STUDY OF PHYSICO-CHEMICAL ATTRIBUTES OF MOHAIR/HAIR FROM ANGORA, LOCAL AND THEIR CROSSBRED GOATS

By

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B. Sc. (Agri.)

A thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH

(AGRICULTURAL UNIVERSITY)

RAHURI, District : Ahmednagar, (Maharashtra State)

in partial fulfilment of the requirements for the degree of

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in

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Post-Graduate School, Rahuri

June, 1976

Inspiringly Dedicated to
the Development of the
Angora Goat Industry in
Maharashtra

THE ANGORA GOAT

PLATE - I

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C E R T I F I C A T E

This is to certify that the thesis entitled, "Study of Physico-Chemical Attributes of Mohair/Hair From Angora, Local and Their Crossbred Goats", submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, District : Ahmednagar, in partial fulfilment of the requirements for the degree of Master of Science (Agriculture) in Animal Science, embodies the results of a piece of bona fide research work carried out by Shri Ramdas Shankarrao Dhumal under my guidance and supervision and no part of this thesis has been submitted for any other degree or publication.

Shri Ramdas Shankarrao Dhumal has completed necessary course work for the degree and passed the preliminary examinations.

I.G. Chavan

(I.G. Chavan)
Research Guide

Rahuri,
Dated : 5-7-1976

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Dated : 5/7/76.

(S.S. Dhurkal)

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CHAPTER I

I N T R O D U C T I O N

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I N T R O D U C T I O N

Goats with their multifaceted utility (meat, milk, mohair, skin, guts and manure) play an important role in the rural economy of the state and the country, especially, in semi-arid regions with marginal and sub-marginal land, unfit for agricultural production, even by using more sophisticated methodology for water and soil utilisation. This species by virtue of its hardiness survived in the famine prone areas of the state in most adverse conditions. This is evident from the facts that the goat number has been increased as revealed from the census figures for 1951, 1956, 1961, 1966 and 1972 that is 47.2, 55.4, 60.8, 67.0 and 70.0 million goats, respectively. Surprisingly enough, these increases have not resulted from any deliberate breeding policy, thereby giving a clear indication that a large number of people are finding goats to be profitable animals. Though habitually destructive in nature, there is something inherently favourable in the eco-system in the major part of the country that encourages goat keeping.

The goat for milk is essentially a subsistence enterprise, for the rural poor and middle class populace which consumes only a meagre quantity of milk from other sources. With the introduction of the 20 point economic programme which mainly aims at improving the conditions of poorer classes, the chances for establishing goats for milk, meat, skin and manure are increased. Inspite of the fact that until today, goats were

referred to as destructive and worthless animals, the present emergency has made them a trumpcard by which to set the economic standards of the landless and marginal farmers on sound economic footing.

Religious prejudices against the consumption of beef and pork, have spurred the importance of goat as a major source of meat. Goat meat contributes about 78 per cent and 35.1 per cent to the total meat production in Maharashtra and in the country, respectively (1972 census). Moreover, poultry and swine industries which compete with human population in their food requirements for cereals, are easily outdone by sheep and goats. The latter two being ruminants, are capable of utilizing the non-protein nitrogenous substances as a source of protein and thus produce meat at lower cost. They also utilise agricultural byproducts and industrial wastes more efficiently than the single stomached animals.

The goats have a good potential for producing animal fibre such as Mohair and Pashmina to meet the internal as well as export requirements. As such, the schemes to develop goat for milk, mutton and fibre are being executed by giving special consideration to the geo-agro-climatic conditions.

Inspite of the goats' multifaceted utility, there are prejudices condemning it to be a destructive deforester agent. These prejudices are, however, born from the scavenger type pattern of goat rearing in India and not from any fault of the goat itself.

Considering the changing pattern of agriculture with

increase in irrigation potential, it is expected in the near future that goat keeping will have to be brought on complete or partial stall feeding patterns, thereby solving this problem automatically. There is no doubt that the range type of goat keeping in Maharashtra is likely to continue unabated. Hence, due to the fact that the vast semi-arid regions, may not have high yielding crop production potentiality as there is a limited scope. A systematic plantation of trees, bushes, creepers and perennial legumes, if undertaken in these areas, will serve the purpose of raising sheep and goat very profitably and will also help the use of land resources more efficiently.

With the new outlook and important role and scope of goats in mix-farming economy in Maharashtra, it is very essential to substantiate the meagre income of farmers by rearing goats which will supply income through meat, milk, hide and manure. To add to this income, if the rough hair coat of local goat is transformed into Mohair by crossing local goats with exotic breeds like Angora, the income of the farmers will be further increased.

The Angora goat, an inhabitant of Turkey and Asia minor, produces an extremely fine coat of Mohair which grows in white lustrous locks of about 8 to 10 cm length, on its fleece, the most desirable type curling in ringlets whilst others grow in flat waves.

Mohair and large quantities of related animal fibres and fur fibres are used in conjunction with wool and artificial

fibres, to produce special effects and give additional beauty, colour, softness or luster and strength in the manufacture of special type of cloth. These fibres are called specialty hair fibres and are classified as wool under the American wool act. Amongst these specialty hair fibres, Mohair with its ability to blend and take dye excellently and maintaining its own luster, is one of the most important fibres. It also fetches very high price ranging from Rs. 60/- to 100/- per kg.

Though, the breeding of the Angora for Mohair upto early parts of the 19th century was restricted to Turkey, increased demands and relatively high prices, spurred sharp increases in Mohair production in other countries. South Africa and United States (Texas), by adopting vigorous crossbreeding and selection programmes, could establish their own Angora breed which is even heavier than the original Angoras from Turkey. These animals produce 4-5 kg Mohair per goat per year (Devendra and Burns, 1970). The above countries along with Turkey account for the major production and export of Mohair. Recently, the U.S.S.R. has also developed her own Mohair breed called 'Soviet Mohair', which was recognised in 1962.

Crossbreeding programmes with Angora have also prospered with relative degrees of success in Madagascar (Guillermo, 1949), Fiji (Devendra and Burns, 1970), India (Pant and Kapri, 1968 and Pant, 1969) and Pakistan (Ghani and Ishaq, 1965). In recent years Australia with its large grazing lands, has ventured into Angora goat rearing for Mohair production. The Australian Mohair Company Private Limited, thus

formed, has opted for Angora goat rearing on a 34,000 acre property in New South Wales to 35,000 Merino sheep, that were originally maintained on the same farm (A.B.M. 1971, Vol. 39, Pt 617 News & Notes).

The lack of co-ordination between producers of Mohair and fabric manufacturers, and the absence of specific quality marks to testify its quality enhanced further by the competitive rates of artificial fibres, had endangered the prospects of the Mohair industry. However, this catastrophe which awaited the fate of the Mohair industry has been effectively tackled with the formation of "The New Mohair Body". This body essentially constitutes the growers of Mohair and fabric manufacturers who have joined forces to promote the use of Mohair in all its various forms - from fleece to finished fabric, on an international basis (Wools and Woolens 1974 Vol. XI No. 12 page 9 News).

In India, the Angora was tried in Himachal Pradesh and Pune for Mohair production. All India Co-ordinated Research Project on Goat Breeding for Mohair Production was established at the Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri, in April, 1972. The object of the project is to evolve a new strain of goat, by crossing local goats with Angora bucks. The genetic potential of the new strain to be developed is, to have an animal which will weigh about 50 kg and yield about 2 kg of Mohair per year. The results so far obtained from the cross-breeding of Angoras with local goats at this centre are very promising.

Short gestation periods along with twinning habits of goats are expected to enhance the chances of speedy increase in population of Mohair producing goats.

The quality of the Mohair, like that of wool, depends mainly on its physical attributes viz., fineness, staple length, medullation and tensile strength. Fineness of fibre in conjunction with the other physical attributes largely determines the drape, handle feel and thus the quality of resultant material or fabric manufactured from it.

The raw Mohair also consists of impurities of animal origin viz., grease and suint collectively called as yolk, and external origin viz., moisture, vegetable matter and dirt, which largely alter the clean yields. These impurities are in fact an economic loss to fabric manufacturers. There does, however, exist the possibility of utilising these impurities as useful byproducts, especially, the grease which has varied uses in cosmetics, water proofing materials, printers ink, polishes and lubricants. Though, due to erratic fluctuations in the demands of wool grease, the future of this industry seems rather uncertain.

It is, therefore, proposed to study the physico-chemical attributes of Mohair/hair from the Angora, local and crossbred (50 %) goats for fibre density, staple length, diameter, medullation, tensile strength, grease, moisture, suint, nitrogen and sulphur contents. This will be a base

level study which will be of a great help in formulating the future breeding programme for Mohair production in the country. The data also will be useful to the Mohair industry and the research workers to plan for future line of action.

CHAPTER II

REVIEW OF LITERATURE

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The quality of fine lustrous Mohair obtained from Angora goat is essentially determined by its physical attributes. The pricing, trend, however, not only depends on the physical qualities but also on the clean yield. The latter varies with per cent of impurities in it. They vary considerably with animals and environment and are inevitably inherent with raw Mohair. Hence, the actual amount of fabric produced from raw Mohair will be less due to presence of various impurities.

The Mohair like the other epidermal tissues of animal origin viz., wool, hooves, hair and feathers is essentially made up of insoluble keratins. It contains various amino acids of which cystine and methionine contain sulphur and are principally responsible for promoting wool growth.

The literature on physico-chemical attributes of Mohair is mainly of foreign origin, owing to its restricted cultivation in South Africa, U.S.A. (Texas), U.S.S.R. and Turkey. The industry, being introduced newly in India, there is but little literature on the physico-chemical attributes of Mohair in the country. However, an attempt has been made to review the available literature from India and abroad in the following pages.

PHYSICAL ATTRIBUTES

Okamer (1945) investigated the morphological and physical qualities of Mohair from the Angora goat. He reported

that the wool of the Angora goat, unlike the wool from sheep, increased in fineness and decreased in length from the shoulder to the hind quarters. It became coarser, shorter and less uniform with age, particularly between the first and second years. He also reported that the tensile strength and elasticity of the Mohair increased with age and fibre thickness, being significantly greater than that of sheep's wool.

Levi (1946) studied the data from various institutes and stations undertaking the crossing of coarse wooled goats of the Caucasus and Central Asia, with Angora goats. He reported the comparative Mohair qualities of the Angora, local and their resulting crossbred generations as follows. In case of pure Angora the wool clip varied from 5 to 5.5 kg in males and 3.5 to 4 kg in females. Clean wool yield varied from 75 to 80 per cent, staple length 21 to 22 cm, wool quality, 44's to 46's and coarse hair 0.6 per cent of the weight of the sample. In indigenous goats from various stations, the wool clip varied from 0.35 kg in Dagestan to 0.5-0.6 kg in Uzbekistan and the Turkman Republics, non-medullated fibres representing 10 per cent (35 g) of the wool in the North Caucasus and 25-30 per cent (120-150 g) in Uzbekistan and Kirgizia. Fineness of non-medullated and medullated fibres in all adult goats was 15-17 M and 63-70 M, respectively. In the first generation crosses of Angora and coarse wooled indigenous goats, the wool clip was increased by 20-40 per cent. The wool quality as regards to staple length, fineness and proportion of medullated and non-medullated fibres was improved over the

indigenous goats. The former two characters attained a better uniformity than local goats. About 85 to 90 per cent of the crosses had white wool whereas majority of the indigenous animals were black. The non-medullated fibres were 1.5 to 2 times longer and the medullated fibres 1.2 to 2 times shorter in the crosses than in case of the indigenous goats. Further, he stated that the wool quality and lustre improved in second generation animals which had an average wool clip from 1.0 to 1.2 kg. Third generation animals examined only in Uzbekistan had wool quality which did not appreciably differ from pure Angoras. The average wool clip was 1.2 to 1.5 kg.

Batu and Okaner (1947) carried out investigations on the wool from 30 yearling Angora goats and reported following average figures.

1 Fineness - 31.74 ± 0.4114 μ

2 Length - 202.6 mm

3 Tensile strength - 17.84 ± 0.460 g/mm^2

4 Elasticity (lengthening - 49.47 per cent

Guillermo (1949) reported that the results of crossing the local Nubian and Angora goats were satisfactory. The fourth generation of the upgraded animals attained an appearance of pure bred Angoras and producing a fleece of white Mohair having a similar length as that of the original breeding stock, imported from South Africa. He further observed that the fleece qualities were transmitted to their descendants.

Zelenskii (1950) reported the work on improving the

fleece qualities in goats. Under this study, he noticed that the indigenous goats of Tadzhikistan were having strong constitution and were on pasture throughout the year. They produced 0.5 to 0.6 kg wool and 20 to 30 kg milk annually and their live weight was about 40 kg. The Angora goats with live weight 32-35 kg and fleece weight of 3-3.5 kg with long white lustrous Mohair of 46's-44's quality were used to improve the fleece quality and production of indigenous goats. A new strain of goat was produced by crossing indigenous breed with Angora goats for 2 generations, then mating interse, crossbred goats with a constitution equal to that of the indigenous breed and with fleece qualities equal to those of the Angoras. At 5-6 years of age, the crosses had live weight of 43-45 kg for females and 65-70 kg for males and a fleece weight of 1.5 to 1.8 kg in females and 2.5-3 kg in males. The Mohair was homogeneous and was almost of the quality of the Angoras. He, however, cautioned that the grading up did not prove satisfactory when the animals with weak constitution were used in breeding programme.

Siskin (1950) reported the crossing between the hardy Karangan goats having heterogenous, coarse, highly medullated mostly black fibred fleece, with the Angora having long, white, silky, fine homogeneous fleece weighing, 1.8 to 2.4 kg in average animals (stud animals yield 3 to 4.5 kg). The first generation was stronger than the second but produced fleece with hardly any improvement over the local animals. The second generation produced fairly homogeneous fine, silky, white and

fairly long fleece almost of the quality of the 3rd, 4th and pure Angora generation. He, however, concluded that the good qualities of the indigenous breeds were better presented by interse breeding of 2nd generation animals than by grading up.

Levi (1954) described a breed group of goat having fleece weight 1.7 to 2.2 kg in females and 3.5 to 3.8 kg in males, the fibres being strong, uniform, of a good lustre and consisting of 1 per cent more kemp than that of the Angora. The group was developed from F_2's obtained by crossing indigenous coarse haired goats, from Uzbekisten, Kazakh, Tadzhik and Turkmen Republics, with the Angora. The F_1 of these crosses was having a very heterogenous fleece with a negligible quantity of better quality fibres.

Rahimov (1957) reported the fleece characters of crosses between indigenous goat and Angora goats, maintained at the collective farm Kossovol in the Samarkand Province. The relative increase of fleece yield in the 1st, 2nd and 3rd generations over the local breeds was 32.7 per cent, 52.2 to 100 per cent, respectively. The third generation animals yielded on an average 1.4 kg (better animals 2.5 to 2.8 kg) of semi-fine wool. The non-medullated and heterotype fibres had increased from 26.4 in indigenous to 96.4 in 3rd generation; percentage kemp decreased from 73.6 to 39, respectively. Wool density was increased and the non-medullated and heterotype fibres increased in length and decreased in fineness.

Van Wyk et al. (1958), in study of the summer and winter Mohair clips from different regions of South Africa,

observed a marked change in diameter of the Mohair fibres within the first 2 years of the goat life. The changes in fibre diameter as reported by them, are as shown in the table below.

Age of animal (year)	Grades	Jansenville fibre (M)	Somerset east fibre (M)	Cradock fibre (M)
1½ year	Summer kid	26.2	27.9	26.9
1 year	Winter kid	30.6	32.2	31.2
1½ year	Young Goats	32.8	35.0	31.8
2 years	Summer firsts	35.3	38.9	41.1
2½ years	Winter hair	35.8	39.1	39.5

They further reported a rather small variation in the fineness (not more than 2-3 microns) within the whole length of the hair. The adult goats showing no difference between summer and winter clips.

Venter (1959) studied the fibre length, fibre diameter and per cent kemp at 10 different points on the body of each of 10 mature Angora goats and found significant differences between goats and between regions. A further study of fibre diameter within Mohair grades based mainly on the age of the goat revealed considerable overlapping between grades.

Bhatia (1960) reviewed the work done on sheep and goat breeding and wool technology at various places in India during

the year 1956-57 and 1957-58. He reported the different attributes of Mohair obtained from different grades of Angora goat kids maintained at Poona, as summarised in table given below.

Strains of kids	Percentage of fine undercoat	Percentage of coarse outer coat	Average fibre diameter in (microns	Mohair density per sq cm
1/2 bred Angora (6)	-	100.00	36.40	200
3/4th bred Angora (2)	89.00	11.00	23.70	281
7/8th bred Angora (4)	90.90	9.10	23.44	1348
15/16th bred Angora (1)	91.00	9.00	21.52	2673

He further reported no appreciable difference in the breaking or tensile strength of Deccani, Entarmedi and 1/2 bred Kambouillet. There was negligible correlation between breaking strength and fleece density and breaking strength and percentage of medullated fibres in the Deccani breed. However, there existed a positive significant association between the breaking strength and the fibre diameter.

Gribovskii and Zanderkin (1963) observed the results of upgrading of local Kashak goats to Angoras for 4 generations and found that the fleece weight and fibre length increased in succeeding generations. The fibres of the third generation crosses were finer than the pure bred Angoras and Kashaks and

69 per cent of them had uniform fleeces without medullated fibres. The fertility and body weight were reduced and the constitution was weakended in the fourth generation animals.

Kosove (1963) presented data on the physical characters of the Mohair of a new breed of Mohair goat (Soviet Mohair breed). The Mohair of the males was of 44's quality and that of females was of 46's while the fibre length was 21.4 and 23.0 cm, respectively. The fibres were stronger than those of fine woaled sheep and 79.1 per cent clean Mohair was obtained.

Ustunlar et al. (1963) made a comparative study of specialty hair fibres in Turkish hairy goat, Cashmere, Ilama, Guanco and Vicuna wools. 293 samples of Cashmere like wool were examined. Wool production per goat was 40-50 gm. The mean fibre diameter was 17.63 microns as against 15.39, 14.73 and 15.50 microns for Cashmere samples from India, Pakistan and Iran, respectively. Llama, Vicuna and Guanco wool from South America had mean fibre diameter of 19.69, 13.44, 13.83 microns, respectively. Kemp and medullated fibres were absent from Cashmere and Turkish goat wool. Llama, Vicuna and Guanco wool had 1.2, 1.1 and 1.97 per cent kemp fibres and 13.5, 3.8 and 5.4 per cent of medullated fibres, respectively.

