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THE QUANTIFYING OF FLUE QUALITY IN OSTRICH PLUMES WITH SPECIAL REFERENCE TO THE FAT CONTENT AND CUTICULAR STRUCTURE OF THE BARBULES*

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(Key words: *Flue quality, ostrich feathers, cuticular structure)*
(Sleutel woorde: *Donskwaliteit, volstruisvere, kutikulêre struktuur)*

OPSOMMING: DIE KWANTIFISERING VAN DONSKWALITEIT BY VOLSTRUISVERE MET SPESIALE VERWYSING NA DIE VETINHOUD EN KUTIKULêRE STRUKTUUR VAN DIE BAARDJIES

Vir die kwantifisering van donskwaliteit by volstruisvere is die werklike vetinhoud (eterekstrak) en die kutikulêre struktuur van die veerdons ondersoek en in verband gebring met 5 gestandaardiseerde kategorieë van visueel waarneembare vetvoorkoms soos in die praktyk toegepas. Met betrekking tot die kwaliteitseienskappe van die veerdons is die kutikulêre struktuur van die baardjies ook met die oppervlaktestruktuur van die vesels van sybokhaar, Merino-, Dohnemerino- en S.A. Vleismerinowol, vergelyk.

Geen getuienis van enige betekenisvolle verwantskap tussen die visueel beoordeelde vetvoorkoms en die werklike eterekstrak van volstruisvere (of wol) kon gevind word nie.

Voldoende getuienis is egter gevind dat die gladheid of reëlmatigheid van die kutikulêre struktuur van die vesels 'n bepalende invloed op eienskappe soos sagtheid, glans, vetvoorkoms en dus kwaliteit van volstruisvere, wol en sybokhaar het.

SUMMARY:

The chemically determined fat content (ether extract) and the cuticular structure of the fibres (barbules) of ostrich plumes were related to the 5 standardized categories of subjectively evaluated fatty appearance as used in practice. With regard to the quality traits of the flue, the cuticular structure of the barbules was also compared with the surface structure of the fibres of mohair and Merino, Dohne Merino and South African Mutton Merino wool.

No evidence was found of any significant relationship between subjectively evaluated fatty appearance and the ether extract of the ostrich plumes or for wool.

On the other hand, it was found that the softness lustre and fatty appearance of ostrich plumes, wool and mohair are caused by the degree of smoothness of the cuticular structure of the fibres.

The flue quality of ostrich plumes is one of the most important economic traits in the fashion plume industry (Swart, 1979). The quality of the flue is determined mainly by subjective traits such as handling, fatty appearance, lustre, density and the regularity of character of the finer flue material (Duerden, 1909; Thornton, 1909; Smith, 1921; Smit, 1963; Swart, 1979). Thus in the broad sense the term "quality" as used in connection with ostrich plumes, has a similar meaning as that described for sheep's wool by Venter (1966, 1967), for mohair by Uys (1965) and for Karakul lamb pelts by Nel (1966).

Observations prior to the present study, indicated that the visually evaluated fatty appearance of the flue of ostrich plumes is not only positively related to flue quality, but also shows striking relationships with other components of the flue quality. Awareness of such a phenomenon led to the general belief among ostrich farmers and feather dealers, that the fatty appearance of the flue is one of the most important single components of flue quality. Furthermore, fatty appearance has an important negative, but favourable, relationship with weathering of the flue (Swart, 1979).

For the purpose of quantifying the flue quality of ostrich plumes in relation to the 5 standardised categories of fatty

