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THE EFFECT OF CEMENT DUST AS INDUSTRIAL POLLUTANT ON SOME WOOL TRAITS OF BARKI SHEEP

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SUMMARY

The present study was carried out at El-Gharbaniate, 50 Km from the west of Alexandria. The wool samples were collected randomly from 171 yearling Barki ewes raised in the surrounding area of a cement factory. This grazing area was divided according to the directions of the wind into 3 equal zones exposed to cement dust, each one about 2 Kms, and 3 equal zones unexposed to cement dust.

The aim was to evaluate changes in some wool traits of Barki ewes exposed to cement dust. Results indicated that the wool growth, clean fleece yield, fibre diameter, staple length, bulk, staple strength, greasy colour grade, handle grade were markedly influenced by cement dust as extraneous material. The back (dorsal position) had lower grades and lower staple strength than the position of the mid-side (lateral line). The wool traits studied seemed to be related significantly to the duration of exposure to the cement dust.

Keywords: Barki sheep, wool traits, cement dust-industrial pollution

INTRODUCTION

In Alexandria, the industrial sector is located in the Western part of the city including a cement plant and other factories. Near these factories there are wide areas for sheep grazing that are exposed continuously to cement dust. However, wool as shorn from sheep contains varying amount of impurities such as natural grease, suint and some foreign substances, which consist chiefly of dirts, sands, vegetable matters and other material attached to the wool. These impurities are removed through scouring causing a considerable loss in the original weight of wool (Freaser and Stamps, 1991). El-Gabbas (1994) indicated that the dirtiness of the fleeces are a big obstacle affecting the market value of the wool. Hence the manufacturers are reluctant to buy this wool due to its high content of non-wool substances which would involve extra cost in scouring and result in a lower clean scoured yield, Consequently, reduced purchase prices are offered for such wool.

Very little research has been done on the effects of cement dust on sheep production. However, Prusiewicz Witaszek *et al.* (1988) estimated the amount of whole pollution and that of keratin fraction in wool samples of Merino, Wiolkopolska and East Fresian breeds as well as their crosses. They indicated that there was a significant deleterious effect on wool composition. Bires and Vizqula (1991) determined the concentration of Cu, Fe, Zn, Cd, Mo, As, Pb and Se in the sheep fleece from industrial pollutants.

The main objective of the present study was to evaluate changes in some wool traits of Barki sheep exposed to cement dust.

MATERIALS AND METHODS

The present study was performed on six commercial flocks of Barki sheep at El-Gharbaniate, 50 kms west of Alexandria. The flocks were scattered in this newly reclaimed area for stubble grazing and other available feed resources. The sheep owners were residents in communities within these region and the management of the flocks studied was almost similar, where they mainly grazed on natural vegetation from September 1998 to March 1999. The wool samples were collected randomly during these period from the back and the left mid-side of 171 yearling Barki ewes (35, 23, 25, 36, 24 and 28 for first, second and third exposed and unexposed zones, respectively) raised in the surrounding area of the cement factory, where each animal was numbered. The grazing area was divided according to the directions of the wind into three equal zones in both sides of the factory (first, second and third). Each zone was of 2 square kms. That would give three zones exposed to the cement dust and other three unexposed zones. During the experimental period the prevailing wind direction was northern west and the weather was characterized by stable atmosphere. The climatic data in the area under investigation during the course of this study was obtained from Egyptian meteorological center office records as shown in the following table:

Months	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Wind speed (m/sec.)	3.9	3.5	2.9	4	3.1	3.6
Relative humidity (%)	63	65	69.3	69	68	66.3
Rain (mm/mth)	0.0	0.0	0.0	11	57	36