Von Borgen (1963) obtained the results from a study made on Texas and Turkish Mohair on medullated fibre per cent as summarised in the table below:

Samples	Average microns	Form	No.of fibres	Medullated fibres	Kemp
Texas Kid Mohair	24	Roving	1000	7	-
Texas Kid Mohair	29	Carded	1000	16	2
Turkish Mohair	9 inch staple	Root part	240	8	6
		Middle part	120	2	-
		Tip	120	-	-

He concluded that the number of medullated fibres in well bred Mohair is normally below 1 per cent. While commenting on the forms of medullae, he stated that as in wool, there are 3 forms of medullae found in Mohair namely, unbroken, interrupted and fragmental types, the unbroken type being most common.

Von Bergen (1963) reported the average fineness and dispersion range existing in Texas Mohair staples as illustrated in the following table.

Diameter in microns	No.1 Kid	Crown Goats			
		1	2	3	4
10.0-20	20	5	1	-	-
20.1-30	71	37	20	2	-
30.1-40	9	56	35	31	5
40.1-50	-	2	25	41	21
50.1-60	-	-	15	10	18
60.1-70	-	-	4	6	30
70.1-80	-	-	-	2	20
80.1-90	-	-	-	-	6
Average	24	30.6	30.8	45	61
Dispersion	10-35	15-50	10-70	25-80	30-90

Von Bergen (1963) reported that the length of the fibre

of kids ranged from 4 to 6 inches for half year's growth and 8-12 inches for a full year's growth. He concluded that due to the difference in age of kids at shearing time, the fleeces are not as uniform in length as those of the grown-up goats.

Utkanlar et al. (1964), in a study of twice yearly shearing of Angora goats, concluded that the Mohair production and staple length was greater and Mohair fibres were finer in 30 females sheared twice yearly (April and October) than in 30 control females sheared in April only, control group having higher average live weight, kid production and production of medullated fibres.

Van Lonsburg (1964) reported that the fibre diameters in Mohair samples from 7 aborting females was significantly less than that in samples from normal females at a similar stage of gestation. Fleece weight increased with increased weight of foetus at abortion. He suggested that the selection for high quality (fine) fleece might have lead to abortions by selecting also for adrenal hyper function.

Aljkov (1965) reported the fleece characteristics of the Altai mountain goats of the Gorno Altai Republic as average fineness 16 to 20 microns, length 8 to 10 cm and the average yield of the Mohair 0.6 to 0.9 kg in males and 0.45 to 0.6 kg in females. The fleece being of dark to dark gray colour and consisting of 60 to 70 per cent Mohair.

Ghani and Ishaq (1965) reported the results on Angora breeding in West Pakistan. The Angora goats which were imported from Texas, U.S.A. thrived well during the first year, although

some heat stress and loss of weights were observed. Analysis of samples of six months growth of Mohair from goats (shoulder and hip) yielded the following results for males and females, respectively. Staple length 4.3 and 4.2 inches, fibre diameter 39.3 and 31.4 microns, true fibre 89.6 and 95.2 per cent, heterotype fibre 7.3 and 2.6 per cent and medullated fibre 3.12 and 1.97 per cent.

Khera (1965) reviewed the research work done on sheep and goat breeding and wool technology in various parts of India during the years 1958-60. He reported the data on fleece qualities of the different strains of Angora goats maintained at Poona as given in the table below.

Grade	Fibre density per Sq cm	Fibre diameter (microns)	Staple length (cm.)	Percentage of Inner coat	Percentage of Outer coat	Year
1/2 Breed Angora	894	25.14	5.7	71.00	28.82	1958-59
1/2 Breed Angora	1168	25.60	-	64.57	35.4	1959-60
3/4 Breed Angora	950	28.90	6.3	77.00	2.86	1958-59
3/4 Breed Angora	6411	19.4	-	94.62	5.38	1959-60

Margolena (1966) concluded from a study of 11 Angora doe skin biopsies (and the corresponding lock samples) from Texas and 9 from South Africa that the skins developing ringlet type locks had the lowest incidence of medullation.

In South African samples (which were mostly of the ringlet type) medullation tended to be reduced or vestigial and was always constricted to the central primary follicles, resulting in a fine fleece, usually containing 1½ per cent or less medullated fibres and in no case more than 3½ per cent medullated fibres. The general trend in maturing fleece was an uncurling of the fleece.

Giulliani (1967) studied some physical characters of Mohair samples from the first annual shearing of Angora goats reared in Madagascar. Measurements determined on 100 fibres from each of 2 samples were respectively as follows. Fibre length - 12.4 and 14.3 cm (Standard deviation 2.1 and 2.8). Fibre fineness - 40.2 and 44.6 microns, breaking strength 20.4 to 26.4 gm (S.D. = 5.2 - 9.6), (S.D. = 4.9 and 7.2), fibre weight - 14.44 and 16.75 m grams per 10 microns, percentage of medullated fibres 12 and 16.

Gribovskii and Kosova (1967), in a study of the inheritance of economical traits in breeding of the Soviet Mohair Goat, reported the fleece characters of the local improved goat in semi-Palatinsk region. The yield is reported as 0.8 to 0.9 kg and staple length 16-17 cm. These goats were crossed with Angoras imported from U.S.A. and then backcrossed with Angoras for 3 generations. Mohair weights in F_1 and in 3 successive backcross generations were 22, 88, 144 and 155 per cent, respectively. In case of the local goats, Mohair quality in the first backcross generation was not inferior to that of Angora while the crossbreds were having white lustrous Mohair.

He also reported the fleece characters of Soviet Mohair breed which was developed from intense crossing of goats of first and second backcross generations, as Mohair weight 1.5-2 kg in females and 3.5 to 3.8 kg in stud males, Mohair length 20 cm, Mohair quality 44's and 56's, respectively.

Imeryuz and Sincer (1967) studied the effect of twice yearly shearing on Mohair quality and production in 220 Angora does aged 6 months, 1½, 2½ and 3½ years at the start of the experiment. Does shorn twice produced 66, 306, 488 and 350 gms, respectively, more Mohair than those shorn once. Summer fleece having higher greasy and clean weight and longer staple than that of the winter fleece for the one year group. Summer fleeces at all ages had higher yields and more kempy fibres than that of the winter fleeces. Twice yearly shearing had no effect on fibre diameter and breaking strength.

Cerensonon (1967) reported fleece characters of the Mongolian goats, majority being from the desert, semi-desert and mountains of the Gobi area. Mohair constituted 39.8 to 45.6 per cent of the fleece of Mongolian goat, fibre length 4.8 to 5.1 cms, fibre diameter 10 to 15 microns. Females, castrates and yearlings yielded 0.19 to 0.23 kg, 0.21 to 0.36 kg and 0.17 to 0.22 kg Mohair, respectively. He further reported that 65.4 to 71.5 per cent of the fleece of crossbreds (Don x Mongolian goat) consisted of Mohair.

Cozzi (1968) examined 2 Mohair samples from Turkey and 3, from South Africa. The Turkish samples had average fibre length 19.3 cm (C.V. 33.2 per cent), average fineness 30.9

microns (C.V. 19.7 per cent) and resistance to traction 14.4 gm (C.V. 44.4 per cent). The South African samples had fibre length 13.6 cm (C.V. 27.9 per cent), fineness 35.0 microns (C.V. 26.8 per cent) and resistance to traction 22.1 gm (C.V. 53.8 per cent).

Lall (1968) reviewed crossbreeding for Indian type Angora goats which were introduced in Chamoli district in U.P. and crossed with indigenous Gaddi females. F_1 crosses did not produce any Mohair and the yield of fleece averaged 0.33 lbs versus 0.58 in Gaddis. F_2 crossbreds produced 0.99 lbs fibres, finer than hair and F_3 animals produced 1.89 lbs Mohair of quality near to Angora. There was no further improvements in F_4 generation and fleece weight decreased to 1.59 lbs. Growth rate of fleece in F_1 and F_2 was poorer than in F_3, F_4 and pure bred Angoras.

Nasarov et al. (1968) compared the Mohair characters of samples from the progeny of Soviet Mohair females having average fibre length 15 to 16 cms and quality 46's to 56's, mated with 2 sets of males that had fibres on the side averaging 23 cms in length and of 40's quality and 18 cms in length and of 48's quality, respectively. At one year of age, the progeny sired by the former sire (23 cms fibre length and 40's quality had longer fibre on the sides than those sired by the latter (18 cms fibre length and 40's quality). Seven and 71 per cent of the progeny, respectively had fibres of 50's and 60's quality. Fibres were more uniform and the moult started later in the

first group than in the second. He also studied the fleece of crossbreeds obtained from Soviet Mohair males and local Tadshik females and reported the average fleece weights and the percentages of non-medullated heterotype fibres of the crossbreeds as being more than double than those of local goats.

Pant and Kapri (1968) reported the average fibre diameter of the September clip for female Gaddi, Angora, 1/2, 3/4, 7/8th and 7/8th graded bred interse, as (in microns 74.48 ± 2.04, 22.89 ± 1.15, 46.0 ± 5.34, 35.27 ± 4.56, 24.71 ± 0.7 and 25.33 ± 1.23 and for males (excluding Gaddi) as 28.27 ± 1.25, 37.49 ± 1.53, 23.15 ± 0.75, 24.72 ± 1.32, and 26.42 ± 2.37. They found no significant difference between sites clipped (shoulder, midside and britch).

Ineryus et al. (1969), reported the effect of twice yearly shearing on Mohair quality from studies carried out from 1965 to 1968, at Lerkoy farm in Turkey. Thirty-five Angora females, aged 6 months to 3½ years were shorn in March and August, each year (experimental group) and 35 controls were shorn only in March. Fleeces of experimental females had 19.1 per cent higher greasy weight than those of controls at all ages and also a higher clean weight and a greater staple length. At one year age, summer fleece had greater greasy and clean weight and a longer staple length than winter fleeces. Fleeces of experimental females had more kemp than those of controls.

Kasternova (1969), studied seasonal changes in skins of Ion goats. He reported the percentage of under coat in the fleece as averaging 78.85, 15.91, 17.92, 43.42 and 76.38 of samples taken from 12 goats in the months of February, April, June, August and October, respectively.

Lemaitre (1969), studied the results of crossbreeding of the indigenous goats with pure bred Angora goats in Southern Madagascar between 1914 to 1963. He found that the third generation crossbreds look like pure breds but the fleece was of inferior quality. He also reported the total Mohair production as 5.7 tonnes with a crossbred population of 120 thousand goats, of which 1/2 were shorn. The average yield per head is 8 kgs for male and 4 kgs for female per year.

Misarev (1969), in a study of the undercoat and kemp of F_1 goats (obtained by crossing a Tur wild goat and one from nature reserve, with the domestic goats) crossed with Soviet Mohair goats reported that the undercoat and kemp fineness over the shoulder averaged 15.9 and 62.9 microns, respectively. He further reported that the hybrids with 75 per cent Soviet Mohair blood which were also produced had the fineness of undercoat and transitional fibres over the shoulder averaging 22.0 microns and of kemp 56.0 microns.

Misarev (1969), studied the results of crossing Bashkir and Ion goats (crossbreds bred intersee) and reported the average undercoat production of 83 yearlings and 139 adult crossbreds as 178 and 345 gms, respectively. He also compared fleece characters of crossbreds and local Bashkirs and found

the undercoat expressed as a per cent of wool coat to be 52.9 to 70.8 in crossbreds as against 36.2 in Bashkirs, for the shoulder region and 37.3 to 63.9 as against 30.5 for the high region. Length of the undercoat fibres on shoulder was 6.5 to 10.3 cms in crossbreds as against 5.7 cms in Bashkir. The fineness of shoulder undercoat averaged 17.41, 20.29 and 16.05 microns, respectively for Class I, II and III crossbreds as against 14.00 in Bashkirs.

Pant (1969), studied the medullated fibres of Angora, Gaddi and their crossbreds and reported the percentage of highly medullated (approximately 80 per cent medullated), intermediate and non-medullated fibres in males respectively as in Angora 2.00, 5.18 and 92.82; Angora x Gaddi 21.85, 6.74 and 71.41; first backcross to Angora 8.56, 5.49 and 85.95; second backcross to Angora 4.75, 6.38 and 88.87 and the first two generations of interse breeding of the second backcross 6.13, 8.33 and 85.49. For the females, the corresponding percentages were 4.21, 2.01 and 93.78; 33.57, 4.87 and 61.56; 19.76, 1.49 and 78.74; 7.41, 1.97 and 90.62 and 5.82, 1.22 and 92.96. The values for pure bred Gaddi females were 56.43, 17.23 and 26.34. He further reported the correlations between sites (shoulder, midside and britch). The correlations between shoulder and britch did not differ significantly. However, the hair from the midside had higher per cent of medullated fibres than had those of the shoulder and britch. Females, except one of the backcrosses to Angora had higher medullation than males of second backcross to Angora (F_3)

and pure bred Angora had similar medullation percentage. But in females, this improvement was only seen in the progeny of interse bred second backcross.

Pretorius (1970), concluded from the study of aggressive behaviour on production and reproduction in the Angora goats that, with a descending order of dominance based on relative aggressiveness, the fibre diameter and Mohair production decreased per year. Further, he observed significant correlation between body weight and Mohair production (0.62) and between Mohair production and fibre diameter (0.40), though agonistic behaviour and cyclic activity were not significantly related with fibre diameter and Mohair production.

Kuyanova (1970), examined Mohair characteristics from one flock of Uzbeck Bulck Down goats (obtained by crossing Angoras with local goats and bred interse since 1942) and reported, average down production per year 450 to 500 gms, percentage of fine down, coarse down and kemp fibres as 43.18 to 52.19, 38.28 to 04.27 and 04.27 to 24.20, respectively and average fibre diameter 17.5 (12.0 to 26.0), 27.2 (16.0 to 38.0) and 04.9 (30.0 to 114.0) microns, respectively.

Tatarenko et al. (1970), obtained data on female progeny of grade one and grade two bucks (down yield 1500 and 925 gms on average, respectively) mated with grade one, two and three does (average down yield 905, 710 and 505 gms, respectively) and reported that 3 year old daughters of grade one bucks and the three grades of does produced 0.2 per cent, 5.2 per cent and 25.4 per cent, respectively more down than their

dams. Production of down in dams was correlated with that of their daughters (0.535 to 0.806).

Kastornova (1971) studied the inheritance of economic traits in Don Mohair goats and concluded that parents with high per cent of undercoat produced a higher proportion of progeny with 80 to 85 per cent undercoat than parents with lower percentage of undercoat. Fibre fineness of progeny not being significantly effected by that of the parents (18 or 23 microns).

Musaliev (1972) examined 80 skins and Mohair samples from Soviet Mohair (S.M.), Dagestan and S.M. x Dagestan goat and reported the proportion of the annual growth of fibres that occurred between April and August as 53.0, 64.3 and 69.7 per cent in the 3 types, respectively. From 4 to 12 months of age, the percentage of undercoat fibres increased by 1.3, 12.8 and 1.8 per cent, respectively. Fineness of undercoat and heterotype fibres changed very little over this period.

Al'Nedv (1973) described a new type of down goat obtained by crossing local Kirgiz goats with Angoras and Dons since 1930 at the Dzhangli - Dzhol State Farm, as producing 500 to 550 gms of down per year for adult males and 320-360 gms from adult females, staple length and fibre diameter averaging 10.7 cms and 18.1 microns, respectively in males and 9.7 cms and 16.6 microns, in females.

Nikitenko and Saporozhtsev (1973) studied the fleece characters of the white crossbred goats (Angora x Dons) and

reported the results of 9 bucks, 1097 does, 48 immature males and 321 goatlings, respectively. The production of undercoat averaged 1639, 1002, 745 and 630 gms/year, length of undercoat fibres 17.8, 16.6, 16.4 and 14.9 cms, per cent of undercoat plus heterotype fibres (hair) in wool coat 99.5, 95.7, 97.7 and 96.2, diameter of undercoat and heterotype fibres 30.4, 27.1, 21.7 and 20.5 microns and quality numbers for these fibres 50's, 56's, 64's and 70's.

Alibaev and Ermeeva (1974) studied fur quality of Kirgiz goats and reported the results for black male castrates, aged 6 months and 1½ to 3½ years - skin area averaged 4600 and 7100 cms^2, respectively, fibre density 3054 and 2129 fibres/sq cm Kemp : undercoat ratio 1:8.1 and 1:8.4 and skin weight 0.58 and 0.86 kg.

Chagarov and Saporozhtsev (1974) reported fleece characters in female progeny from 3 types of matings (Soviet Mohair x Soviet Mohair, S.M. x Karachaev and Karachaev x Karachaev), as average Mohair yield at first clip 1.01, 0.19 and 0.15 kg, undercoat (down yield) 0, 230 and 41 gms; staple length 17.7, 8.9 and 5.0 cms; percentage of kemp in fleece 7.1, 25.7 and 74.4; undercoat and heterotype fibre diameter 19.8, 17.3 and 13.7 microns, kemp fibre diameter 45.7, 53.3 and 69.0 micron; undercoat and heterotype fibre length 17.1, 9.3 and 3.5 cms; and kemp fibre length 7.0, 5.0 and 3.9 cms, respectively.

Gee and Noble (1974) examined 95 Mohair samples from winter clips (i.e. winter growth) from kids, young goats and

mature animals and reported that the Mohair yield in clip (70 per cent) was the same as that in summer clip from mature goats and 3 per cent lower than that in summer clips from kids and young goats. Fibre diameter in clips from kids, young goats and mature goats, respectively, averaged 28, 31 and 36 microns in winter and 28, 35 and 36 microns in summer (S.D. = 0.6, 0.6 and 1.0 microns, respectively in winter and 0.6, 1.0 and 1.2 microns, in summer).

Khadzhiev (1974) observed the effect of twice yearly shearing on Mohair production in 40 Soviet Mohair goats shorn in April and September 1969 and April, 1970. Average fleece weights were 1.06 (1.5 - 2.3), 1.16 (1.00 - 1.3) and 1.96 kgs, (1.7 - 2.2) as against 1.91 (1.4 - 2.4) and 2.15 kgs (1.9 - 2.4) for 40 goats shorn in April, 1969 and April, 1970.

