

Results and discussion

The industrial classification of wool consisted of dividing the fleece into parts representing different wool classes, distinguished by their physico-mechanical and technological properties (thickness, length, strength, elasticity, colour, pollution). During the classification, new batches are formed and further submitted to specific treatments (washing, carding etc.). The results from the industrial classification of the studied merino wool batches are presented in Table 1. In the Bulgarian batch, the highest percentage was that of merino carded wool grade 64s – 54.22%. The share of high-grade wools was 40.98%, including 36.28% fine merino worsted and 4.70% - merino worsted wool. The proportion of cut hair and paint-stained wool was high (2.88%). The fine merino worsted wool from the Russian wool batch was 93.95 – 95.94% of the total amount of sorted wool. The percentage of merino worsted wool was low (0.94-2.08%). The proportion of low-grade wool was also low (3.12 – 3.97%).

The range of wool types obtained after the classification was the broadest in batches imported from Romania. The share of merino worsted wool in batch 1 was 90.23% including grade 64s merino worsted (71.69%) and grade 60s merino worsted (18.54%). The percentage of medium worsted wool attained 7.19%. In batch 2, merino carded wool prevailed with 57.52%. The relative proportion of merino worsted wool was low (34.26%), and that of fine merino wool – only 14.69%. The amount of medium worsted wool classes was 4.75% relative to the total batch volume. The major proportion of the batch imported from the Czech Republic consisted of semifine worsted wool (57.62%), followed by semifine carded wool with 21.21%. The percentage of merino worsted wool was low (15.39%). The share of the medium worsted wool was 3.52%, and other sorts (medium worsted grey wool, white felt wool, etc.) – 2.36%. As fibre diameter was concerned, the wool imported from Spain could be classified as fine merino wool (98.92%). According to the length, merino worsted wool prevailed (57.85% of the batch) The share of merino carded wool was 41.07%.

The results of classification of wool showed that the two Russian wool batches consisted exclusively of a single industrial class – grade 64s merino worsted wool (95.94% and 93.95% of all batches, respectively). The wool imported from Spain contained two classes of wool. With regard to the relative share of merino worsted wool, the Bulgarian batch came after the Russian, Romanian (batch 1) and Spanish wool.

One of the important technological features of the primary wool treatment influencing the cost of the end product (the tape of merino wool) is the washing yield. Out of the five studied batches, Russian wool exhibited the highest washing yield – 55.51% (Table 2). The lowest yields were established for the Romanian batch (R2) and the mixed batch with Czech and Bulgarian wool – 42.68% and 44%, respectively. The Spanish (47.60%) and R1 Romanian (47.89%) batches occupied an intermediate position. The Spanish and Romanian (R2) batches were with the lowest mean weighted

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

Kinds of wool, received a classification	Quality of Bradford	Bulgarian, %	Russian, %		Romanian, %		Czech, %	Spanish, %
			Batch 1	Batch 2	Batch 1	Batch 2		
Merino worsted wool	64	36.28	95.94	93.95	71.69	14.69	15.39	57.85
Merino worsted wool	60	4.70	0.94	2.08	18.54	19.57	-	-
Merino carded wool	64	54.22	1.14	2.18	-	-	-	41.07
Merino carded wool	60	-	-	-	-	57.52	-	-
Semifine worsted wool	56/58	-	-	0.16	0.02	-	57.52	-
Semifine carded wool	56	0.09	-	-	0.35	-	21.21	-
Merino muddy wool	-	-	0.41	0.21	-	-	-	-
Medium worsted wool	50	1.56	0.03	0.12	4.98	2.17	-	-
Medium worsted wool	48/50	-	-	-	2.21	2.58	3.52	-
Medium worsted grey wool	48/50	0.27	-	-	0.68	0.45	1.38	-
Cut hair and wool stained with paint	-	2.88	1.54	1.30	0.01	0.37	-	1.08
White felt wool	-	-	-	-	0.02	0.14	0.10	-
Other grade	-	-	-	-	1.50	2.51	0.88	-
High-grade	-	40.98	96.88	96.03	90.23	34.26	15.39	57.85
Low-grade	-	59.02	3.12	3.97	9.77	65.74	84.61	42.15

Table 2. Technological characteristics of clean wool

Origin	Yield, %	Fibre diameter, µm	CV	Quality of Bradford	Length, mm	Short fibres, %	Fatness, %	Mineral matter (dustiness), %	Vegetable matter, %	Moisture, %
Russian	55.51	24.62	24.50	60	55.35	29.77	0.48	0.99	1.20	16.01
Spanish	47.60	22.62	23.65	64	42.67	38.44	0.74	1.39	2.57	16.49
Czech + Bulgarian	44.00	24.39	23.50	60	44.87	34.61	0.53	1.09	1.28	15.72
Romanian, batch 1	47.89	23.83	22.99	60	43.17	38.56	0.43	1.11	1.43	17.13
Romanian, batch 2	42.68	22.86	23.18	64	51.77	29.88	0.70	1.48	3.56	15.86

Table 3. Laboratory analysis of batches of merino wool sliver

Origin	Yield, %	Fibre diameter		Wool length				Fatness,%	Vegetable matter, %	Moisture,%
				Mean weighted length		Length B				
		µm	CV	mm	Short fibres, %	mm	Short fibres, %			
Russian	80.63	24.70	25.83	67.77	23.39	71.60	20.30	0.60	0.02	19.27
Spanish	80.12	23.66	24.94	57.96	23.50	-	-	0.58	0.02	19.87
Czech + Bulgarian	70.54	24.86	23.53	50.83	24.41	56.30	27.90	0.60	0.01	18.97
Romanian	72.06	23.57	21.92	60.23	26.23	63.68	22.08	0.40	0.01	18.25

lengths – 22.62 – 22.86 µm (corresponding to Bradford grade 64s) whereas the other batches had mean weighted lengths ranging within 23.83 – 24.62 µm (grade 60s).