According to Turner and Young (1969) greasy wool growth per unit area (GWA) was determined by clipping the wool from measured patches of about 100 cm^2 on the back and the left mid-side at three months intervals for each animal in the second and third zones. As for the flocks in the first zone animals were divided randomly into two groups (20, 15 vs 24, 12 animals) and wool samples were taken from the first group at 3 months intervals (20 and 24 animals) while it was taken after 6 months (15 and 12 animals) from the second group. The dimensions of these squares were recorded for each animal, position and sampling occasion to calculate the area shorn. Ten staples were taken from each greasy sample and used for measuring fibre diameter (FD), staple length (STL) and staple strength (SS) according to El-Gabbas (1998). The greasy sample was scoured to estimate clean yield (YLD), clean wool per unit area (CWA) (Chapman, 1960), loose wool bulk (BUL) (Bedford *et al.*, 1977). Wool samples taken from animals were subjectively assessed to determine greasy colour grade (GCG), and handle grade (HG) according to El-Gabbas (1994). Dust samples were collected by metal gauge, located within the areas in both directions to test the dust composition according to Kirk (1979).

Data were analyzed by least squares analysis procedure with unequal subclass numbers (Harvey, 1977). The analysis was conducted using Generalized Linear Model Procedure on SAS (1995). The statistical model included the effects of exposure, zones, positions and duration of exposure. All factors in the model were assumed to be fixed, except the error term which it was assumed to be randomly and independently distributed with mean=0 and variance = σ^2e. Comparisons between each two means of any factor were carried out by Duncan Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The term cement dust, as used in this work is a mineral dust. It consists of nuisance particles with value of 30 million particles per cubic foot of air (Fahmy, 1990). The chemical analysis of the collected dust samples from the exposed zones composed of SiO_2, Al_2O_3, TiO_2, Fe_2O_3, CaO, MgO and So_3 which mostly are components of cement dust emitted from the chimney of cement factor. However, these compositions were not clear in case of unexposed dust samples. Table (1) showed that the GWA was significantly higher in the first and second exposed zones than the third one, and the comparisons between the GWA of exposed zones and GWA of unexposed zones showed that the latter was significantly lower. On the other hand, CWA and YLD% of the first exposed zone were significantly lower than other zones. Moreover, the differences of YLD% among zones were significant and wool sample of the first zone had lower YLD% compared with those from the other zones. That probably might be due to more exposure to cement dust and hence higher impurities in the fleeces which increased the GWA and decreased the CWA and YLD%. The exposure to cement dust would lead to deleterious effect on wool follicles. Fahmy (1990) indicated that when cement dust with little moisture content gets in contact with skin, it would absorb moisture from it, causing the skin to become dry, hard and thickened. Moreover, the grains of silica mixed in cement dust might cause additional mechanical irritation. Consequently, the skin exposed to the cement dust might be liable to crack and fissure which might affect the structure of the skin follicles. The results also pointed out that STL, FD, BUL and SS seemed to differ significantly among zones. Wool produced by the first, second and third of exposed zones was shorter, had coarser, lower bulk, lower strength, was harsher and more fads yellowness than those of the unexposed zones.

The present results indicated that all wool traits of exposed sheep differed significantly ($P<0.01$) from those unexposed to the cement dust. However, the estimate of unexposed wool samples showed that CWA, YLD%, STL, FD, BUL, SS, GCG and HG were better than those of exposed wool samples (Table 2). The differences in these traits might reveal that it might be important to control this environmental factor.

Table 1. Least square means and standard error of some wool traits at different zones

