VARIATION IN FIBRE CHARACTERISTICS OF AWASSI SHEEP

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INTRODUCTION

The first major step in the establishment of a fat-tail sheep breeding industry in Australia was completed in January 1987 when 40 Awassi lambs arrived in Kununurra (Lightfoot 1987). The arrival ended five years of planning which included breed selection, embryo collection in Cyprus, embryo transfer on Cocus Island and finally transportation to Kununurra. In July of 1990, the flock which had increased to 280, was transported to new quarantine facilities at the Wongan Hills Research Station, north of Perth.

The project was commenced with the long term objective of establishing a fat-tail sheep breeding industry in Australia with the aim of supplying; i) premium quality ram lambs for live export, ii) young breeding rams for live export, iii) premium quality fresh and chilled carcases to be airfreighted to the Middle East, iv) fat-tail stock for the local sheep dairy industry and v) carpet wool for the local carpet manufacturing industry (Lightfoot 1987). Potential gains from a fat-tail industry in Australia have been estimated at $20-$100M annually (Anon 1989).

Initially, the Awassi, the Najdi and the Barbary breeds of fat-tail sheep were considered as having high potential for commercialisation within Australia. The Western Australian Department of Agriculture selected Cyprus as the best source of Awassi genetic material (Lightfoot 1987). Embryos from the highly selected nucleus Awassi flock of the Cyprus Ministry of Agriculture were collected. This flock was based on the Ein Harod Ihud and Sadeh Nahum studs from Israel. These studs had no "outside" sheep introductions for more than 10 years, full pedigree control and comprehensive production documentation (Lightfoot 1987).

The Awassi is the most numerous and widespread type of sheep in Southwest Asia, particularly in Iraq, Lebanon, Jordan, Israel, Turkey and Cyprus (Epstein 1977). The Awassi is a triple purpose breed being farmed for its milk, meat and wool production. Intense selection for milk production has resulted in the existence of two types of Awassi. The "improved" Awassi has undergone intense selection for milk production and is a larger, heavier animal than the "unimproved" Awassi. The weight range for the unimproved Awassi is 60 - 90kg for males and 30-50kg for females and the range for the improved variety is 60-70kg for ewes and upwards of 100kg for rams (Epstein 1982). Lactation yields of 160-180kg have been recorded in Syria and 100-185kg in Turkey. In Israel, where intensive selection has been practiced for 40-50 years, average yields in many flocks exceeds 400kg (Epstein 1977).

In the Middle East religious preferences result in locals preferring sheep meat above all other types of meat. In particular Arab consumers prefer fresh meat from young lean rams, particularly of the indigenous fat-tail breeds. The fat tail of the Awassi acts as a store of reserve material which is not additional to the normal accumulation of fat in the body (Epstein 1985). This results in a leaner carcase.Thus, leaving Awassi male lambs entire and slaughtering at or before 6 months of age satisfies the Arab preferences. The average dressed weight of ram lambs is generally around 50% of liveweight, with the hindquarters (including the fat-tail) accounting for more than 50% of the carcase. The fat-tail can account for up to 5.3% of liveweight in ewes and 6.2% in rams (Epstein 1982).

The Awassi is a long-wool sheep with an open lofty and moderately lustrous fleece of carpet wool with distinct wide crimps. The fleece consists of an outer coat, undercoat and kemp and is characterized by brown to black colouration on the head, neck and hocks with white body wool. The colouring of the Awassi is seen as a problem by Australian wool industry organizations because of potential contamination of the Merino wool clip with coloured fibres. This study is aimed at understanding the "sources of contamination" issue by simulating situations during which fibre contamination can occur. These situation include: i) mating an Awassi ram to a Merino ewe, ii) crossbred lambs suckling on Merino ewes and iii) paddock experiments running Awassis and Merinos together and in adjacent paddocks. Aspects of fleece biology relevant to the contamination issue will also be investigated. These include follicle and fleece development of pure Awassi animals and Awassi-Merino cross animals, timing of fibre shedding and microscopic fibre structure.

The aim of this introductory study was to identify sources of variation in the fibre characteristics of pure Awassi animals. The results from this study are required to make decisions about future experimental design.

MATERIALS AND METHODS

Samples from five two-year old pure Awassi rams from the initial importation were available for measurement. These animals had been housed in an open-sided shed at the Kununurra quarantine facility. The samples were taken from the shoulder, midside and hip of each animal and represented 5 months wool growth. For measurement, two subsamples of approximately 0.5g were taken from each sample site. The characteristics measured were the fibre type ratio, fibre length, the fibre diameter,the number of coloured fibres in each sample, and the percentage of medullated fibres in each sample.