Pohle et al. (1974) studied physical properties of greasy Mohair (spring and fall clips). They observed that grade of greasy Mohair had little effect on clean yield but the autumn clip yielded about 5 per cent more clean Mohair than did the spring clip. Average staple length did not appear to be related to grade. The content of kemp and medullated fibre was low, ranging from 0.7 to 2.0 per cent and was twice as high in autumn clip as in spring clip.

The physical attributes of Mohair/hair obtained from pure Angora, 50 per cent crossbred Angora, 75 per cent crossbred Angora and local goats, were reported in the Agresco report of the Mahatma Phule Krishi Vidyapeeth, Rahuri as given

in the Appendix F. Mohair was not obtained in I_1 crosses. However, in I_2 crosses, Mohair characters were seen.

In the same report, weekly staple growth of Mohair from different sides of the Angora and the average rate of growth during April to October and October to April were studied. It was concluded from this study that the rate of growth was higher during April to October than during October to April.

CHEMICAL ATTRIBUTES

The chemical attributes comprise of grease, suint, moisture, sulphur and nitrogen contents of Mohair. Literature on the chemical attributes of Mohair is very meagre. However, being closely related in its chemical composition to other animal fibres like wool, Cashmeri etc., an attempt has been made to review the literature on Mohair and the other allied animal fibres. The literature is given separately under the above mentioned heads, viz. grease, moisture, suint, nitrogen and sulphur.

I Grease content

Lifschutz (1924) studied the variation in wool wax from root and tip parts of wool obtained from South American crossbred sheep, Montevideo Merinos and Australian Merinos. He reported the wax content from the roots and tips of the wool of the 3 groups of sheep, respectively as 9.2 and 4.3, 22.6 and

19.5, and 24.3 and 14.2 per cent. He concluded that there was a considerable variation in grease content in the individual staple of wool, the roots containing higher proportions of wax than the tips.

Spencer et al. (1928), in a study of factors that influenced wool production with range Rambouillet sheep, reported that the quantity of grease not only increased with the fineness of the wool, ranging from 5 to 20 per cent of its grease weight but varied in the wool of sheep of different ages. He reported the grease per cent in the fleece of 1, 2, 3, 4, 5, 6 and 7 year old sheep to be 12.9, 13.5, 14.9, 14.4, 15.3, 15.7 and 14.7, respectively.

Baker (1931) reported the per cent distribution of grease in the fleece of Wittenburg sheep as 8.24, 8.83, 10.20, 10.52, 12.42 and 15.41 in wools of the shoulder, neck, legs, sides, belly and back, respectively. He concluded that there was a substantial difference in the amount of grease found in wool on different parts of the body.

A study in U.S.A. revealed that the ram wool had a shrinkage of 6 per cent more than ewe wool, because of its higher grease content (Wyoming Agricultural Experiment Station Bulletin No. 316 (1952).

O'connell and Lundgreen (1954) studied wool samples obtained from the shoulder region of five different breeds, kept together in a single flock for one year on irrigated pasture in California. He reported the grease contents as

13, 11, 11, 6 and 6 per cent from wool of Rambouillet (21.4 diameter and 64's quality), Columbia (28.1 M + 56's), Suffolk (34.7 M + 46's), Navajo (37.7 M and 40's) and Lincoln (38.5 and 40's), respectively.

Ross (1957) reported from a study of 66 samples of 48's quality New Zealand wools that the grease content increased with increasing counts, ranging from 4 to 7 per cent, the average being 5.2 per cent. He concluded that the New Zealand wool, obtained mainly from Romney sheep, contained 3 or more times less wax than the fine wooled Merino sheep.

Van Wyk et al. (1958) studied the summer and winter Mohair clips and reported the grease contents of different grades of Mohair S.C.J., SYG, SC, SWH, SWK as 6.8, 5.6, 5.2, 6.2 and 8.3, respectively. The first 3 groups representing summer clips and the latter two, the winter clips.

Von Bergen (1963) reported that the grease content in the spring Mohair of Texas Angora goats ranged from 5 to 8 per cent whereas the fall clip ranged from 3½ to 7 per cent. He stated that over wide ranges of fibre diameter the finer fibres contain more wax.Over narrower ranges of diameter this relationship may not obtain, this conclusion being drawn from Diameter and Grease content of various sheep breeds.

Lipson (1965), in an article on fleece properties and textile processing, gave some of the mean values and variations in fleece constituents. Amongst the various constituents, he reported the maximum, minimum and average wax per cent as 25.4,

10.0 and 16.1 in Merino wool as against 19.3, 5.3 and 10.6 in crossbred wool.

Chenekar and Bhatwadekar (1973) studied the physical and chemical characters of wool from Deccani x Patanwadi sheep. They found that the grease content had increased in ½ Patanwadi and ¾th Patanwadi as compared to Deccani sheep.

II Moisture content

Von Bergen (1937) found that the moisture content of Mohair fibres when exposed to standard conditions was equal to that of wool. He compared data on adsorption and desorption at various relative humidities with that of data obtained by Speakman. Speakman reported the adsorption as 3.41, 6.93, 14.41, 24.24 and desorption as 4.87, 8.6, 16.26, 25.82 at 7, 25, 63.3 and 92.5 per cent relative humidity, respectively. While according to Von Bergen, the adsorption was 8.7, 14.7 and 21.9 and desorption 9.2, 17.6 and 23.2 at 20, 65 and 90 per cent relative humidity, respectively.

Simmonds (1954) reported the average moisture contents of 64's quality Virgin Merino wool as 11.5 per cent.

Von Bergen (1963) noticed that the moisture adsorptive and desorptive powers of Mohair were similar to wool and the same marked hysteresis existed in the moisture content of Mohair, Cashmere, camel hair and the fibres of the Llama family. The moisture regains of Alpaca fibres at 20, 65 and 90 per cent relative humidity as reported by him were 8.3, 14.4, and 21.4

per cent, respectively from dry side and 8.4, 17.2 and 24.5 per cent from wet side as against that of Cashmere fibre being 15 per cent at 65 to 75 per cent relative humidity. He further reported the variation in amount of impurities, moisture and wool fibre found in raw wools. The amounts of moisture of different grades of wool (fine to coarse hairs) was reported by him to vary from 8 to 12 per cent.

Lipsom (1965) reported the maximum, minimum and average moisture per cent of Merino wool as 12.6, 8.1 and 9.6 per cent, respectively while that of crossbred wool was 14.2, 9.5 and 12.0 per cent, respectively.

Chanekar and Bhatwadekar (1973) reported that there was no change in moisture content in the wool of Deccani, Patanwadi and their crossbred progeny.

III Suint content

Veitch and Benedict (1924), while working on domestic South American, Cape, Australian and New Zealand wools of 70's quality and lower, found that the suint content of greasy wool was independent of wool quality. Its average was 15 per cent based on greasy weight.

Freney (1940) made a careful study of the composition of wool suint and found that it consisted in part of a mixture of potassium soaps and fatty acids, ranging from valeric to palmitic acids. In addition, he found that suint contains minor amounts of lactic, hippuric and succinic acids, urea and lanaurin.

O'connell and Lundgreen (1954) reported that the suint content of wool of 5 different breeds of California ranged from 10-15 per cent. The breedwise suint content in wool, as reported by him, was as follow.

Rambouillet	(21.4 M	Diameter	+ 64's	quality	) - 13	per cent
Columbia	(28.1 M	"	+ 56's	"	) - 10	"
Suffolk	(34.7 M	"	+ 46's	"	) - 14	"
Navajo	(37.7 M	"	+ 40's	"	) - 15	"
Lincoln	(38.5 M	"	+ 40's	"	) - 13	"

Ross (1957) studied 66 samples of 40's quality New Zealand wools and found that the suint content ranged from 2.2 to 12.1 per cent, averaging 8.0 per cent. Suint being rich in potassium compounds, he suggested that future research may find new uses for suint thereby making it a valuable byproduct of wool production.

Van Wyk et al. (1958) studied the summer and winter Mohair clips and reported that the suint content of 3 different summer group averages, viz : S.S.F, SYG and SG as 1.7, 1.1 and 1.3 per cent, respectively while that of 2 winter group averages, SWH and SWK as 1.7 and 1.9 per cent, respectively.

Lipson (1965) reported that the maximum, minimum and average suint contents of Merino wools was 12.0, 2.0 and 6.1 per cent, respectively while that of crossbred wools was 13.4, 4.4 and 8.2 per cent, respectively.

Chanekar and Khatwadekar (1973 , in a study of the

physical and chemical characters of wool in Deccani x Patanwadi sheep, found that the suint content was reduced in ½ Patanwadi and ¾th Patanwadi as compared to the Deccani sheep.

IV Nitrogen content

Geiger (1944) made a separate analytical study on the nitrogen content of the cuticle and whole wool and reported 16.67 per cent nitrogen in the cuticle of the wool while in whole wool, it was 13.53 per cent.

Simmonds (1954), in an estimation of the amino acids of 64's quality Virgin Merino wool, found that the wool contained 16.62 per cent nitrogen.

Von Bergen (1954) reported from a basic analysis of the principal chemical elements found in wool, that it contained nitrogen ranging from about 16 to 17 per cent.

Ward et al. (1955), in a study of the amino acid composition of normal wools, wool fractions, Mohair, feathers and feather fractions, found that the Mohair sample was similar to the wool sample in chemical composition. They reported that the nitrogen contents were 16.80, 16.78, 16.82, 16.91 and 16.78 per cent in Solvent 'B'scoured wool of Idaho Rambouillet, Australian Merino, Idaho Medium, New Zealand 58's quality and New Zealand 60's quality, respectively.

Simmonds (1956) conducted the basic analysis of wool and reported the nitrogen content as 16.4 ± 0.3 per cent.

Von Bergen (1963) reported that the chemical

composition of Mohair and other specialty fibres was similar to that of wool. He observed that the nitrogen content of Vicuna wool fibres was 16.3 per cent.

Patil (1966) studied the nitrogen and sulphur content of wools from Deccani and its crosses with the Merino and Rambouillet breeds of sheep. Amongst the 20 animals studied, he observed that the nitrogen content was of the same order ofor the 3 groups (Deccani, Deccani x Merino and Deccani x Rambouillet). He reported that the average nitrogen content was 16.27 ± 0.044 per cent and concluded from his observations that the nitrogen content did not affect the wool quality.

Chanekar and Bhatwadekar (1973), while studying the physical and chemical characters of wool in Deccani x Patanwadi sheep, found that the nitrogen content remained unchanged in all genotypes.

V Sulphur content

Barrit and King (1926), in a study of the sulphur content in different wools, reported that there was inherent variations in sulphur content of different wools. He conducted the studies on the wools of Cape Merino, Australian Merino (100's) and the London Lincoln breeds of sheep and observed that the sulphur contents were 4 per cent, 3.67 per cent and 3.10 per cent in the 3 breeds, respectively. He concluded that the sulphur contents of different wools were far from constant.

Harston (1928) reported that the sulphur content of wool

taken from a variety of fleeces was constant at 3.6 per cent but he stated that it was sometimes necessary to equilibrate the wool in 0.01 N HCl to obtain this sulphur content.

Barrit and King (1931) studied the sulphur content in the wool of Black Face sheep and from an analysis of the isolated medullae, found them to be free of sulphur.

Larose and Tweedie (1937) analysed the medullated and non-medullated fibres of Canadian wools separately for their sulphur content. They reported that the non-medullated fibres had a greater sulphur content than the medullated fibres of the same fleece.

Larose and Tweedie (1937) found no change in the sulphur content of several wool samples when treated with HCl. They suggested without direct evidence that the composition of food and plane of nutrition were probably the most important factors influencing the sulphur content of wool.

Freney (1940) stated that the internal factors which influenced the sulphur contents of wool included the proportion of medullated fibres, nutrition, inherent differences (between both the individual sheep and breeds) and variations with site. He suggested that site variations might have been due to differences between the fibres from different sites (that is fibre diameter and number of medullated fibres) or physiological factors such as blood supply.

Gieger (1944) reported analytical studies on the cuticle and whole wool. He found that the proportions of the same amino acids differed in the 2 materials, the scales

containing larger per cent of sulphur than the whole wool. He reported the sulphur contents in per cent of the scales as 4.83 per cent (analytical value) and 4.42 per cent (corrected value for the presence of ethyl groups and bound lipids) while that of the untreated whole wool was 3.5 per cent.

Simmonds (1954), in an estimation of the amino acids of 64's quality Virgin Merino wool, conducted a complete analysis of one sample of this wool for ascertaining the principal elements found in wool. He reported that the sulphur content was 3.68 per cent.

Van Bergen (1954) reported the sulphur content of wool to vary from 3 to 4 per cent.

Ward et al. (1955) studied the amino acid composition of normal wool, wool fractions, Mohair, feathers and feather fractions. They reported the sulphur contents of solvent 'E' scoured wool obtained from the Idaho Rambouillet, Australian Merino, Idaho medium, New Zealand 58's quality and New Zealand 60's quality, as 3.72, 3.70, 3.64, 3.68 and 3.74 per cent.

Simmonds (1956), reported the sulphur content, amongst other principal components of wool, as 3.7 ± 0.1 per cent.

Reis and Schinckell (1962), examined the effects on wool growth and the sulphur content of wool of supplementation of l-cystine, DL-methionine and casein given per abomasum as a continuous infusion. They found that daily supplements of 2 gm l-cystine or an equivalent amount of DL-methionine (2.46 gm),

given for 6 weeks resulted in an increase in the sulphur content of wool of 24-35 per cent. Supplements of 60 gm casein per day per abomasum for 6 weeks was also found to have produced an increase in the sulphur content of wool of 15-20 per cent.

Von Bergen (1963) reported that the Mohair is chemically identical to wool, the sulphur content varying with origin. He quoted Harris, who found that the sulphur content of Texas Kid Mohair was 2.92 per cent and that of Turkish Mohair fleeces was 3.58 per cent. Similarly, for Chinese-Cashmere wool, it was 3.39 per cent. He also reported the sulphur contents of camel hair and Vicuna wool fibres as 3.5 per cent and 4.1 per cent, respectively.

Reis (1964) examined the effect of abomasal supplements of casein, gelatin and of L-cystine and DL-methionine added to the proteins on growth and sulphur content of wool. The supplements were administered as a continuous infusion over a period of 10-12 hours each day. He found that the sulphur content of the wool was increased by 9-19 per cent during casein supplementation, but was not increased during gelatin supplementation. During protein and sulphur containing amino acid supplementation, the sulphur content of the wool was increased by 17-30 per cent.

Reis (1965) reported that the sulphur content of wool was altered by changes in nutritive status. He observed variations upto 0.6 per cent sulphur, the wool growth and sulphur content increasing with improved nutrition and vice versa. Further, he found considerable variation in sulphur contents

between individual sheep receiving similar diets, differences of upto 0.9 per cent being observed. Sulphur contents ranging from 2.7 to 4.1 per cent were seen due to the combined effects of individual differences in nutrition. A site wise analysis of wool revealed differences upto 0.3 per cent sulphur, the wool of the dorsal sites of some of the sheep having the highest sulphur content. He found no relationship between sulphur content and fibre diameter in wool from similarly fed sheep.

Patil (1966), in a study of the nitrogen and sulphur contents of wools from Deccani (average diameter 35 M and medullation 16 per cent), Merino x Deccani (av. 30 M and 6 per cent med.) and Rambouillet x Deccani (27 M + 5 per cent med.), found no significant difference between the sulphur contents of the 3 breeds. However, he concluded that the Deccani had 3.10 per cent sulphur which seemed to be lower than that of Deccani x Merino sheep (3.29 per cent) and Deccani x Rambouillet sheep (3.25 per cent).

Reis (1969) studied the effect of dietary protein and methionine on the sulphur content and growth rate of wool produced by milk fed lambs, in an experiment lasting 6 weeks and commencing when the lambs were 30 days old. Measurements were also made on 2 lambs left with their mothers. He observed that the sulphur content of the birth coat was uniformly high, with a mean value of 3.79 per cent. Lambs receiving methionine supplemented diets and those left with their mothers grew wool of a high sulphur content equivalent to birth coat values.

He reported, however, that the sulphur contents of wool grown by lambs receiving 3 diets with protein contents between 11 and 39 per cent of dry matter, were similar to each other and were significantly lower than birth coat values.

Reis (1969) studied the influence of abomasal supplements of some amino acid and sulphur containing compounds on wool growth rate. He observed that none of the abomasal supplements apart from methionine hydroxy analogue (sulphur containing) was effective for stimulating wool growth. Methionine hydroxy analogue did not, however, influenced wool growth rate when given as a dietary supplement.

Chanekar and Bhatnadekar (1973), in a study of the physical and chemical characters of wool in Deccani x Patanwadi sheep, reported that the sulphur content was the same in Deccani and ½ Patanwadi animals whereas it increased in ¾ Patanwadi.

Usha Nandurkar et al. (1975) studied the chemical characters of various Indian wools and concluded that the Autumn clip from Rajastan, Gujarat, Haryana and adjoining areas from nothern plains were damaged by alkaline suint and this reflected in the lower values of cystine and sulphur content in the wools produced in autumn compared to spring clips. They suggested that the higher values of sulphur and cystine contents of some coarse wools from Deccan plateaus might have been due to higher degree of keratinization. The farm wools have higher per cent of sulphur and cystine compared to the wools produced by sheep reared by shepherds. Thus the scope of improving some of the Indian wools through improved feeding of the sheep was possible.

CHAPTER III

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHOD

The present investigation to study the physico-chemical attributes of Mohair/hair from the Angora, local and their crossbred goats was undertaken at the All India Co-ordinated Research Project on Goat for Mohair Production. This project was started at the Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri from April, 1972. The strength of the goats maintained on this project is given in Appendix I.

The pure Angora goat foundation stock was purchased from the Jeori Farm, Himachal Pradesh. The object of the project is to introduce the Mohair producing quality from the Angora into the local goats. Sangamneri is a well established strain of local goat which is available in drought prone areas of the State. This is a very hardy breed with many positive characters such as heat resistance, resistance to tropical diseases and is capable of surviving in most adverse conditions. It is genetically very stable breed with an excellent adaptability with the local conditions. There is only one drawback in this breed. It has very rough coating and hence the hair obtained from the body has no economic value. By introducing the Angora blood in the local Sangamneri goat, it is possible to transform the rough coating of the Sangamneri goat into soft and lustrous Mohair. Since Mohair fetches very high price in the market, the genetical change brought in the local goat can create a new source of income to the cultivators.