Traits	Sig. level	Exposed			Unexposed		
		0 – 2 kms	2 – 4 kms	4 – 6 kms	0 – 2 kms	2 – 4 kms	4 – 6 kms
Obs. No.		40	46	50	48	48	56
GWA (g/cm^2)	**	0.101±0.003 ^{a}	0.097±0.003 ^{a}	0.082±0.003 ^{c}	0.071±0.003 ^{b}	0.071±0.003 ^{b}	0.070±0.002 ^{b}
CWA (g/cm^2)	**	0.029±0.001 ^{a}	0.036±0.001 ^{b}	0.037±0.001 ^{b}	0.035±0.001 ^{b}	0.038±0.001 ^{b}	0.041±0.001 ^{b}
YLD (%)	**	47.78±0.223 ^{a}	51.04±0.208 ^{c}	52.28±0.200 ^{b}	51.96±0.204 ^{b}	54.09±0.204 ^{d}	54.92±0.189 ^{f}
STL (cm)	**	3.83 ± 0.087 ^{a}	4.25 ± 0.081 ^{b}	4.15 ± 0.078 ^{b}	4.62 ± 0.079 ^{c}	4.73 ± 0.079 ^{c}	4.71 ± 0.073 ^{c}
FD (µm)	**	31.18±0.181 ^{a}	31.43±0.169 ^{b}	31.1±0.162 ^{bc}	30.71±0.165 ^{c}	30.85±0.165 ^{c}	30.8 ± 0.153 ^{c}
BUL (cm^3/g)	**	21.78±0.199 ^{a}	22.82±0.185 ^{b}	23.97±0.178 ^{d}	24.77±0.181 ^{e}	25.83±0.181 ^{c}	26.12±0.168 ^{c}
SS (N/Ktex)	**	49.43±0.201 ^{a}	53.02±0.188 ^{c}	54.83±0.180 ^{b}	54.83±0.184 ^{b}	56.1 ± 0.184 ^{d}	56.80 ± 0.17 ^{f}
GCG	**	1.20 ± 0.053 ^{a}	1.30 ± 0.05 ^{a}	1.60 ± 0.05 ^{c}	1.90 ± 0.05 ^{d}	2.50 ± 0.05 ^{b}	2.40 ± 0.05 ^{b}
HG	**	1.30 ± 0.04 ^{a}	1.50 ± 0.04 ^{b}	1.50 ± 0.04 ^{b}	2.10 ± 0.04 ^{c}	2.30 ± 0.04 ^{d}	2.60 ± 0.04 ^{e}

[a,b,c,d,e and f]Within a row followed the same superscript letter are not significantly different.

** P<0.01. *P<0.05. NS: not significant Obs. No. = Observation numbers.

Table 2. Least square means and standard error of some wool traits in exposed and unexposed to cement dust

Traits	Sig. Level	Exposed		Unexposed	
		Obs. No.	Mean ± SE	Obs. No.	Mean ± SE
GWA (g/cm^2)	**	136	0.09 ± 0.001^a	152	0.07 ± 0.001 ^{b}
CWA (g/cm^2)	**	136	0.034 ± 0.001^a	152	0.038 ± 0.001 ^{b}
YLD (%)	**	136	50.37 ± 0.12^a	152	53.66 ± 0.11 ^{b}
STL (cm)	**	136	4.08 ± 0.031 ^{a}	152	4.68 ± 0.03 ^{b}
FD (µm)	**	136	31.57 ± 0.098 ^{a}	152	30.79 ± 0.093 ^{b}
BUL (cm^3/g)	**	136	22.85 ± 0.108 ^{a}	152	25.58 ± 0.102 ^{b}
SS (N/Ktex)	**	136	52.43 ± 0.106 ^{a}	152	55.91 ± 0.1 ^{b}
GCG	**	136	1.39 ± 0.03 ^{a}	152	2.26 ± 0.03 ^{b}
HG	**	136	1.42 ± 0.02 ^{a}	152	2.38 ± 0.02 ^{b}

[a,b]Within a row followed the same superscript letter are not significantly different.

** P<0.01. *P<0.05. NS: not significant. Obs. No. = Observation numbers

The effect of duration of exposure to the cement dust on wool traits studied was presented in the table (3). As indicated, the YLD, BUL and SS decreased in the exposed wool samples of six months compared to the wool samples of three months and the differences were significant. However, the duration of exposure had no significant effect on FD and GCG, but HG was markedly influenced by the duration of exposure to cement dust as compared with the grades of unexposed wool samples. Fahmy (1990) concluded that the skin dryness increased by the duration of exposure due to the irritant nature of cement dust. The irritant properties of dust were well documented on basis of its alkalinity, hygroscopicity and abrasiveness.

The differences in GWA, STL, SS and GCG among positions of exposed wool were found to be significant (Table 4). Moreover, highly significant differences were found among positions of unexposed wool in GWA and STL. Generally, the back as the dorsal position had lower grades of colour and lower sound especially when it was exposed to cement dust than those of the mid-side as lateral line. Of course, the back represented the site most frequently involved due to direct contact with cement dust.