The wool length varied substantially between the batches. The longest fibres were those from the Russian (55.35 mm) and Romanian (R2) batches (51.77% mm) and the shortest from Spanish wool (42.67 mm). The other two batches had intermediate fibre lengths. The percentage of short fibers is the highest in the batches from Romanian (P1) (38.56%) and Spanish (38.44%) wool, and the lowest in Russian (29.77%) and Romanian (P2) (29.88%). The batch from Czech and Bulgarian wool occupies an intermediate position (34.61%).

Clean wool fatness is necessary for maintenance of the strength, pliability and elasticity of fibres. When the fatness of fibres is low, they break down extensively, whereas high fatness (>1%) impedes further processing. The optimum clean wool fatness ranges between 0.5 – 1.0% (average 0.75%) (Nitschke, cited by Rogachev et al., 2000). Fatness of clean wool in the studied batches varied from 0.43 to 0.74%, but did not exceed the value stipulated by the standard (0.75%).

The vegetable and mineral matter contents were the highest in Spanish (1.39% and 2.57%, respectively) and Romanian (R2) wool (1.48% and 3.56%, respectively), exceeding the reference values (1.2% and 2.2%, respectively). The values of these parameters of the other three batches were comparable to standards.

The drying of wool is exceptionally important for preserving the technological properties of fibres. Robinson (cited by Rogachev et al., 2000) assumed that the moisture content of clean wool should not be below 15%. A number of observations from the practice have confirmed that clean wool moisture should not be lower than 12%, because this is the limit where fibres lose their elasticity and become easily broken. According to the Bulgarian State Standard 4591, standard moisture content of clean wool should be 17% with variations up to 5%. The moisture content of the studied batches varied from 15.72% to 17.13% and was compliant with the standard.

The analysis of results showed that Russian wool was superior to other batches with respect to washing yield, mean weighted length and cleanness of fibres, i.e. it had the lowest content of mineral and vegetable matter. The other batches could not receive a consistent estimate. There were no considerable differences with respect to yield, mean weighted length and short fibre percentage between Spanish and Romanian (R1) wool batches, however, the mineral and vegetable matter percentages were significantly higher in Spanish clean wool. The lowest yield and the highest mineral and vegetable matter contents were exhibited by the Romanian (R1) batch. It ranked second after the Russian batch with regard to the length of fibres. The batch from Czech and Bulgarian wool had a higher fibre length, lower dustiness and less vegetable matter content than the Spanish batch, but its washing yield was inferior. Compared to both Romanian batches, it occupied an intermediate position.

The results from the laboratory tests of tape of wool from classified merino wool batches (Table 3) showed the highest yield for slivers produced by Russian and Spanish wool (80.12 – 80.63%). The yields of the other two batches were lower (70.06 – 72.54%). The mean fibre diameter (measured by means of lanameter) varied from 23.57 to 24.86 µm, corresponding to Bradford grade 60s and 60/64s. The highest fibre length determined in both tests was established for wool tapes made from Russian wool (67.77 and 71.60 mm respectively) and Romanian wool (60.23 and 63.68 mm). The fatness and vegetable matter contents of the studied of wool tapes were compliant to the standards.

Conclusions

The two Russian wool batches were superior to all other tested batches with respect to high-grade wool content – 96.88% and 96.03%. They consisted exclusively of a single industrial class – grade 64s merino worsted wool (95.94% and 93.95% of batches, respectively). With regard to the relative share of merino worsted wool, the Bulgarian batch (40.98%) came after the Russian (96.88% and 96.03%), Romanian (batch 1) (90.23%) and Spanish wool

(57.85%).

Russian wool was superior to the other batches with respect to washing yield (55.51%), mean weighted length (55.35 mm) and fibre cleanness (it had the lowest mineral (0.99%) and vegetable matter content (1.2%)). There were no considerable differences with respect to yield, mean weighted length and short fibre percentage between Spanish and batch 1 Romanian wool, although the mineral and vegetable matter percentages were significantly higher in Spanish clean wool.

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The highest yield was established for slivers produced by Russian and Spanish wool – 80.63% and 80.12%. The yields of the other two batches were substantially lower (72.06% for Romanian and 70.54% for the mixed Bulgarian and Czech batch).

The highest mean weighted fibre length was determined for slivers made from Russian wool (67.77mm) whereas the lowest – for slivers produced from mixed Bulgarian and Czech batch (50.83 mm).

The studied Russian wool batches were of greatest interest as their technological properties were concerned. Mixed with Bulgarian wool batches, they could be largely used to correct and improve the yield, short fibre length and proportion in clean wool and wool sliver.

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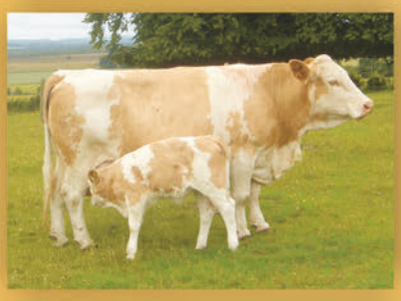

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