The goats are maintained at this project on a semi-stall

feeding pattern. They are allowed to graze in the harvested fields and the grazing lands of the university for few hours, ranging from 3 to 6 hours. At farm, they are fed with chaffed dry kadbi (Sorghum vulgare), groundnut (Arachis hypogea) leaves and vines. They receive green fodder in the form of Shevri (Sesbania egyptica), lucerne (Medicago sativa), green maize (Zea mays) and different grasses which are grown on the farm. The quantity of dry fodder varied from 1 to 1½ kg and green fodders, from 2 to 2½ kg per head per day depending on grazing available. In addition, 350 gr. concentrates under the trade name Hygro was fed to the goats. This feed is manufactured by the Maharashtra State Agro-Industries Development Corporation. A routine work of preventive disease control measures such as, vaccination against Goat Pox, Black Quarter, Haemorrhagic Septicemia and Enterotoxemia is carried as per the decisions of the workshop. Deworming or drenching and dusting against ecto-parasites is also done at regular intervals.

The physical and chemical attributes of Mohair/hair from Angora, local and their crossbreds were studied.

SELECTION AND GROUPING OF ANIMALS

Thirty goats, 10 of each group, viz pure Angora, halfbreds (50 %) and local goats were selected. While selecting and grouping the goats, age, body weight and health of the animal was taken into consideration so as to avoid the

variation within the groups. Allocation of the 30 experimental goats among the 3 groups was done as shown in Appendix B.

METHODS USED FOR ESTIMATION OF PHYSICAL ATTRIBUTES

1. Sampling of Mohair

The method of collection of density wool sample described by Ramchandran and Yeri (1954) was followed. The method consisted of a small brass block in the centre of which were 4 holes which enclosed an area of 4 sq cm. The block was held in position at the place of sampling and 4 points were tattooed with the help of a fine needle and Indian ink through the 4 holes in the block. The position of the block was held taut and the animal was prevented from moving. The block was removed and the fibres in the 4 tattooed corners were parted so that the sample of fibres was enclosed in the given area. Hair clips were used to keep away the hair fibres around the periphery of the sample. The central lock enclosed in the tattooed patch was cut close to the skin by a fine pair of scissors.

Each sample of Mohair/hair collected was analysed for the various characters,viz fibre density, staple length, fibre diameter and medullation.

2. Fibre Density

This was estimated by the procedure described by Ramchandran and Yeri (1954) wherein the cleaned density Mohair sample was weighed accurately and spread on a velvet

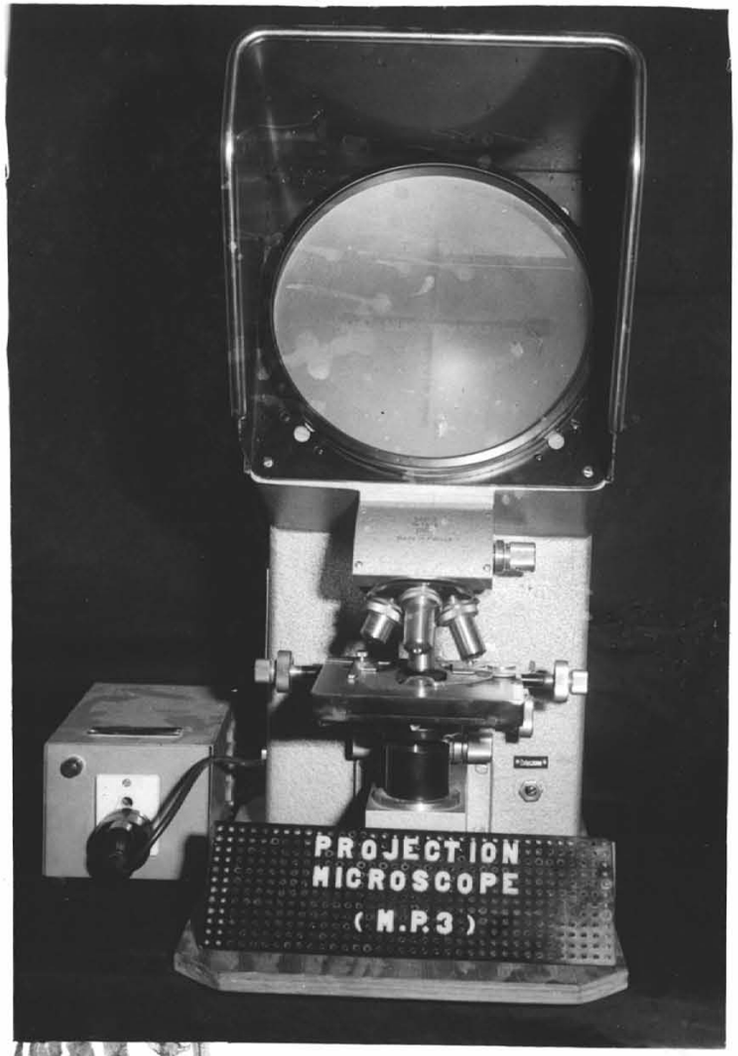
board. Three bunches of approximately 100 fibres each were drawn out at random from the basal end of the sample and weighed accurately. The number of fibres in each bunch was counted. The population of fibres in entire sample was calculated on the basis of the average weight and count of the 3 bunches of Mohair fibres.

3. Staple Length

The method described in I.S.I. bulletin No. 6653, 1972, for the estimation of staple length was followed. Ten well defined locks were measured by placing them on the scale. The measurements were taken nearest to 5 mm from the base to the tapering tip where majority of the fibres ended. The samples were straightened to remove the bends, if any.

4. Fibre Diameter

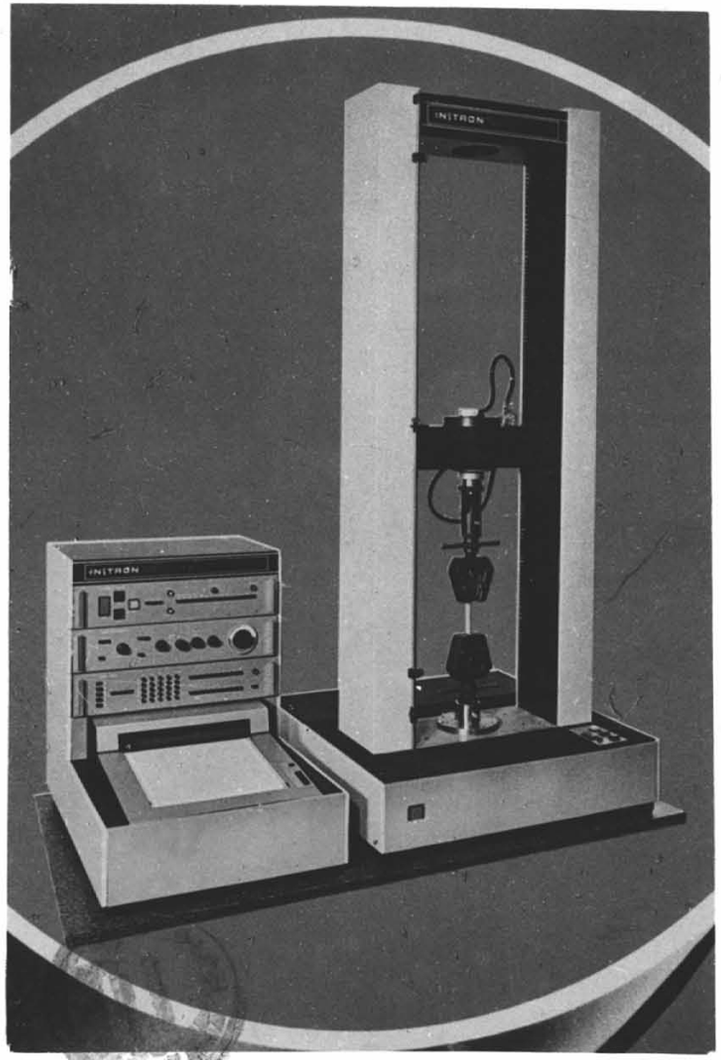
This was estimated by the procedure described in I.S.I. bulletin No. 744 (1966). With the help of pointed pair of scissor, the sample was cut into pieces of 0.5 mm in length over a glass plate. The pieces were thoroughly mixed and a small quantity fibre pieces was taken with the help of a mounting needle. These were transferred to a few drops of cedar wood oil on a clean slide. A cover glass was gently lowered on to the slide. The care was taken to avoid air bubbles. The measurements of fibre diameter were taken on the projection microscope (MP-3) at a magnification of



(a)

FIBRE DIAMETER

MEASURING APPARATUS



(b)

TENSILE STRENGTH

TESTING APPARATUS

PLATE-III

500 λ. Three hundred observations were taken for each slide and the mean fibre diameter was worked out by using the following formula.

Mean fibre diameter D in microns = 2 (A + Σfd/n)

Where,

A = Assumed origin

Σfd = Algebraic sum of values of 'fd'

f = observed frequencies

d = deviation from 'A'

n = number of observations

5. Medullation

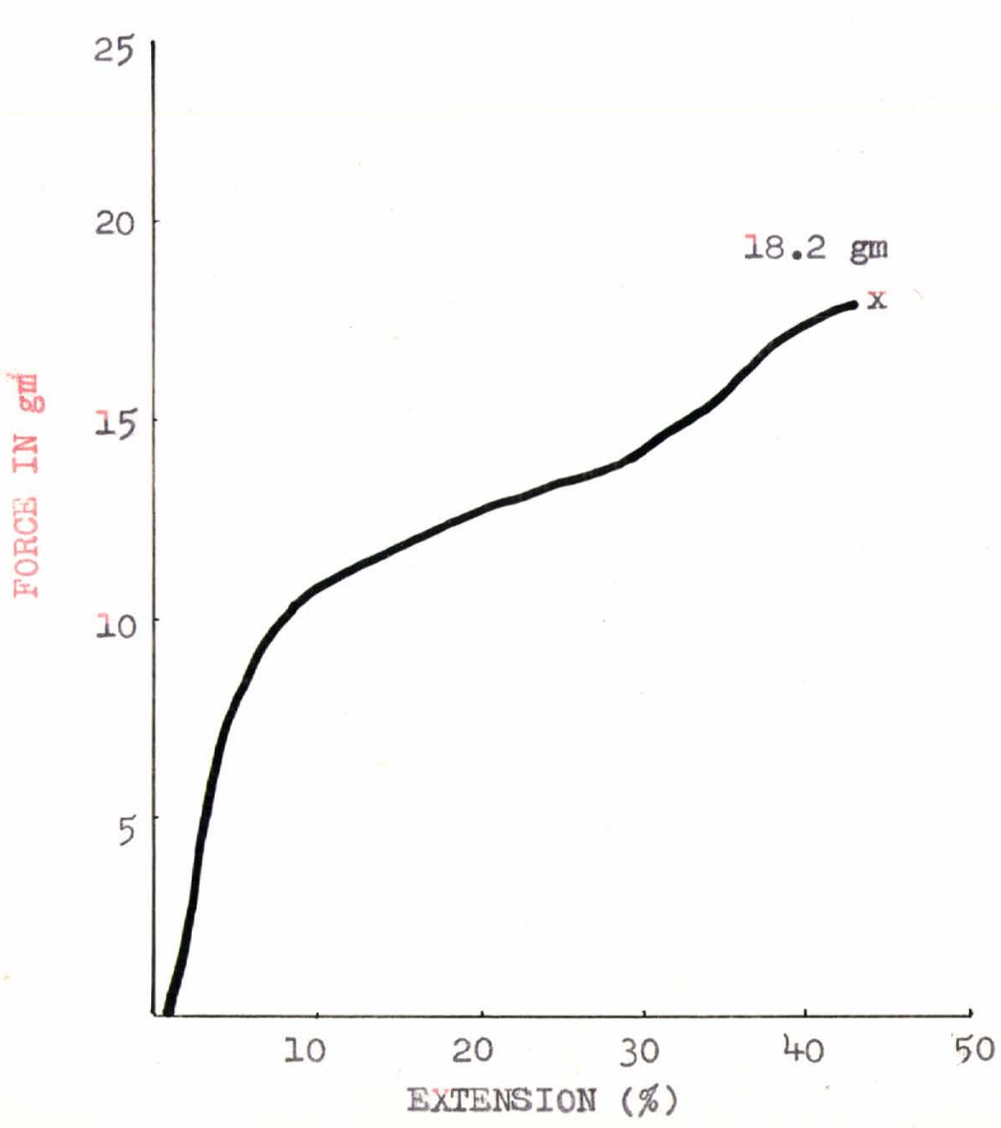
Percentage of fibres medullated (partially and completely) was estimated by counting the number of medullated fibres in a run of 300 fibres of the total population. This was estimated at a magnification of 500 x and concurrent with the fibre diameter measurements (I.C.I. bulletin No. 2899,1965).

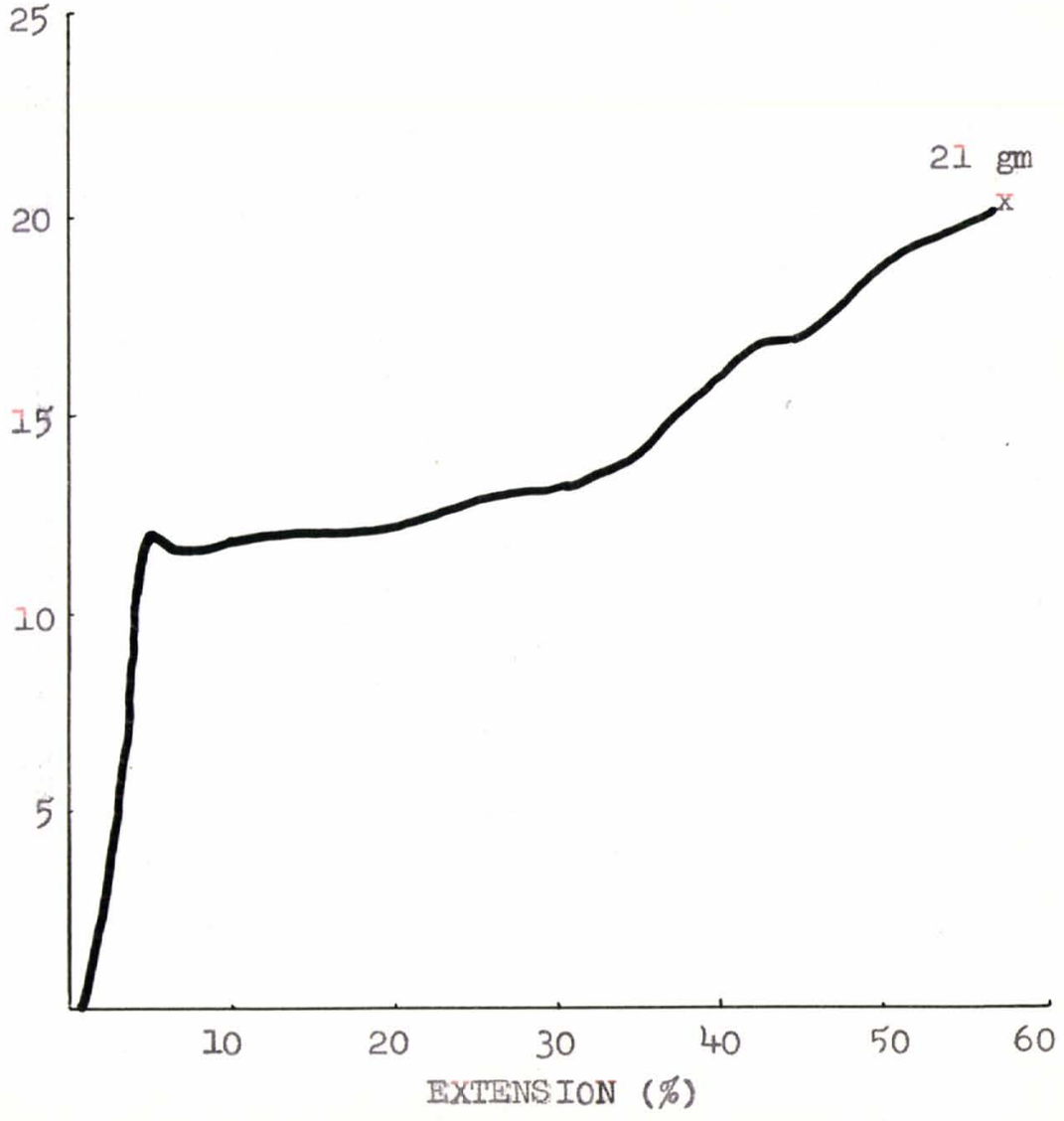
6. Tensile Strength

This was measured on the 'Instron' apparatus designed for measuring the tensile strength of various materials. This instrument is manufactured by "INSTRON LTD." United Kingdom. In India, it is available from the Toshniwal Bros Pvt. Ltd., Churchgate, Bombay agents. Its price is about Rs. 2 lakhs.

The apparatus is shown in adjoining plate. It is

TYPICAL FORCE EXTENSION CURVES FOR MOHAIR FIBRES AT CONSTANT RATES OF EXTENSION





designed for applying a constant rate of extension upto 500 kg and confirms to ASTM, BS, DIN, ISO and other international standards for materials testing machines.

Sample or fibre is gripped in the sample grips provided in the load frame. The grip has two jaws which are air operated. The jaws can be adjusted to hold a specific length of fibre. The fibres below 3 cm cannot be tested. A constant rate of extension is applied to the fibre held tight in between the two jaws (or sample grips), by an electronically operated load cell. The load is measured by an electronic sensing device using foil strain gauges that produce signals corresponding to load variations which operate a pen on a high speed graphic recorder. Thereby, the load or extension applied is automatically recorded until breaking point. At this stage, the pen returns to zero, leaving in its wake a stress/strain graph ending in the maximum load tolerated by the mounted fibre. A typical graph so obtained during measurements is given alongside.

Twenty fibres from each sample were read for their breaking strength and the average was taken as the tensile strength in grams of the whole sample.