It could be concluded that the effect of cement dust on some wool traits as an environmental factor had negative effects and might mask the genetic effect in controlling the wool handle. In the light of the present results it could be recommended to use electrostatic filters in the cement factory which would be quite reasonable to reduce the source of air pollution. This would improve the quality of the product, hence better prices of wool produced in this area.

Table 3. Least square means and standard error for some wool traits at three and six months intervals of wool growth

Traits	Sig. level	Exposed				Unexposed			
		No.	3 months	No.	6 months	No.	3 months	No.	6 months
GWA (g/cm^2)	**	40	0.1 ± 0.003^a	30	0.16 ± 0.004^c	48	0.07 ± 0.003^b	24	0.17 ± 0.004^c
CWA (g/cm^2)	**	40	0.03 ± 0.001	30	0.07 ± 0.001^c	48	0.04 ± 0.001^b	24	0.09 ± 0.002^d
YLD (%)	**	40	47.78 ± 0.29^a	30	41.96 ± 0.33^c	48	51.96 ± 0.26^b	24	51.24 ± 0.37^b
STL (cm)	**	40	3.83 ± 0.06^a	30	4.92 ± 0.07^c	48	4.62 ± 0.06^b	24	6.44 ± 0.08^d
FD (μm)	NS	40	32.18 ± 0.19^a	30	32.59 ± 0.22^a	48	30.71 ± 0.17^b	24	30.90 ± 0.25^b
BUL (cm^3/g)	**	40	21.78 ± 0.20^a	30	19.82 ± 0.23^c	48	24.77 ± 0.18^b	24	25.51 ± 0.25^d
SS (N/Ktex)	**	40	49.43 ± 0.27^a	30	45.67 ± 0.32^c	48	54.83 ± 0.25^b	24	56.76 ± 0.36^d
GCG	NS	40	1.2 ± 0.04^a	30	1.1 ± 0.04^a	48	1.9 ± 0.03^b	24	1.8 ± 0.05^b
HG	*	40	1.3 ± 0.03^a	30	1.1 ± 0.04^c	48	2.1 ± 0.03^b	24	2.2 ± 0.04^b

[a,b,c,d]Within a row followed the same superscript letter are not significantly different.
** $P<0.01$. *$P<0.05$. NS: not significant No. = Number of observations

Table 4. Least square means and standard error for some wool traits in back and mid-side positions

Traits	Sig. level	Exposed			Sig. level	Unexposed		
		No.	Back	Mid-side		No.	Back	Mid-side
GWA (g/cm^2)	**	68	0.11 ± 0.002^a	0.08 ± 0.012^b	**	76	0.08 ± 0.002^b	0.06 ± 0.002^c
CWA (g/cm^2)	NS	68	0.03 ± 0.001^a	0.03 ± 0.001^a	NS	76	0.04 ± 0.001^b	0.04 ± 0.001^b
YLD (%)	NS	68	50.65 ± 0.17^a	50.08 ± 0.17^a	NS	76	53.93 ± 0.16^b	53.39 ± 0.16^b
STL (cm)	*	68	4.48 ± 0.04^a	3.67 ± 0.04^b	*	76	5.90 ± 0.04^c	4.28 ± 0.04^d
FD (μm)	NS	68	31.72 ± 0.14^a	31.42 ± 0.14^a	NS	76	30.71 ± 0.13^b	30.87 ± 0.13^b
BUL (cm^3/g)	NS	68	22.66 ± 0.15^a	23.05 ± 0.15^a	NS	76	25.47 ± 0.14^b	25.68 ± 0.14^b
SS (N/Ktex)	**	68	51.95 ± 0.16^a	52.91 ± 0.15^c	NS	76	56.03 ± 0.14^b	55.79 ± 0.14^b
GCG	*	68	1.3 ± 0.04^a	1.50 ± 0.04^c	NS	76	2.30 ± 0.04^b	1.20 ± 0.04^b
HG	NS	68	1.4 ± 0.03^a	1.40 ± 0.03^a	NS	76	2.40 ± 0.03^b	2.30 ± 0.03^b

[a,b,c,d]Within a row followed the same superscript letter are not significantly different.
** $P<0.01$. *$P<0.05$. NS: not significant.

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