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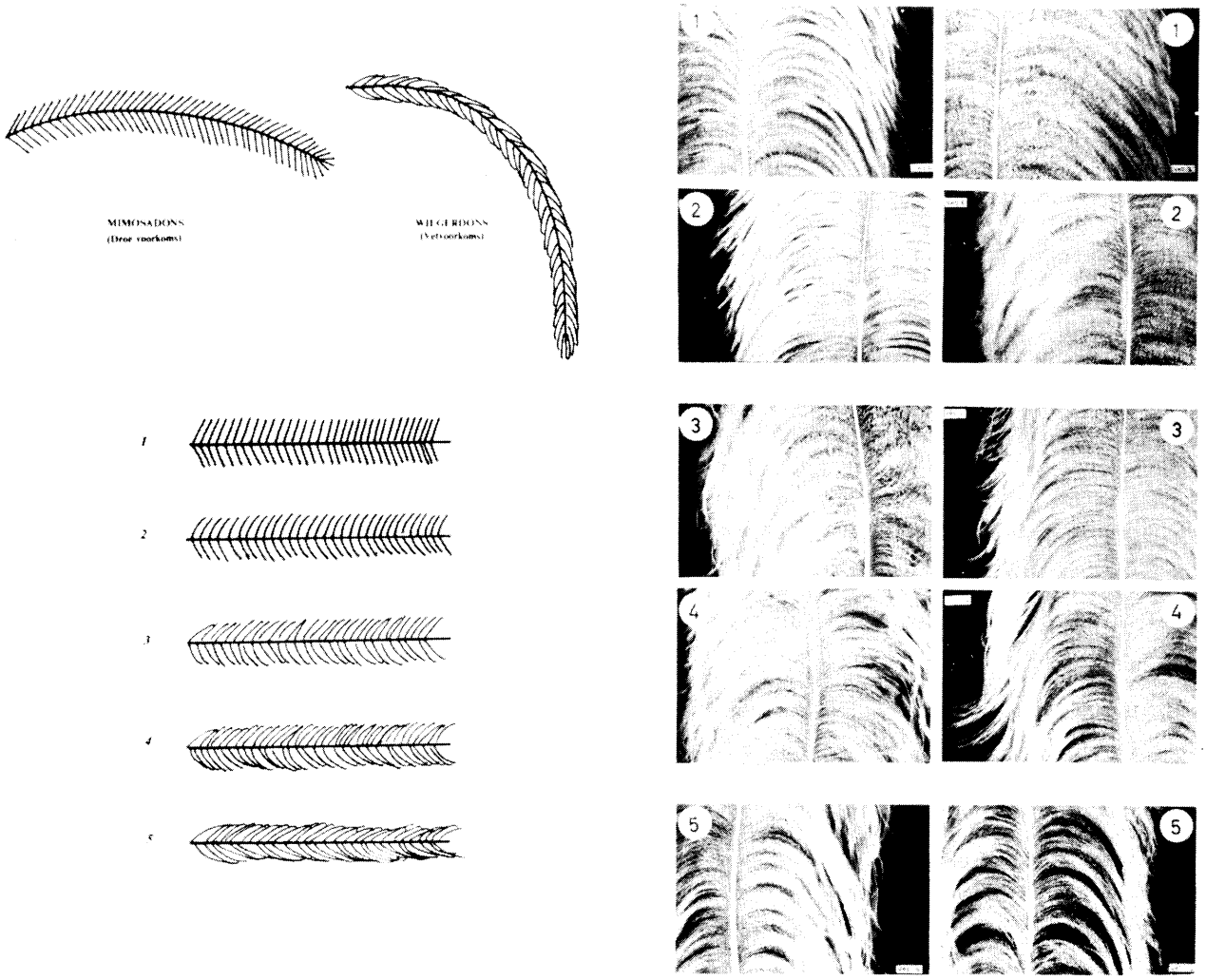

Fig. 1 *Schematic drawings and photo illustrations of the numeric classes of the visual fatty appearance of ostrich feathers.*

appearance as used in practice, a study was made of the chemical fat content as well as of the cuticular surface structure of the flue.

Since the evaluation of quality in sheep's wool and mohair is based on similar subjective methods as in ostrich plumes, a comparison was also made with the cuticular structure of a limited sample of wool and mohair fibres.

Procedure

Originally a random sample of 222 ostrich plumes was evaluated and classed according to methods described by Roux (1961), Nel (1966), Nel (1970) and Van Niekerk (1972). It was found that the observations of visually recognizable fatty appearance of the flue showed a normal distribution when plotted on a linear X-axis divided into 5 categories for fatty appearance (Fig. 1). Similar procedures were applied to test the other components of plume quality for normality of distribution. In all cases 5 categories of quality were used.