METHODS USED FOR ESTIMATING CHEMICAL COMPOSITION OF MOHAIR/HAIR

Composite samples of Mohair/hair consisting of a few locks from each of 3 sites, that is shoulder, mid side and britch, were collected. These samples were used for the estimation of grease, suint, moisture, nitrogen and sulphur content.

1. Grease Per Cent

About 4 to 5 grams of the Mohair/hair sample, previously obtained from the fleece by the process of repeated halving, were taken and weighed accurately at room temperature and room humidity. The grease per cent or wax content of the sample was determined by extracting grease with petroleum ether using a soxhlet apparatus as described by Ross, 1957.

2. Moisture Per Cent

The sample after grease extraction was dried in an oven for 2-3 hours at 105°C and weighed bone dry. The difference in weight before and after drying expressed as a per cent is taken as moisture content. This was done as suggested by Chanekar and Bhatwadekar (1973).

3. Suint Per Cent

Suint content of the sample was determined by washing the grease extracted sample with water (7 times) at 60°C . Dirt and floating material was removed from the solution by filtering (pressure filtering used wherever necessary). The filterate obtained was then evaporated and the residue was weighed and the percentage of suint was calculated. This was done as suggested by D.A. Ross, 1957, Chanekar and Bhatwadekar (1973).

4. Nitrogen Per Cent Estimation

The grease and suint free samples obtained above were

dried thoroughly and weighed accurately prior to analysis. Nitrogen content was estimated by the macro Kjeldahl method as described by Bremner (1965),and suggested by Patil (1966).

5. Sulphur Estimation

This was done by the semi-micro method of high accuracy described by Myers (1959). The method is essentially a gravimetric estimation. The Mohair sample was digested in a mixture of conc. nitric acid, per chloric acid and potassium dichromate and the sulphur was precipitated in the form of barrium sulphate by using barrium chloride.

The estimates of all the above chemical traits were obtained by analysing each sample in triplicate so as to reduce the analytical error and the averages were taken as the final estimate.

STATISTICAL ANALYSIS AND INTERPRETATION OF DATA

The data collected during the experiment for different treatment groups namely, Angora (T_1), crossbred (50%)(+2) and local (T_3) goats were statistically analysed as described by Snedecor and Cochran (1967), Panse and Sukhatme (1961).

The null hypothesis, treatment groups T_1 = Pure Angora goats = T_2 = Crossbred (50%) goats = T_3 = local goats was tested by 'F' test by carrying out analysis of variance.

Simple correlation between some important attributes were worked out and tested for significance at 5% and 1% level of significance, as described by Snedecor and Cochran (1967).

CHAPTER IV

R E S U L T S

CHAPTER IV

R E S U L T S

The study of the physico-chemical attributes of Mohair/hair from Angora, local and their crossbred goats was completed in the Post Graduate laboratory of the Department of Animal Science and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri. The results obtained from these studies are presented under the following heads.

A. PHYSICAL ATTRIBUTES

I. Fibre Density
II. Staple length
III. Fibre Diameter
IV. Medullation
V. Tensile Strength

B. CHEMICAL ATTRIBUTES

1. Grease
2. Moisture
3. Suint
4. Nitrogen
5. Sulphur

C. STATISTICAL ANALYSIS AND INTERPRETATION OF DATA

TABLE 1

FIBRE DENSITY OF MOHAIR AS OBSERVED IN TAGGED GOATS

Tag No.	Date of birth	Age on 10-10-75 Y.M.D.	Av. yield/year Kg.	Fibre density (No./sq.cm.)
A-8	2-5-71	4-4-8	2.60	1126
A-5	16-4-72	3-4-24	3.38	1303
A-19	18-3-70	5-5-22	1.70	670
A-13	19-4-72	3-4-21	2.45	1198
A-18	17-4-72	3-4-23	2.50	1427
A-7	28-2-70	5-6-12	2.61	1390
A-11	22-3-70	5-5-18	2.99	1269
A-22	10-4-72	3-5-0	2.92	1166
A-12	14-3-71	4-5-26	2.85	1525
A-2	8-4-70	5-5-2	2.02	902
Total			26.02	11976.00
Mean			2.60	1197.60
S.D.				64989.60
S.E.				20553.320
C.V. %				54.27

TABLE 2

STAPLE LENGTH OF MOHAIR/HAIR AS OBSERVED IN GOATS

Angora		Crossbred (50%)		Local	
Tag No.	Av.staple length cm	Tag No.	Av.staple length cm	Tag No.	Av.staple length cm
A-8	9.25	C-1	3.30	L-109	3.04
A-5	10.40	C-2	3.20	L-165	2.80
A-19	8.70	C-3	2.90	L-172	3.03
A-13	9.10	C-4	3.50	L-79	2.88
A-18	10.00	C-5	3.05	L-54	3.00
A-7	10.25	C-6	3.00	L-59	2.63
A-11	9.65	C-7	2.95	L-16	2.79
A-22	10.05	C-8	2.10	L-58	3.00
A-12	9.10	C-9	3.00	L-146	2.80
A-2	9.30	C-22	2.00	L-63	3.15
Total	95.80		29.00		29.12
Mean	9.58		2.90		2.91
S.D.	0.327		0.233		0.024
S.E.	0.103		0.073		0.007
C.V. %	0.034		0.080		0.008

Observations per goat - 10
No. of samples studied - 300

TABLE 2(a)

ANALYSIS OF VARIANCE FOR STAPLE LENGTH OF LOHAIR/YAIR

Source of variation	D.F.	S.S.	M.S.S.	F Cal.	F table 5%	F table 1%
Between groups	2	296.9492	148.4746	760.24	3.35	5.49
Error	27	5.2740	0.1953			
Total	29	302.2232				

** Highly significant.

TABLE 2(b)

SUMMARY OF RESULTS FOR STAPLE LENGTH OF LOHAIR/YAIR

Treatments	Angora T_1	local T_3	Crossbred (50%) T_2
Mean	9.580	2.912	2.900
S.E.	± 0.1397		
C.D.	0.4055		

The results shown in Table 2(b) clearly indicate that the treatment T_1 is significantly superior to T_2 and T_3 as regards the average staple length (cm). Treatments T_3 and T_2 are at par with each other.

GRAPH I : VARIATIONS IN STAPLE LENGTH AS OBSERVED IN GOATS

(Scale 2 cm = 1 cm)

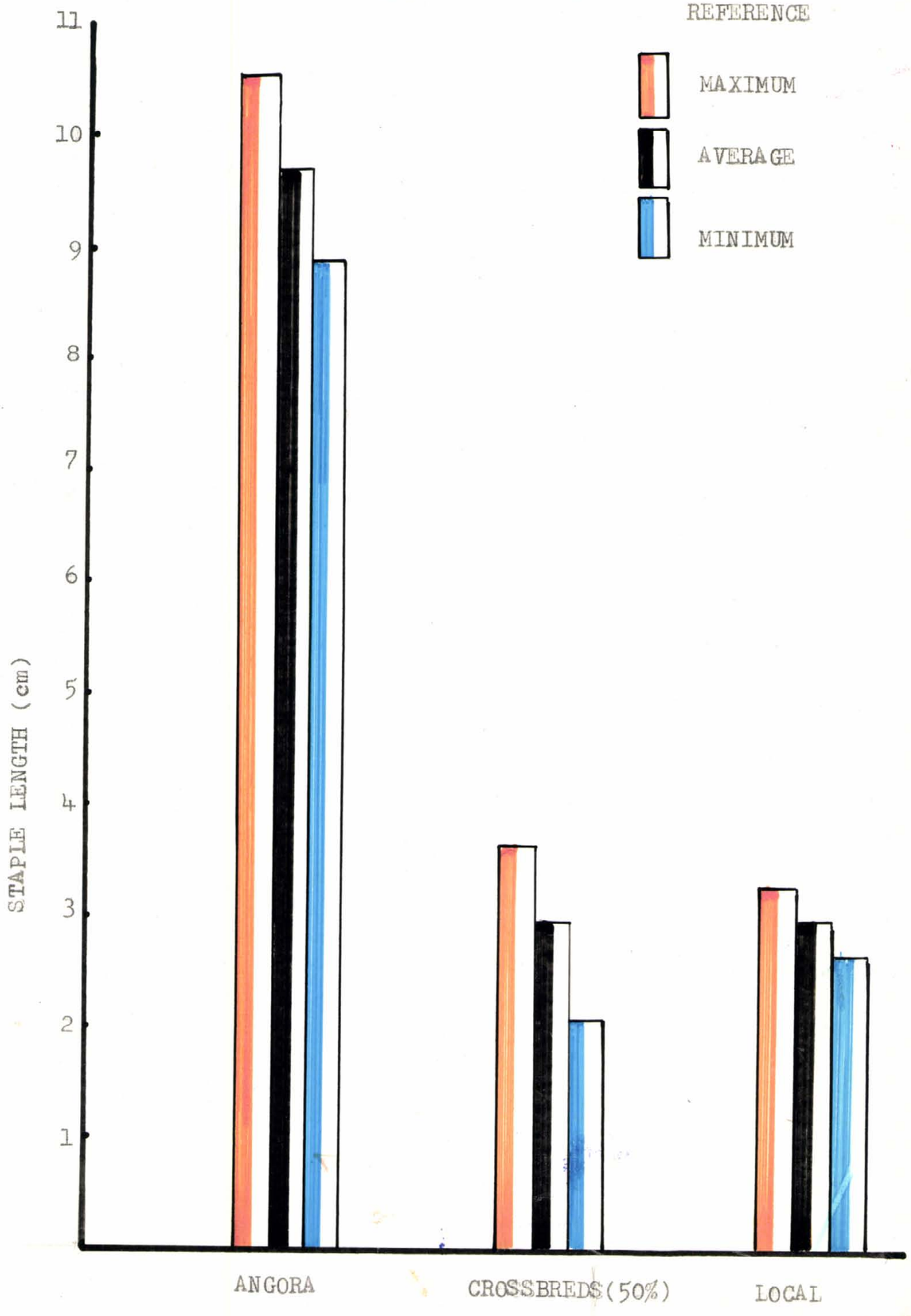


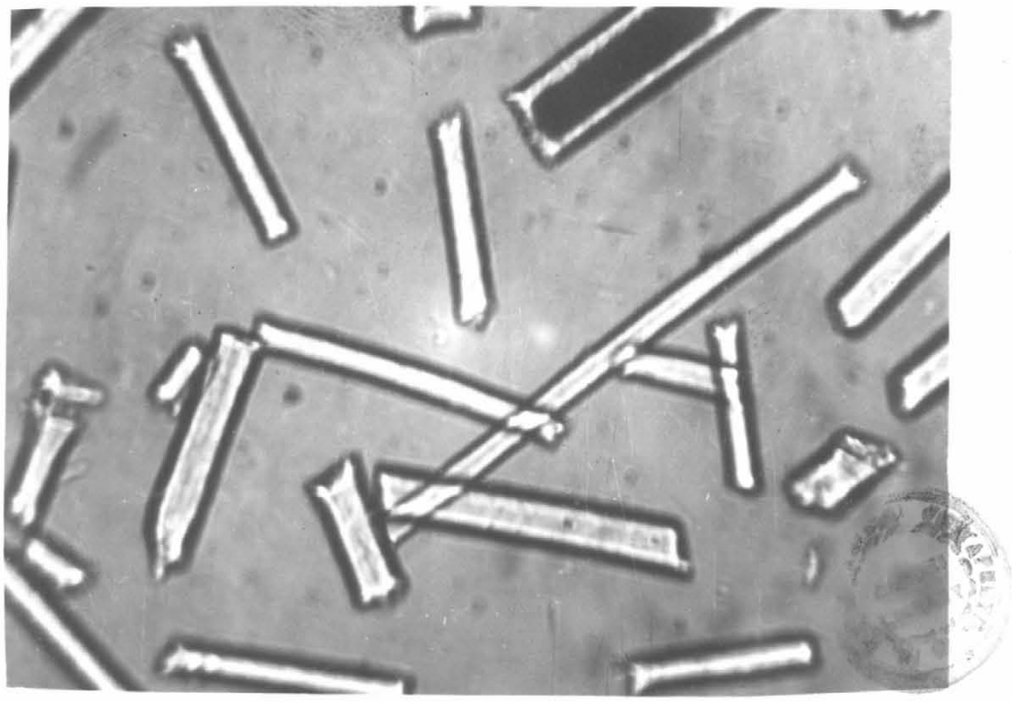
TABLE 3

FIBRE DIAMETER OF MOHAIR/HAIR AS OBSERVED IN COAT

Angora		Crossbred (50%)		Local	
Tag No.	Mean fibre diameter micron	Tag No.	Mean fibre diameter micron	Tag No.	Mean fibre diameter micron
A-8	26.04	C-1	17.68	L-109	97.61
A-5	32.51	C-2	112.13	L-165	110.92
A-19	25.33	C-3	89.01	L-172	108.67
A-13	31.92	C-4	79.78	L-79	110.56
A-18	31.57	C-5	128.09	L-54	75.01
A-7	31.27	C-6	87.53	L-59	104.08
A-11	32.80	C-7	84.98	L-16	110.75
A-22	34.24	C-8	84.64	L-58	94.94
A-12	28.68	C-9	124.28	L-146	108.44
A-2	26.56	C-22	89.31	L-63	106.26
Total	300.92		897.43		1027.24
Mean	30.092		89.743		102.724
S.D.	10.095		945.684		125.574
S.E.	3.192		299.074		39.713
C.V. %	0.335		10.538		1.222

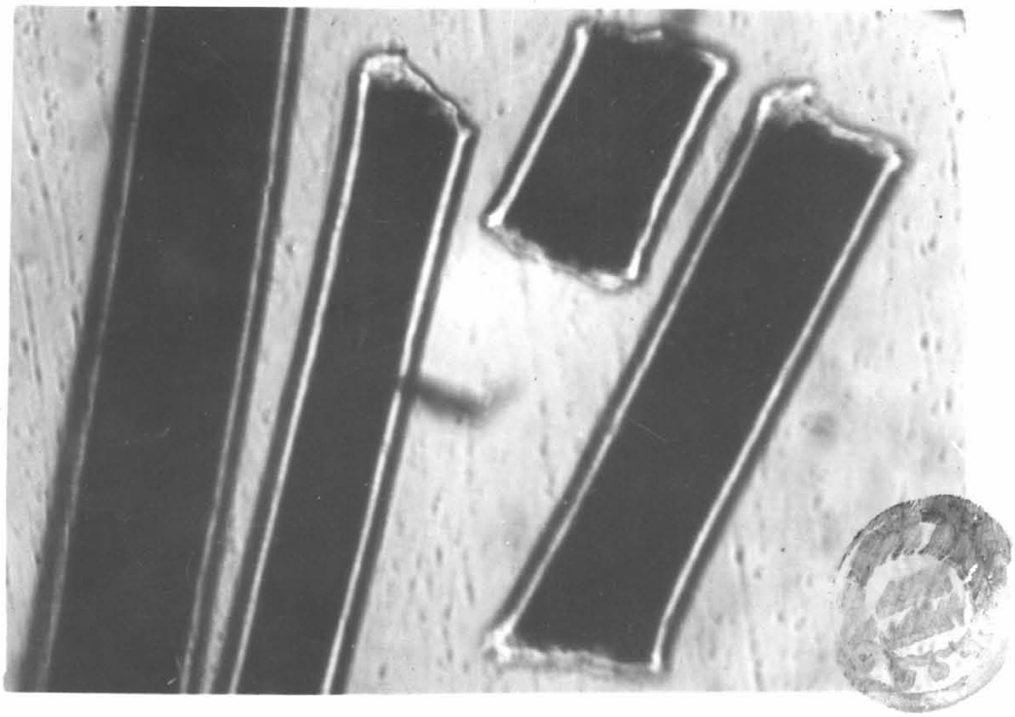
PLATE-IV

(a)



MOHAIR FIBRES OF ANGORA
(MAGNIFICATION 110 X)

(b)



HAIR FIBRES OF LOCAL
(MAGNIFICATION 110 X)

TABLE 3(a)

ANALYSIS OF VARIANCE FOR FIBRE DIAMETER OF MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal.	F table 5%	F table 1%
Between groups	2	3007.19	15003.59	41.6284	3.35	5.49
Error	27	9732.20	360.45			
Total	29	39739.38				

** Highly significant

TABLE 3(b)

SUMMARY OF RESULTS FOR FIBRE DIAMETER OF MOHAIR/HAIR

Treatments	Angora T_1	Crossbred (50 %) T_2	Local T_3
Mean	30.092	89.743	102.724
S.E.	± 6.004		
C.D.	17.420		

The results shown in Table 3(b) clearly indicate that treatment T_1 is significantly superior as regards mean fibre diameter (m), than treatments T_2 and T_3. Further, though treatment T_2 is superior to T_3, there is no significant difference between the treatments.