The samples were sorted into fibre types on the basis of a length distribution. Each sample was drawn out onto black velvet and the resulting length distribution classes were visually classified into either hair, heterotype, wool or kemp fibre groups. The sorted samples were allowed to condition in standard atmosphere conditions for 4 hours and were weighed to 0.001g. The fibre type ratio was determined by weight and not by count as some of the fibre types, especially the kemp and hair, were extremely brittle. This could result in a large number of small broken pieces. Unfortunately, due to the coarseness of the Awassi fleece and the large variability in length and diameter, none of the 'automatic' methods of wool measurement work on Awassi wool. For this reason the length of the fibres were measured one by one on a ruler. The fibre diameter, medullation percentage and amount of coloured fibres were determined via a projection microscope.

The significance of sources of variation in fibre diameter and length was identified by least squares analysis of variance. The model included effects of animal , site, subsample, fibre type and appropriate first order interactions.

RESULTS

An analysis of variance performed on the fibre diameter data indicated that there was a difference ($p<0.05$) in average fibre diameter between the shoulder, midside and hip of the animals (Table 1). The shoulder site was significantly different from the hip but not from the midside position. Large differences in fibre diameter ($p<0.001$) occurred between animals and between fibre types, all of which were significantly different from each other. Fibre length was different between sampling sites and between fibre types ($p<0.0001$). Each sampling site was significantly different from the others in fibre length as was each fibre type.

Table 1 Variation in average fibre diameter and fibre length due to sampling position and fibre type *

Source of Variation	Fibre diameter (μm) Mean	Standard error of mean	Coefficient of variation %	Fibre length (mm) Mean	Standard error of mean	Coefficient of variation %
Site						
Shoulder	55.20^{ab}	1.29	92.26	73.4^{a}	0.30	17.84
Midside	53.95^{a}	1.33	94.92	78.6^{b}	0.29	16.37
Hip	56.51^{b}	1.43	94.03	71.7^{c}	0.30	18.07
Fibre type						
Hair	60.38^{a}	0.87	54.75	101.6^{a}	0.33	12.58
Heterotype	48.28^{b}	0.96	62.71	82.0^{b}	0.34	15.77
Wool	31.84^{c}	0.87	105.04	58.9^{c}	0.33	21.70
Kemp	80.39^{d}	1.15	31.34	55.6^{d}	0.37	23.94

* For each trait, different superscripts between rows within effects denote significant differences ($p<0.05$).

DISCUSSION

The variation in fibre diameter of the fleece was largely explained by the variation in both the proportions of the fibre types present at each sampling site and the variation in fibre diameter of each of the fibre types. Sampling sites which contain high proportions of the coarser hair and kemp fibres will have a greater average fibre diameter than sampling sites with lower proportions of these two fibre types. Similarly, sampling sites which contain high proportions of the finer heterotype and wool fibres, will have a lower average fibre diameter than sampling sites with lower proportions of these two fibre types. The variation in fibre length throughout the fleece can be explained in the same way. Each of the four fibre types have characteristic length ranges, with the hair fibres being the longest, followed by heterotype, wool, and kemp fibres. Therefore, those sampling sites with higher proportions of hair and heterotype fibres will be longer than those sampling sites with lower proportions of these fibre types.

The midside position of the Merino has been shown to be representative of the whole fleece. This study indicates that this is not the case with the Awassi due to the large variation in fibre diameter and fibre length between the sampling sites. If this proves to be the case with other fleece characteristics, such as medullation percentage and percentage of coloured fibres, then it can be concluded that none of the sampling sites used in this study provide a representative sample of the fleece. Therefore, a thorough study of topographical variation of the fleece of pure Awassi and Merino-cross animals needs to be undertaken to identify trends or patterns in the fleece characteristics. This will enable a representative site or combination of sites to be determined. In conjunction with this, a study of seasonal fibre shedding and growth rates will be undertaken. The seasonal variation in the fleece is important for both the timing of contamination experiments and for determining high risk periods for fibre contamination in practical farming situations.

Future work on the fleece characteristics of the Awassi will include a study of microscopic characteristics of each of the fibre type groups. These characteristics will include the medullation characteristics of the fibres, the appearance of the root and tip potions of the fibres, the pigmentation characteristics, the cross-sectional characteristics of the fibres and the scale pattern of the fibres. The results of this study will verify the visual classification of the fibre types upon which most of the fleece measurements are based.

A study of follicle and fleece development from birth to maturity of pure Awassi and crossbred lambs, generated from a backcrossing programme with the Merino, will aid in determining the suitability of the fleece of these crosses for the manufacture of carpets. Together with the availability of full pedigrees of each animal in the flock, this study will enable the mode of inheritance of pigmented and kemp fibres to be determined.

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