For the present study a sample of 24 plumes was chosen from the previously evaluated 222 plumes, but in such a way that all the existing categories of visually recognizable fatty appearance were clearly represented. Subsequently, the ether extract of the 24 plumes was determined by washing the intact flue for a period of 8 hours in distilled diethyl ether in a soxhlet apparatus.

The ether extract includes any oil, fat and even a proportion of light waxes that might be present in the flue material. However, as no effort was made to distinguish between the proportions of oil, fat and wax in the ether extract and because of the fact that all these properties are referred to collectively as plume fat in the ostrich terminology, hereinafter the term "fat content" will be used to indicate "ether extract".

Representative flue fibres (barbules) from the 5 subjectively evaluated categories of fatty appearance were photo-micrographed with a scanning electron microscope (SEM) to show the cuticular surface structure of the barbules. SE Micrographs were taken both before and after ether extraction.

Scanning electron micrographs were also made of the cuticular surface structure of fibres from good, medium and poor quality Merino wool as well as from S.A. Mutton Merino wool, Dohne merino wool and mohair.

Results

For the 5 subjective categories of fatty appearance of the flue, the fat content varied from 0,5 to 1,5 per cent, with an average of 1,03 per cent and a coefficient of variation of 23,83 per cent. In contrast, the visually evaluated fatty appearance of the same plumes varied by 41,7 per cent.

The correlation (r = 0,238) between the true fat content and the visual fatty appearance was non-significant. Furthermore, no significant relationships were found between the fat content and any of the other components of flue quality (Table 1; requirement for significance: r = 0,4 at $P \leqslant 0,05$). Of particular importance was the finding that the flue material was placed in exactly the same subjective categories before and after the ether extraction.

All the correlations between visual fatty appearance and the components of flue quality were highly significant (Table 1; requirement for significance: r = 0,51 at $P \leqslant 0,01$). This result was in good agreement with the relationships found between the same characteristics in a large sample of 222 plumes (Swart, 1979).

Table 1

Correlations between the fat content and the components of flue quality

Flue trait	Correlation (r) with							
	Fat		Qual.	Softness	Lustre	Density	Character	Weathering
	%	Appearance						
% Flue fat		0,238	0,317	0,133	0,295	0,048	0,376	−0,241
Fatty appearance			0,695**	0,715**	0,694**	0,477*	0,558**	−0,425*
Quality				0,818**	0,801**	0,639**	0,713**	−0,183
C.V.%	23,83	41,68	37,98	31,52	30,59	39,95	33,00	43,96

*r = 0,40; $P \leqslant 0,05$ ** r = 0,52; $P \leqslant 0,01$ n = 24

SEM studies of the flue fibres exposed striking differences between the cuticular surface structures of flue with a high, medium and low fatty appearance (Fig. 2). Flue with a high fatty appearance showed a smooth and regular cuticular surface comparable to a young unripe reed in which the leaves are still closely folded around the stem. However, flue with a dry appearance had an irregular surface structure, comparable to a ripe dry reed with weathered leaves protruding away from the main stem.

No recognisable changes were observed in the micro structure of the barbules after ether extraction.

The Merino wool samples differing in quality also showed definite differences in smoothness of the cuticular surface structure as observed for the ostrich plumes (Fig. 3). The cuticular scales of the wool fibres became markedly smoother as the quality (handling) of the sample increased. Mohair which is normally more silky in handling and more glossy than Merino wool, had the smoothest surface structure.

SE Micrographs of the typical tiled-roof structure of fibres from good quality Merino wool, Dohne merino wool, S.A. Mutton Merino wool and mohair, respectively, are given in Fig. 4. As the natural quality (handling) of the respective fibres increased in the order: S.A. Mutton Merino, Dohnemerino, Merino and mohair, there was a marked increase in the smoothness of the micro surface structure of the fibres. From the literature (Table 2) it appears, however, that the oil content of these fibres increased in the opposite direction.

Discussion

No significant relationship was found between the 5 standardized categories of subjectively evaluated fatty appearance of the flue of ostrich plumes as used in practice and the true fat content. Judged by their coefficient of variance, the variance in visually appraised fatty appearance was almost twice that of the real fat content. Therefore, it is difficult to explain the differences in fatty appearance and consequently flue quality, in terms of differences in fat content. This result may be caused by the inability to evaluate visual fatty appearance very accurately.