GRAPH II : VARIATION IN FIBRE DIAMETER OF MOHAIR/HAIR AS OBSERVED IN GOATS

Scale 1 cm = 10 microns

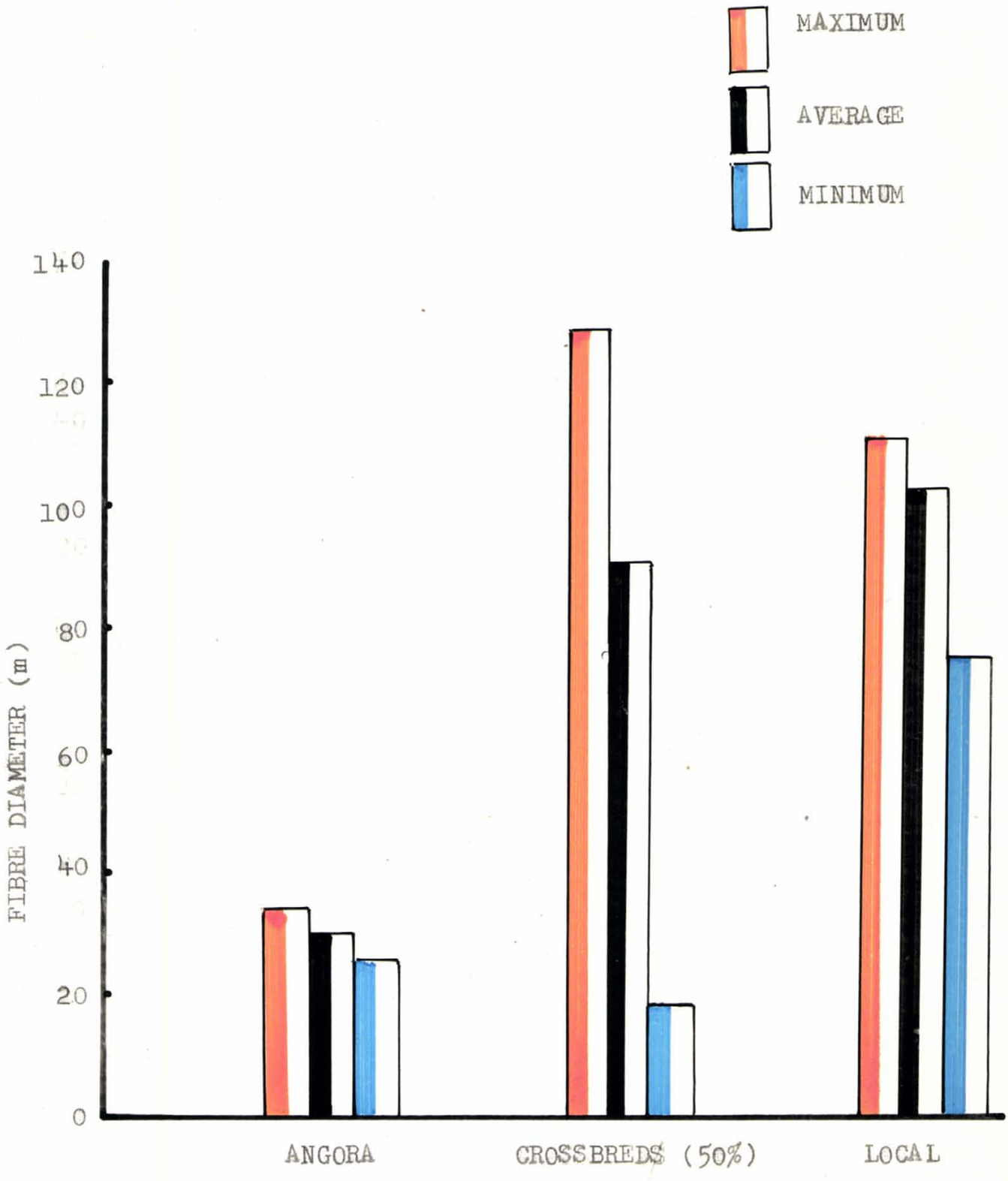


TABLE 4

PARTIALLY MEDULLATED FIBRES IN MOHAIR/HAIR AS OBSERVED IN COATS

Angora		Crossbred (50%)		Local	
Tag No.	Av. partially medullated fibres %	Tag No.	Av. partially medullated fibres %	Tag No.	Av. partially medullated fibres %
A-8	0.00	C-1	0.33	L-109	6.66
A-5	0.00	C-2	4.00	L-165	7.00
A-19	0.33	C-3	1.33	L-172	1.66
A-13	1.33	C-4	2.33	L-79	3.33
A-18	0.00	C-5	11.00	L-54	20.00
A-7	0.33	C-6	13.33	L-59	3.33
A-11	0.00	C-7	2.66	L-16	9.00
A-22	0.33	C-8	6.00	L-58	8.00
A-12	0.00	C-9	0.66	L-146	1.66
A-2	0.33	C-22	3.66	L-63	5.66
Total	2.65		45.30		66.30
Mean	0.265		4.530		6.630
S.D.	0.1669		19.2992		28.7234
S.E.	0.0527		6.1030		9.0833
C.V. %	0.6298		4.260		4.332

TABLE 4(a)

ANALYSIS OF VARIANCE FOR PARTIALLY MEDULLATED FIBRES IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal.	F table 5%	F table 1%
Between groups	2	210.3782	105.1891	6.5404**	3.35	5.49
Error	27	433.7069	16.0632			
Total	29	644.0851				

** Highly significant

TABLE 4(b)

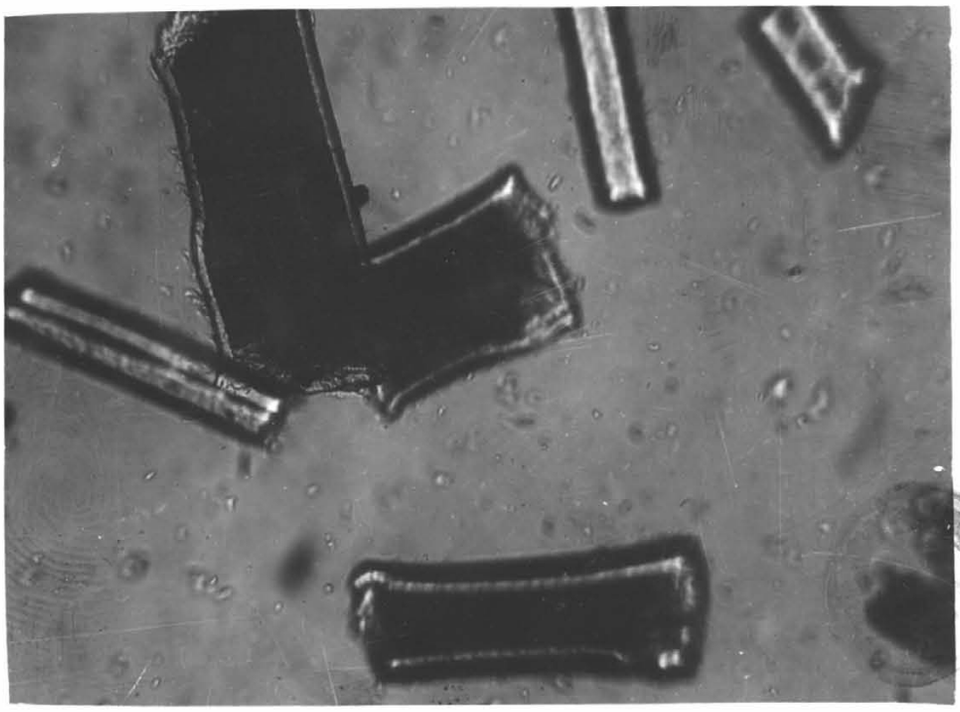
SUMMARY OF RESULTS FOR PARTIALLY MEDULLATED FIBRES IN MOHAIR/HAIR

Treatments	Angora T_1	Crossbred (50%) T_2	Local T_3
Mean	0.265	4.530	6.630
S.E.	±1.267		
C.D.	3.677		

The results shown in Table 4(b) clearly indicate that treatment T_1 is significantly superior as regards partially medullated fibres (per cent) than treatments T_2 and T_3. Further, though treatment T_2 is superior to T_3, there is no significant difference between the treatments.

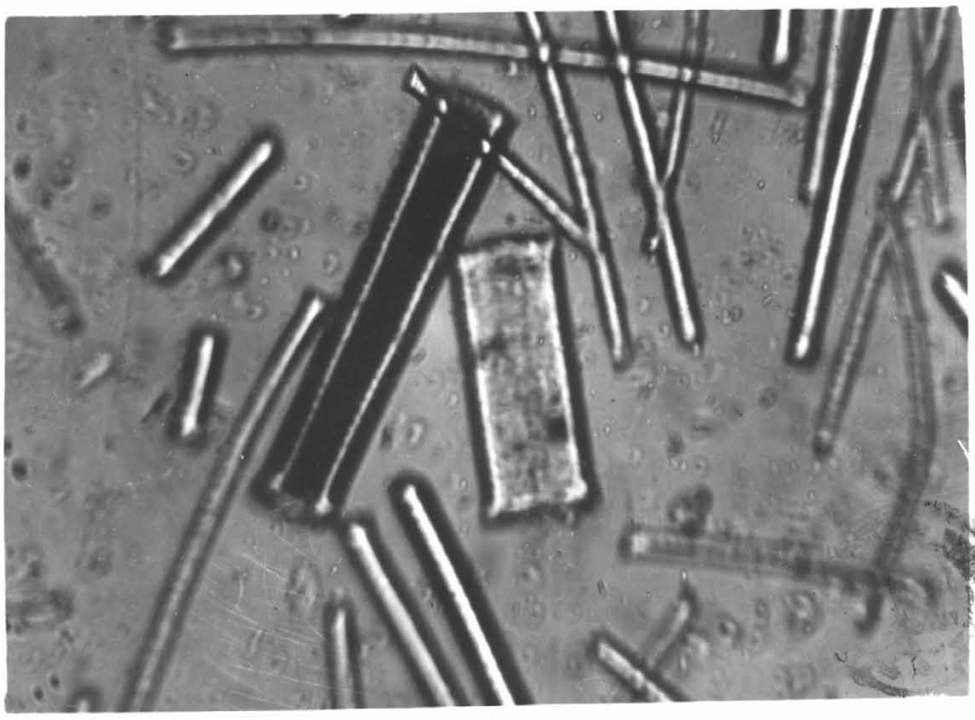
PLATE - V

(a)



HAIR FIBRES OF 50 % CROSSBRED
(MAGNIFICATION 110 X)

(b)



MOHAIR FIBRES OF 75 % CROSSBRED
(MAGNIFICATION 110 X)

TABLE 5

COMPLETELY MEDULLATED FIBRES IN MOHAIR/HAIR AS OBSERVED IN COATS

Angora		Crossbred (50%)		Local	
Tag No.	Av. completely medullated fibres %	Tag No.	Av. completely medullated fibres %	Tag No.	Av. completely medullated fibres %
A-8	1.00	C-1	14.67	L-109	89.34
A-5	0.66	C-2	81.66	L-165	85.00
A-19	4.33	C-3	67.00	L-172	91.34
A-13	1.33	C-4	81.67	L-79	94.00
A-18	1.66	C-5	52.33	L-34	73.66
A-7	0.33	C-6	69.00	L-59	79.00
A-11	1.66	C-7	86.00	L-16	77.00
A-22	3.00	C-8	77.00	L-58	83.33
A-12	0.33	C-9	72.67	L-146	91.34
A-2	2.33	C-22	84.61	L-43	77.00
Total	14.97		686.61		846.01
Mean	1.497		68.661		84.601
S.D.	2.189		462.6037		53.5910
S.E.	± 0.6922		146.2917		16.9473
C.V.%	1.4622		6.7375		0.6334

TABLE 5 c

ANALYSIS OF VARIANCE FOR COMPLETELY RANDOMISED DESIGN IN MOHAIR/HAIR

Source of Variance	D.f.	S.S.	M.S.S.	F cal	F table 5%	F table 1%
Between groups	2	38904.5377	19452.2688	112.97**	3.35	5.49
Error	27	4665.4546	172.7946			
Total	29	43569.9923				

** Highly significant

TABLE 5(b)

SUMMARY OF RESULTS FOR COMPLETELY RANDOMISED DESIGN IN MOHAIR/HAIR

Treatments	Angora T_1	Crossbred (50%) T_2	Local T_3
Mean	1.497	68.661	84.601
S.E.	± 4.1568		
C.D.	12.061		

The results of Table 5(b), reveal that treatment T_1 is significantly superior to treatments T_2 and T_3, and the treatment T_2 is significantly superior to T_3.

TABLE 6

* TOTAL MEDULLATION IN MOHAIR/HAIR AS OBSERVED IN GOATS

Angora		Crossbred (50%)		Local	
Tag No.	Av. medullation %	Tag No.	Av. medullation %	Tag No.	Av. medullation %
A-8	1.00	C-1	15.00	L-109	96.00
A-5	0.66	C-2	85.66	L-105	92.00
A-19	4.66	C-3	68.33	L-172	93.00
A-13	2.66	C-4	84.00	L-79	97.33
A-18	1.66	C-5	63.33	L-94	93.66
A-7	0.66	C-6	82.33	L-59	80.33
A-11	1.66	C-7	88.66	L-16	86.00
A-22	3.33	C-8	83.00	L-58	96.33
A-12	0.33	C-9	73.33	L-146	93.00
A-2	2.66	C-22	88.33	L-63	82.66
Total	19.28		731.97		912.31
Mean	1.93		73.20		91.23
S.D.	1.9194		491.9564		30.9715
S.E.	0.0069		155.5740		9.7942
C.V. %	0.9955		6.7255		0.3394

* - Total medullation includes partially and completely medullated fibres.

TABLE 6(a)

ANALYSIS OF VARIANCE FOR MEDULLATION IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F cal	F table 5%	F table 1%
Between groups	2	44598.4044	22299.2022	127.4610**	3.35	5.49
Error	27	4723.6271	174.9491			
Total	29					

** Highly significant

TABLE 6(b)

SUMMARY OF RESULTS FOR MEDULLATION IN MOHAIR/HAIR

Treatments	Angora T_1	Crossbred (50%) T_2	Local T_3
Mean	2.928	73.197	91.231
S.E.	± 4.1826		
C.D.	12.1357		

The results of Table 6(b) reveal that the treatment T_1 is significantly superior to treatments T_2 and T_3 and T_2 is significantly superior to T_3.

GRAPH III : VARIATION IN MEDULLATION OF MOHAIR/HAIR AS OBSERVED IN GOATS

Scale 2 cm = 10 per cent

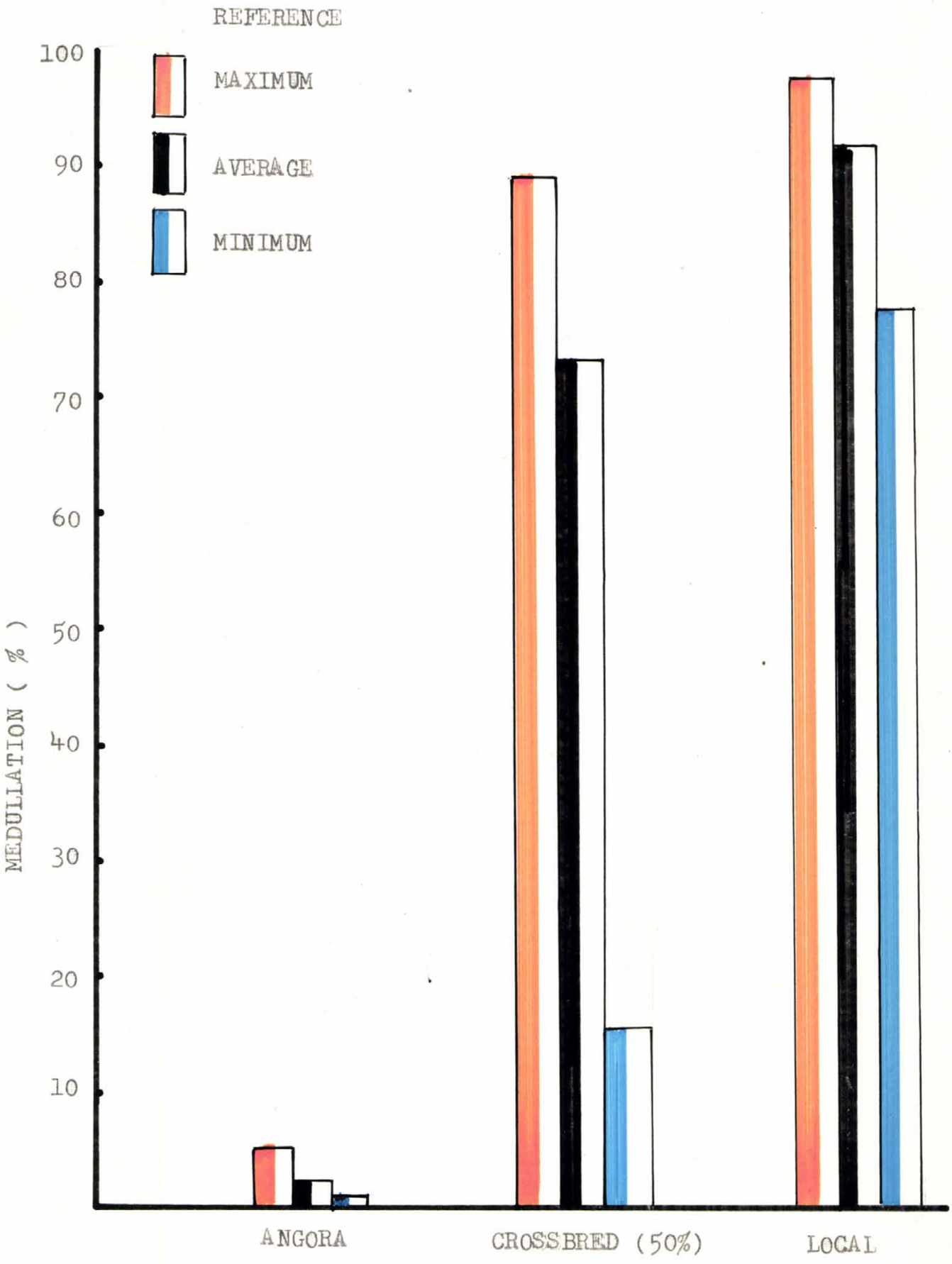


TABLE 7

TENSILE STRENGTH OF MOHAIR AS OBSERVED IN ANGORA GOATS

Tag No.	Date of birth	Age as on 10-9-75 Y.M.D.	Av. yield/year kg	Av. tensile strength gm
A-8	2-5-71	5-5-8	2.60	17.90
A-5	16-4-72	3-4-24	3.38	19.15
A-19	18-3-70	5-5-22	1.70	14.32
A-13	19-4-72	3-4-21	2.45	20.18
A-18	17-4-72	3-4-23	2.50	21.00
A-7	28-2-70	5-6-12	2.61	19.36
A-11	22-3-70	5-5-18	2.99	22.02
A-22	10-4-72	3-5-00	2.92	23.62
A-12	14-3-71	4-5-26	2.85	16.37
A-2	8-4-70	5-5-2	2.02	15.00
Total			26.02	199.920
Mean			2.60	18.092
S.D.				9.102
S.E.				± 2.878
C.V. %				0.481 %

No.of observations - 200.

TABLE 8

GREASE CONTENT IN MOHAIR/HAIR AS OBTAINED IN COATS

Angora		Crossbred (50%)		Local	
Tag No.	Grease %	Tag No.	Grease %	Tag No.	Grease %
A-8	7.0	C-1	2.06	L-109	2.66
A-5	6.5	C-2	1.02	L-165	0.61
A-19	6.0	C-3	1.08	L-172	0.37
A-13	5.5	C-4	3.30	L-79	0.46
A-18	6.2	C-5	1.78	L-54	0.59
A-7	6.0	C-6	1.05	L-59	0.90
A-11	6.8	C-7	1.89	L-16	0.60
A-22	6.5	C-8	1.76	L-58	1.24
A-12	7.2	C-9	1.39	L-146	0.51
A-2	6.3	C-22	1.89	L-63	0.63
Total	64.0		17.22		8.57
Mean	6.4		1.722		0.857
S.D.	0.2622		0.4591		0.4627
S.E.	0.0829		0.1451		0.1463
C.V. %	0.040968		0.2666		0.5399

No.of observations - 90.