Venter (1966, 1967) could not establish a significant relationship between the visually evaluated and true oil content of Merino wool as was the case with the flue of ostrich plumes in the present study. Nevertheless, Venter (1966) found a highly significant positive relationship ($r = 0{,}298$; $P \leqslant 0{,}01$) between subjectively evaluated oil content and the quality of Merino wool. Furthermore, the same author found the true oil content of Merino wool to have a low but negative relationship with wool quality.

Venter (1967) was of opinion that the opposing relationships he found between visually appraised oil content, quality and the true percentage of oil, indicate an

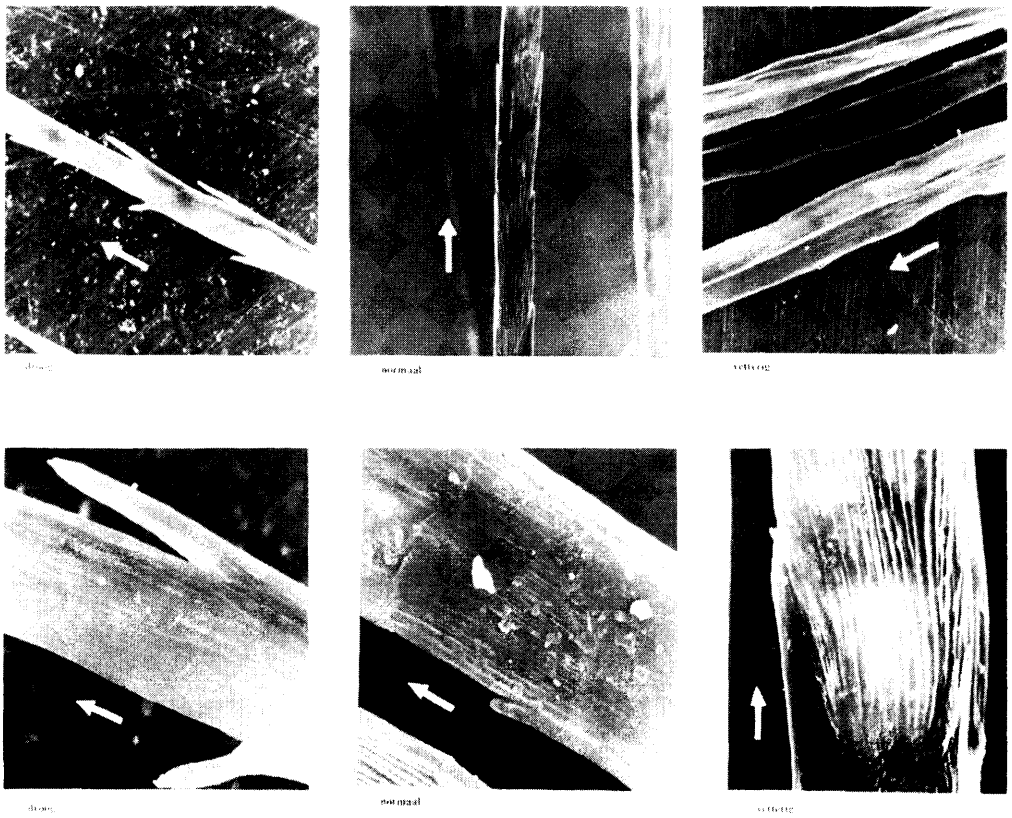

Fig. 2 *SE Micrographs of flue fibres to illustrate the cuticular structure of dry, normal and greasy flue (400 x and 1800 x).*

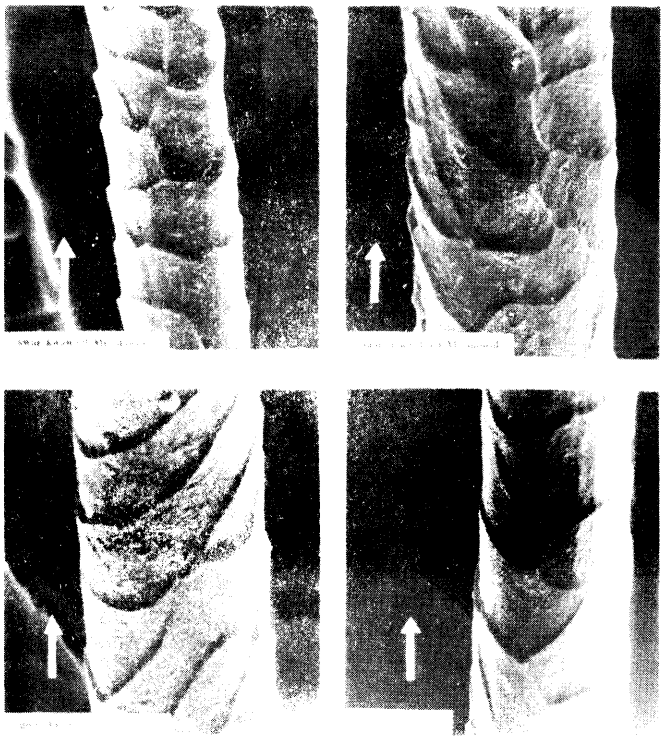

Fig. 3 *SE Micrographs of poor, medium and good quality fibres of Merino wool, as well as of a fibre of mohair (1800x).*

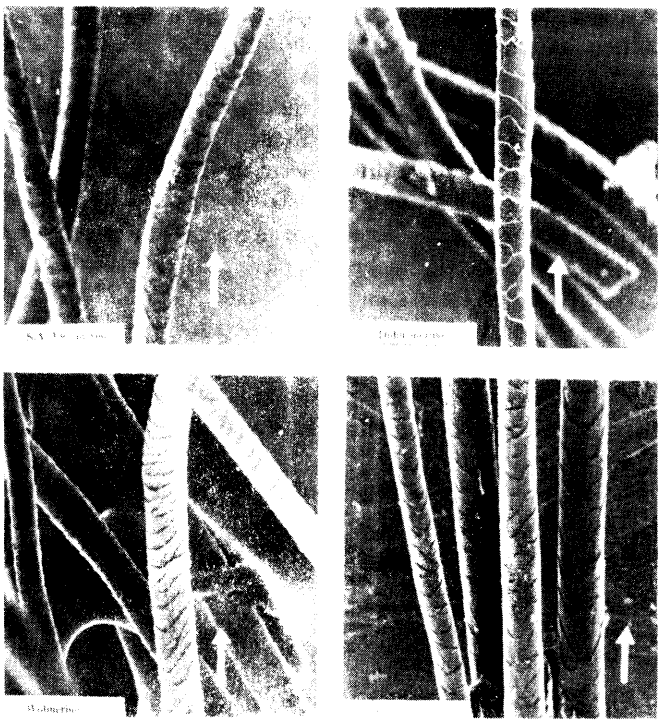

Fig. 4 *SE Micrographs of the fibres of S.A. Mutton Merino, Dohne Merino and Merino wool as well as fibres of mohair (400x).*

Table 2

The percentage of flue, hair, and wool fat in ostrich feathers, mohair and sheep wool respectively

Ostrich plumes[1]	Mohair[2]	S.A. Mutton Merino wool[3]	Merino wool[4]
1,01	3,10	12,03	15,39

[1]Swart, 1979
[2]Venter, 1981
[3]Vosloo, 1963
[4]Vosloo, 1966

inaccuracy in subjectively evaluating the oil content of the wool. However, the results of Venter (1966, 1967) and those of the present study seem to indicate that what was thought to be a subjective evaluation of oil (wool) or fat (plumes) content was in actual fact an evaluation of some other characteristic which has a strong relationship with quality.

The present investigation of the micro structure of the barbules of ostrich plumes provides sufficient evidence that the smoothness of the cuticular surface structure has a definite influence on traits such as fatty appearance, lustre, softness, elasticity and consequently on flue quality. From the comparisons made with SE Micrographs of wool and mohair it appears that the cuticular-surface theory may also be applicable to quality differences in Merino wool and to quality differences between the wools of different sheep breeds and mohair.

The factors causing differences in the cuticular surface structure of plume, hair and wool fibres within breeds and species are still unknown. Further research is necessary therefore, especially as far as a possible relationship of the micro surface structure with the weathering of the fibre is concerned. The economic importance of the latter aspect is obvious.

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