TABLE 8(a)

ANALYSIS OF VARIANCE FOR GREASE CONTENT IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal	F table 5%	F table 1%
Between groups	2	177.8559	88.92	225.3621	3.35	5.49
Error	27	10.6568	0.3946			
Total	29					

** Highly significant

TABLE 8(b)

SUMMARY OF RESULTS FOR GREASE CONTENT IN MOHAIR/HAIR

Treatments	Angora T_1	Crossbred (50%) T_2	Local T_3
Mean	6.4	1.72	0.857
S.E.	± 0.1984		
C.D.	0.5755		

The results of Table 8(b) clearly indicate that the treatment T_1 has significantly higher per cent grease content than treatments T_2 and T_3, and T_2 has significantly higher per cent grease content than T_3.

GRAPH IV : VARIATION IN GREASE CONTENT IN FIBRES AS OBSERVED IN GOATS

Scale 2 cm = 1 per cent

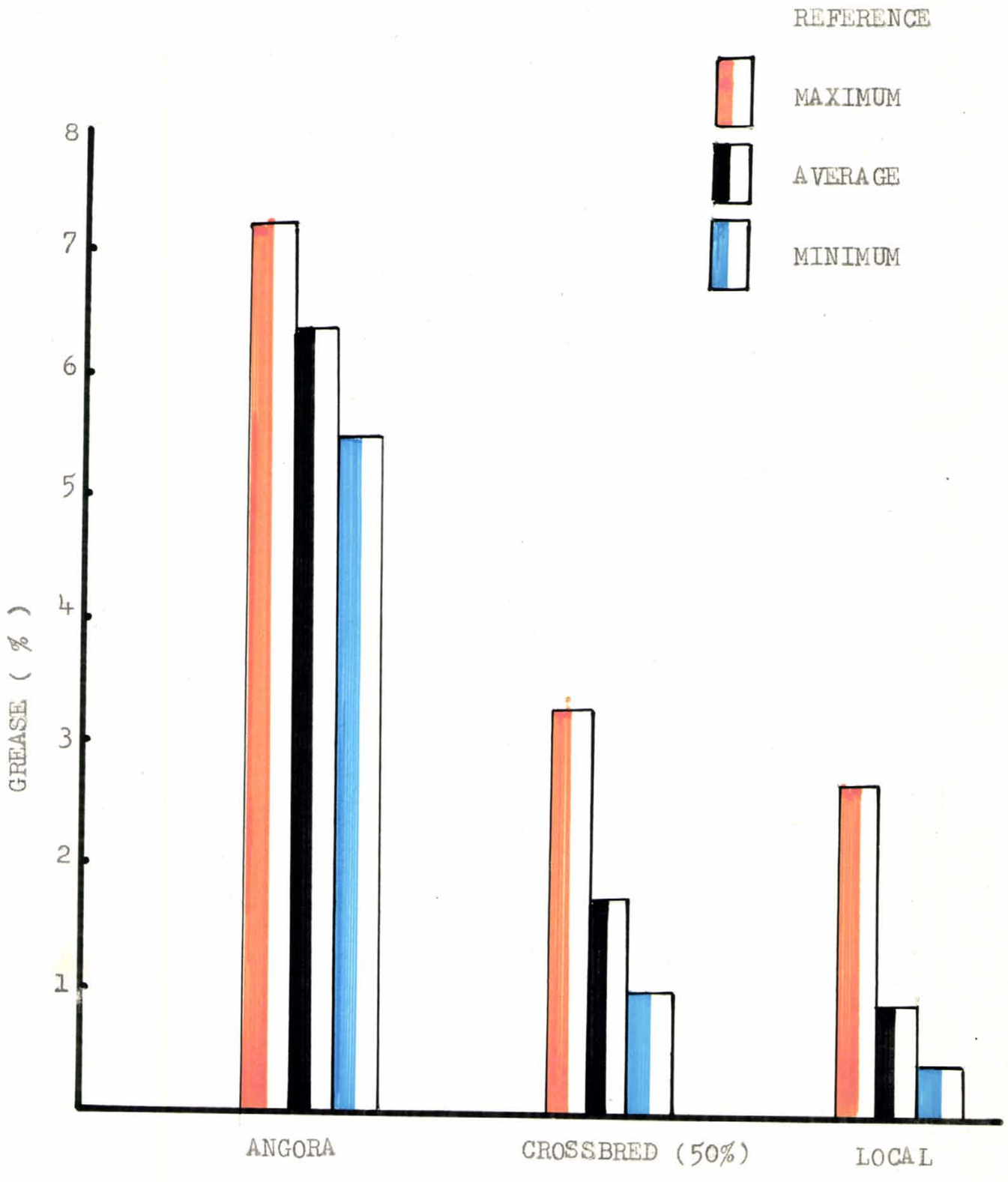


TABLE 9

MOISTURE CONTENT IN MOHAIR/HAIR AS OBTAINED IN COAT

Angora		Crossbred (50%)		Local	
Tag No.	Moisture %	Tag No.	Moisture %	Tag No.	Moisture %
A-8	8.2	C-1	5.89	L-109	5.74
A-5	8.8	C-2	6.18	L-165	6.59
A-19	9.2	C-3	5.77	L-172	6.53
A-13	9.4	C-4	6.28	L-79	6.64
A-18	8.1	C-5	5.65	L-54	5.92
A-7	8.2	C-6	6.39	L-59	5.60
A-11	8.2	C-7	6.21	L-16	6.05
A-22	8.4	C-8	6.46	L-58	6.55
A-12	8.9	C-9	6.64	L-146	7.14
A-2	9.1	C-22	6.12	L-63	6.08
Total	86.5		61.59		62.84
Mean	8.6		6.2		6.3
S.D.	0.2361		0.0974		0.2307
S.E.	0.0746		0.0308		0.0729
C.V. %	0.0272		0.0158		0.0367

No.of observations - 90.

TABLE 9(a)

ANALYSIS OF VARIANCE FOR MOISTURE CONTENT IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal	F table 5%	F table 1%
Between groups	2	39.3955	19.6977	104.71**	3.35	5.49
Error	27	5.0794	0.1881			
Total	29	44.4749				

** Highly significant

TABLE 9(b)

SUMMARY OF RESULTS FOR MOISTURE CONTENT IN MOHAIR/HAIR

Treatment	Angora T_1	Crossbred(50) T_2	Local T_3
Mean	8.65	6.28	6.16
S.E.	± 0.137		
C.D.	0.3976		

The results of Table 9(b) clearly indicate that the treatment T_1 has significantly higher per cent moisturecontent than treatments T_2 and T_3. The treatments T_3 and T_2 are, however, at par with each other.

GRAPH V : VARIATION IN MOISTURE CONTENT IN MOHAIR/HAIR AS OBSERVED IN GOATS

Scale 1.5 cm = 1 per cent

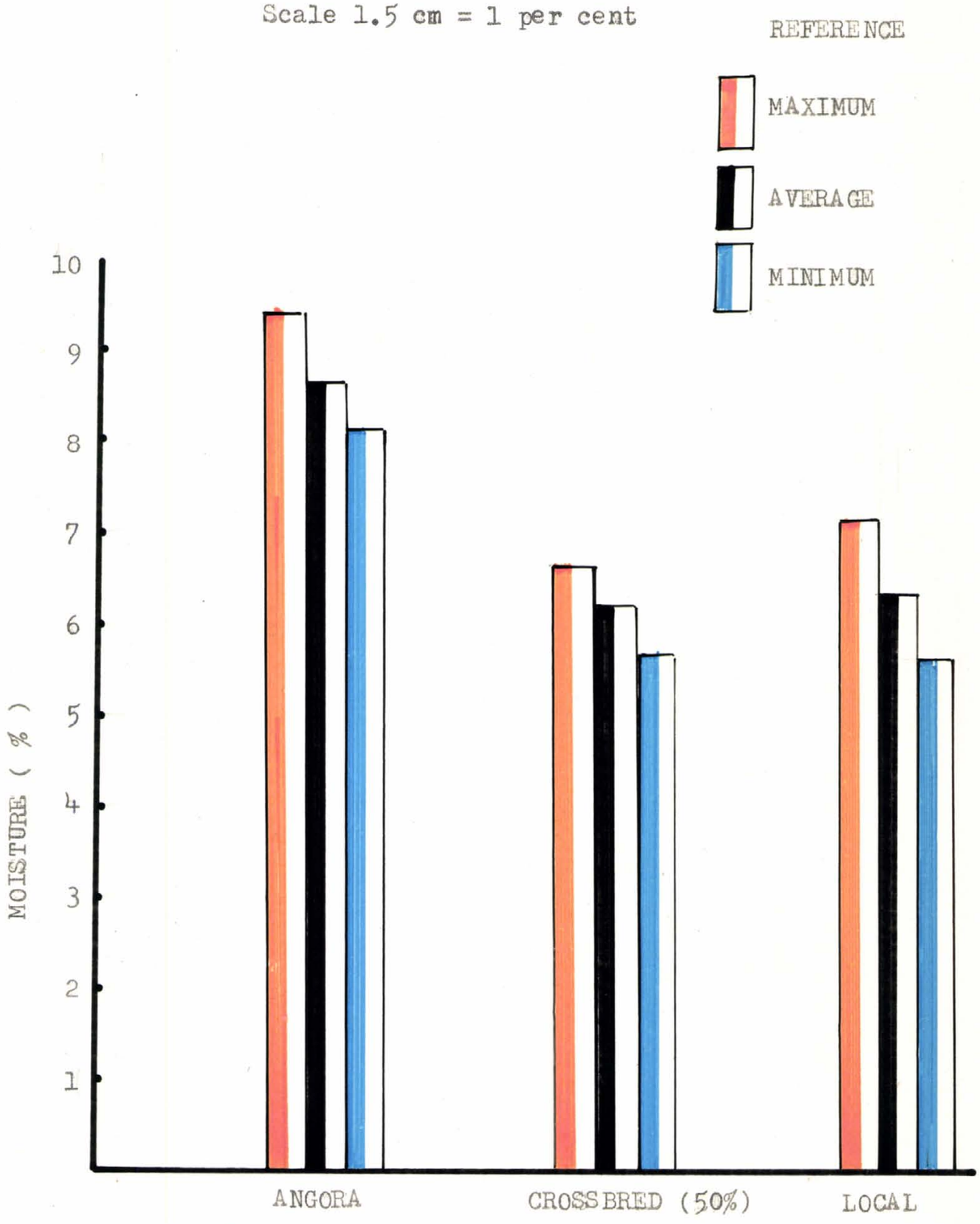


TABLE 10

SUINT CONTENT IN MOHAIR/HAIR AS OBSERVED IN GOATS

Angora		Crossbred (50%)		Local	
Tag No.	Suint %	Tag No.	Suint %	Tag No.	Suint %
A-8	2.73	C-1	2.50	L-109	6.87
A-5	1.23	C-2	3.94	L-165	3.47
A-19	3.01	C-3	2.75	L-172	3.20
A-13	2.38	C-4	3.08	L-79	7.94
A-18	3.03	C-5	2.50	L-54	3.12
A-7	2.40	C-6	2.42	L-59	4.14
A-11	3.23	C-7	3.32	L-16	3.50
A-22	1.56	C-8	2.35	L-58	6.08
A-12	3.06	C-9	2.15	L-146	3.24
A-2	2.62	C-22	3.85	L-63	4.77
Total	25.28		28.46		46.33
Mean	2.528		2.846		4.633
S.D.	0.4242		0.3255		3.0239
S.E.	0.1341		0.1029		0.9562
C.V. %	0.1678		0.1143		0.6526

No. of observations - 90.

TABLE 10(a)

ANALYSIS OF VARIANCE FOR SUINT CONTENT IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal	F table 5%	F table 1%
Between groups	2	25.7517	12.8750	10.2367**	3.35	5.49
Error	27	33.9630	1.2578			
Total	29					

** Highly significant

TABLE 10(b)

SUMMARY OF RESULTS FOR SUINT CONTENT IN MOHAIR/HAIR

Treatments	Angora T_1	Crossbred(50%) T_2	Local T_3
Mean	2.528	2.846	4.633
S.E.	± 0.3545		
C.D.	1.028		

The results Table 10(b) clearly indicate that the treatment T_3 has significantly higher suint content than treatments T_2 and T_1. Further, though treatment T_2 has greater suint content than T_1, they do not differ significantly.

GRAPH VI : VARIATION IN SUINT CONTENT IN MOHAIR/HAIR AS OBSERVED IN GOATS

Scale 2 cm = 1 per cent

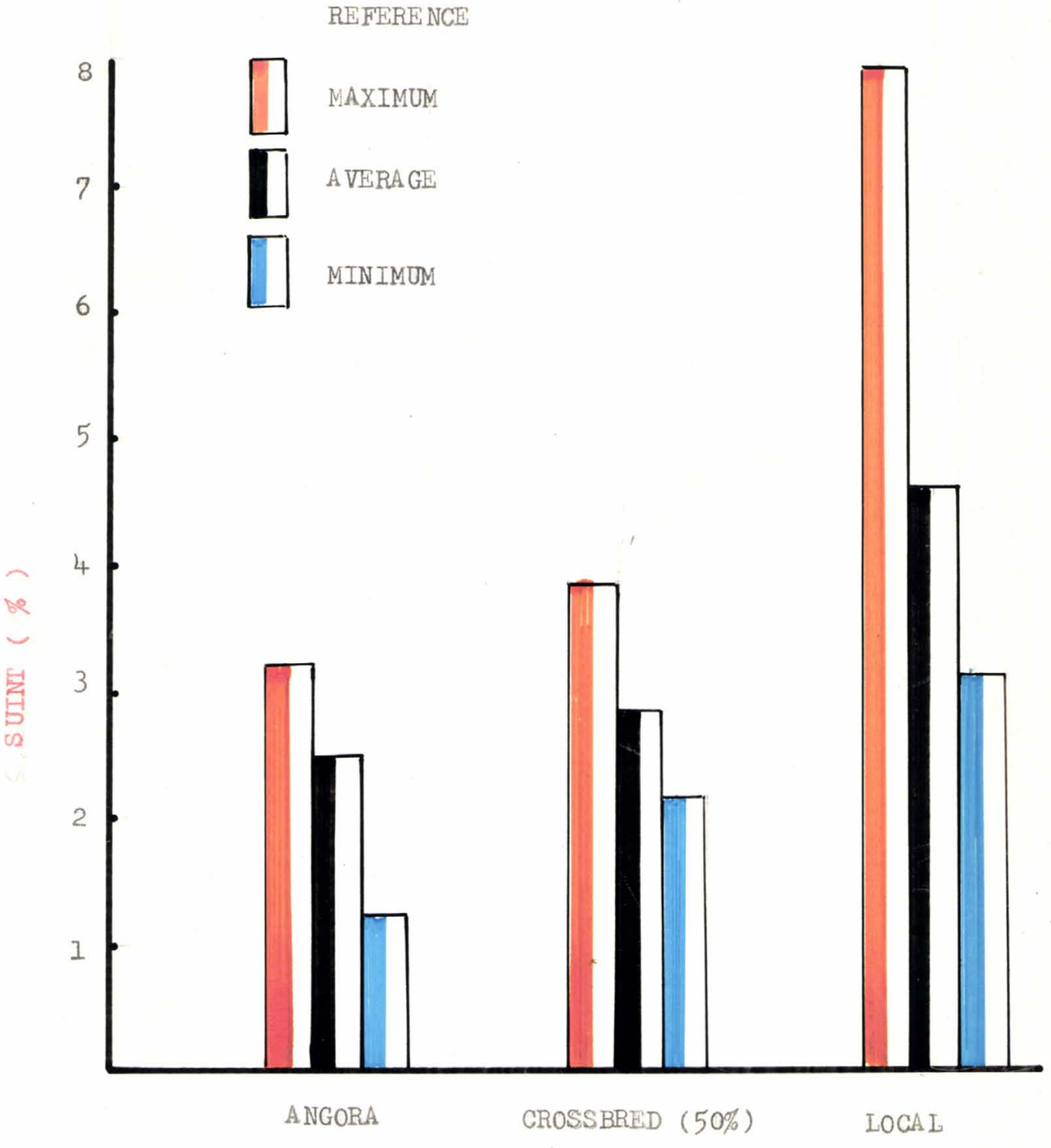


TABLE 11

NITROGEN CONTENT IN MOHAIR/HAIR AS OBSERVED IN GOATS

Angora		Crossbred (50%)		Local	
Tag No.	Nitrogen %	Tag No.	Nitrogen %	Tag No.	Nitrogen %
A-8	14.51	C-1	17.68	L-109	16.48
A-5	14.09	C-2	16.77	L-165	15.41
A-19	16.67	C-3	16.74	L-272	16.06
A-13	16.32	C-4	16.80	L-79	16.74
A-18	15.68	C-5	17.00	L-94	16.98
A-7	17.48	C-6	16.58	L-59	17.08
A-11	16.70	C-7	16.48	L-16	16.87
A-22	15.15	C-8	16.30	L-58	16.96
A-12	17.08	C-9	16.83	L-146	16.42
A-2	16.69	C-22	16.56	L-43	15.73
Total	160.37		167.74		164.73
Mean	16.038		16.774		16.473
S.D.	1.2837		0.1412		0.3274
S.E.	0.4059		0.0446		0.1035
C.V. %	0.080		0.0084		0.0198

No. of observations - 90.

TABLE 11(a)

ANALYSIS OF VARIANCE FOR NITROGEN CONTENT IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal	F table 5%	F table 1%
Between groups	2	2.7462	1.3731	2.003 NS	3.35	5.49
Error	27	18.51	0.6855			
Total	29					

NS = Not significant

TABLE 11(b)

SUMMARY OF RESULTS FOR NITROGEN CONTENT IN MOHAIR/HAIR

Treatments	Crossbred (50%) T_2	local T_3	Angora T_1
Mean	16.774	16.473	16.037
S.E.	± 0.2617		
C.D.	———		

It is clear from the results in Table 11 (b) that there are no significant differences between nitrogen contents of the 3 treatments, viz., T_1, T_2 and T_3.

TABLE 12

SULPHUR CONTENT IN MOHAIR/HAIR AS OBTAINED IN GOATS

Angora		Crossbred (50%)		Local	
Tag No.	Sulphur %	Tag No.	Sulphur %	Tag No.	Sulphur %
A-8	3.18	C-1	2.62	L-109	1.96
A-5	2.85	C-2	2.07	L-105	2.30
A-19	4.47	C-3	2.50	L-172	2.50
A-13	3.43	C-4	2.16	L-79	2.17
A-18	2.95	C-5	2.60	L-54	2.50
A-7	3.55	C-6	2.25	L-59	2.95
A-11	4.16	C-7	1.90	L-16	2.75
A-22	3.69	C-8	2.27	L-58	2.41
A-12	3.66	C-9	2.44	L-146	2.02
A-2	3.82	C-22	2.07	L-63	2.72
Total	35.96		22.88		24.28
Mean	3.59		2.28		2.42
S.D.	0.5999		0.0599		0.1045
S.E.	0.1897		0.0189		0.033
C.V. %	0.167		0.026		0.043

No.of observations = 90.

TABLE 12(a)

ANALYSIS OF VARIANCE FOR SULPHUR CONTENT IN MOHAIR/HAIR

Source of Variation	D.F.	S.S.	M.S.S.	F Cal	F table 5%	F table 1%
Between groups	2	10.3156	5.1578	35.7091**	3.35	5.49
Error	27	3.87920	0.1436			
Total	29					

** Highly significant

TABLE 12(b)

SUMMARY OF RESULTS FOR SULPHUR CONTENT IN MOHAIR/HAIR

Treatments	Angora T_1	local T_3	Crossbred (50%) T_2
Mean	3.596	2.428	2.208
S.E.	± 0.1195		
C.D.	0.3465		

The results of Table 12(b) clearly indicate that the treatment T_1 has significantly higher sulphur content than the treatments T_3 and T_2. Further, though the treatment T_3 has higher sulphur content than T_2, it does not different significantly from T_2.

GRAPH VII : VARIATION IN SULPHUR CONTENT IN MOHAIR/HAIR AS OBSERVED IN GOATS

Scale 3 cm = 1 per cent

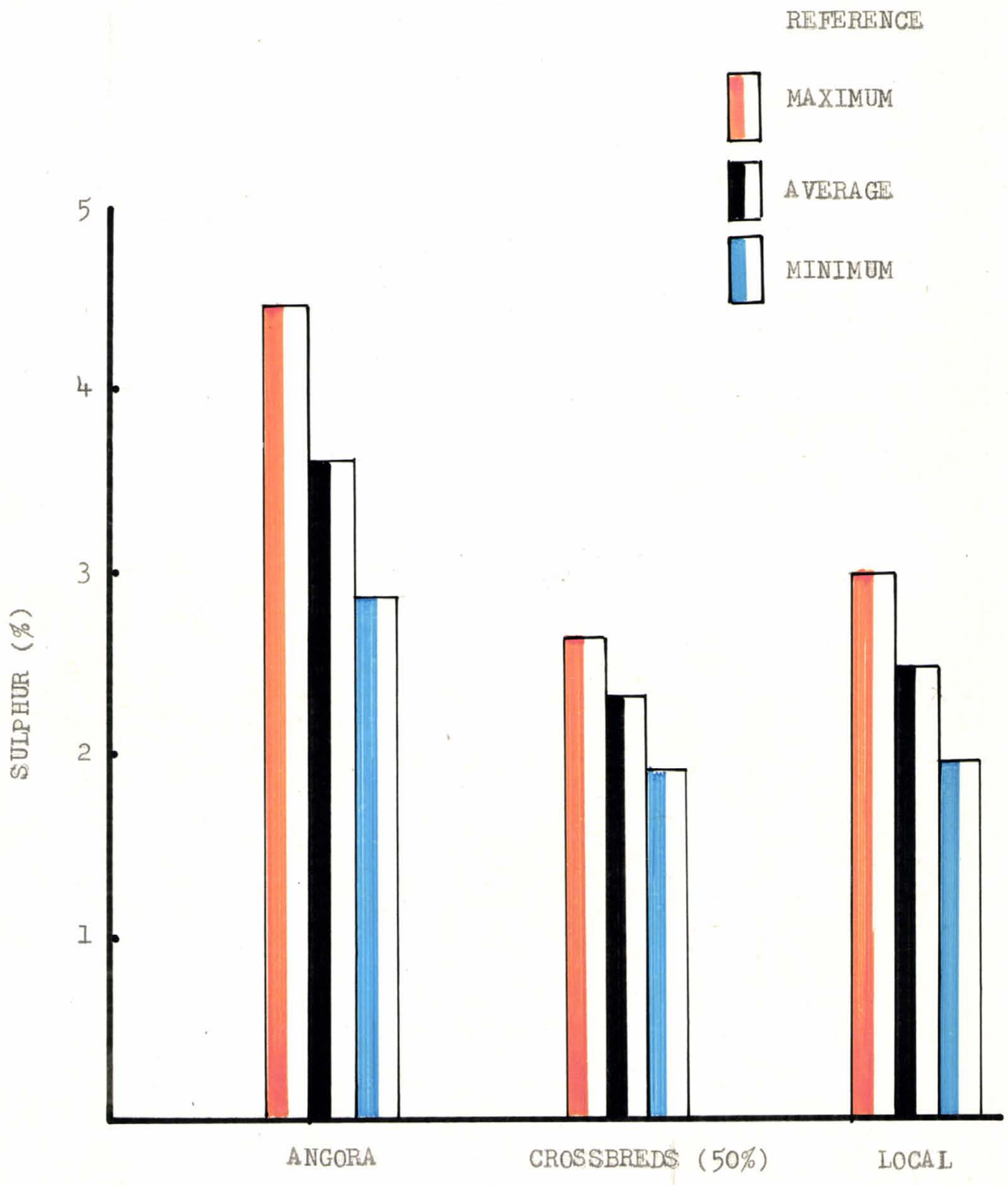


TABLE 13

CONSOLIDATED STATEMENT SHOWING PHYSICO-CHEMICAL ATTRIBUTES OF MOHAIR/HAIR AS OBSERVED IN GOAT

Attribute	Av. values (of 10 animals each)		
	Angora	Crossbred(50%)	Local
Fibre density (No./sq cm)	1197.60	-	-
Staple length (cm)	9.58	3.90	2.91
Fibre diameter (microns)( )	30.09	89.74	102.72
Partially medullated fibre(%)	0.27	4.53	6.63
Completely medullated fibre(%)	1.50	68.66	84.60
Total medullation (%)	1.92	73.20	91.23
Tensile strength (gm/cm)	18.89	-	-
Grease content (%)	6.40	1.72	0.86
Moisture content (%)	8.60	6.16	6.30
Suint content (%)	2.52	2.85	4.63
Nitrogen content (%)	16.04	16.77	16.47
Sulphur (%)	3.60	2.29	2.43

TABLE 14

CORRELATION COEFFICIENT FOR VARIOUS PHYSICO CHEMICAL ATTRIBUTES OF MOHAIR/HAIR AS OBSERVED IN COATS

characters studied	Angora "r"	Crossbred (50.5) "r"	Local "r"
Fibre Diameter x Density	+ 0.58 NS	-	-
Fibre Diameter x Medullation %	- 0.20 NS	0.65 *	0.31 NS
Fibre Diameter x Tensile strength	+ 0.90 **	-	-
Fibre Diameter x Grease %	- 0.13 NS	- 0.34 NS	-0.27 NS
Fibre Diameter x Suint %	- 0.54 NS	+ 0.01 NS	+0.06 NS
Fibre Diameter x Sulphur %	- 0.25 NS	- 0.123NS	-0.0034 NS
Fibre Density x Staple length	+ 0.54 NS	-	-
Fibre density x Medullation %	- 0.82 **	-	-
Fibre Density x Tensil strength	+ 0.50 NS	-	-
Fibre Density x Sulphur %	+ 0.57 NS	-	-
Medullation x Sulphur %	- 0.68 *	- 0.767**	-0.819 **
Tensile Strength x Medullation %	- 0.13 NS	-	-
Tensile strength x Sulphur %	- 0.33 NS		

NS = Not significant
* = Significant at 5 per cent level of significance
** = Significant at 1 per cent level of significance
\- = Characters not studied

Correlation coefficient at 5 per cent levels of significance and at 8 degrees of Freedom = 0.632.

Correlation coefficient at 1 per cent levels of significance and at 8 degrees of Freedom = 0.765.

CHAPTER V

D I S C U S S I O N

CHAPTER V

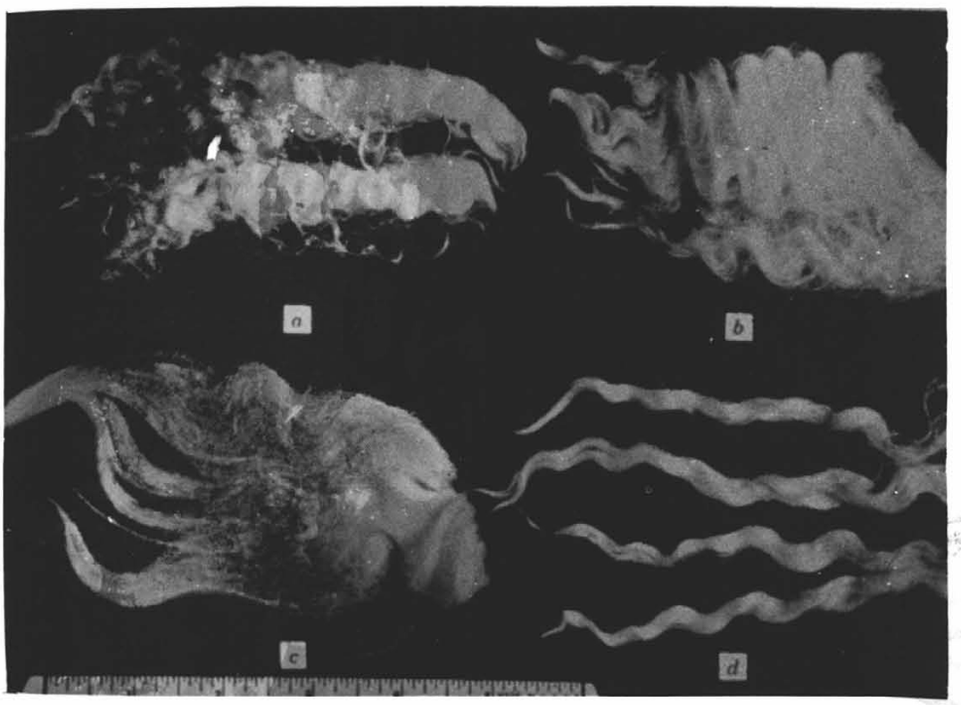
D I S C U S S I O N

The investigation on physico-chemical attributes of Mohair/hair from Angora, local and their crossbreds (50%) were completed at the All India Co-ordinated Research Project on Goat for Mohair Production at the Central Campus, Rahuri. The results obtained from this study are briefly discussed in the following pages.

The results in respect of yield and fibre density of Mohair as observed in Angora goats are given in Table 1. It is seen from the data that the average yield per adult female Angora goat was 2.6 kg with a range of 1.7 to 3.38 kg. The average fibre density in numbers per sq cm was 1198 fibres with a range of 670 to 1525 fibres. This shows that there was a considerable amount of variation both in yield of Mohair as well as the fibre density. These facts should be borne in mind while using the exotic germ plasm to cross with local goats for obtaining better performance in future progeny. The fibre density studies in case of local goats and crossbreds could not be carried due to the short staple lengths of their hair coating. The yields of Mohair per adult female are lower than those reported by Lemaitre (1969). This might be due to the fact that the Angora foundation stock used in this project was purchased from the Himachal Pradesh Government where it was highly inbred due to non introduction of unrelated animals.

The data presented in Table 2 give information about the staple length of Mohair/hair observed in Angora, local and

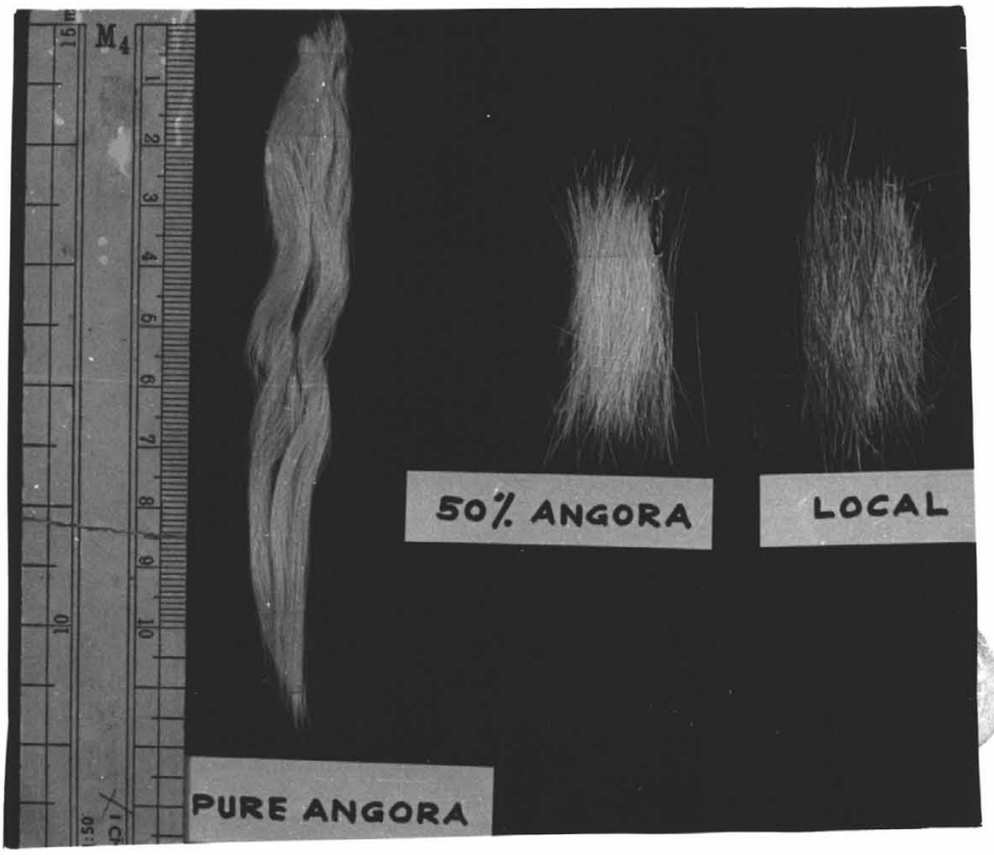
PLATE VI (a)



LOCK TYPES OF MOHAIR

a) Web lock b) Flat lock c) Lock from an older goat showing loss of character d) Tight lock or ringlet.

PLATE VI(b)



MOHAIR / HAIR FIBRES

crossbred females. The average staple length in Angora Mohair was 9.58 cm with a range of 8.7 to 10.40 while in local goats, it was 2.91 cm with a range of 2.63 to 3.15. The average staple length of Crossbred (50%) hair was 2.9 cm with a range of 2 to 3.5 cm. It is seen from the staple length of hair from local and crossbred females that there was not much difference in it. This shows that at 50 per cent exotic blood level, the characters for staple length were not transmitted in crosses by Angora. This emphasises the need of increasing the exotic blood level in crossbred progeny to get the advantage of staple length from the Angora. Even in this case, there is a need of selecting Angora males with long staple length for crossing with the local goats or crossbred (50%) progeny. In this investigation the staple length in crossbred (50%) was observed to be short, which is quite contradictory to the longer staple length of F_1's (Angora x local) reported by Kheera (1965). This might be due to breed differences as the Jamnapari which is local parent of the experimental crossbreds also has very short hair. The staple lengths observed in the experimental Angoras were more or less, in agreement with those reported by Levi (1946), Batu and Ohmer (1947), Von Bergen (1963), Ghani and Ishaq (1965). However, contradictorily high staple length has been reported for Mohair from Turkish Angora by Cozzi (1968). The results obtained on staple length are shown graphically in Graph I and Plate VI (b).

The studies on diameter of Mohair/hair as observed in

Angora, local and crossbred (50%) are presented in Table 3. It is seen that the average fibre diameter in Angora was 30.092 microns, with a range from 25.33 to 34.24 while in case of crossbred (50%), it was 89.743 microns with a range of 17.68 to 128.09. In case of local goats, the average fibre diameter was 102.724 microns with a range of 75.01 to 130.92. It is seen from the fibre diameter studies that there is uniformity in fibre diameter of Angora and local goats while there was maximum variation in the fibre diameter of hair from the crossbred goats. In crossbred goat number C-1, the average fibre diameter was 17.68 microns while in case of C-5 it was 128.09. This shows that there is a tremendous amount of variation in the fibre diameter of crossbreds (50%). The work planned on selection differential basis may help to give solutions for obtaining Mohair from the crossbred (50%). Unless this work is planned systematically and the final solution is obtained, the statement that the F_1 crossbred progeny with 50 per cent exotic blood level does not produce Mohair, may not stand correct.

Wide controversies exist amongst various scientists regarding the fibre diameter of F_1 crosses (Angora x Indigenous). Levi (1946) reported a better uniformity of fibre fineness in F_1 crosses of Angora and indigenous goats of Russia. Pant and Kapri (1968) reported average fibre diameter of F_1 (Angora x Gaddi) which was not far different from the fibre diameters of the experimental Angoras. On the contrary, Hall (1968) reported no Mohair production in F_1's of Angora and Gaddi goats.

Similarly, Iskin reported that the crosses of Hardy Kanangan goats and Angoras were strong. However, they produced a fleece of no appreciable improvement over the local animals. Bhatia (1963) and Khoora (1965) reported the fibre diameters of F_1's which were bred at the same breeding station (Pune). The results reported by them were contrary to each other. These variations are quite in agreement with those observed in the present investigation. The results on fibre diameter are also shown graphically in Graph II and Plates IV(a) and IV(b). and V(a).

Data in respect of partially and completely medullated fibres and total medullated fibres are presented in Tables 4, 5 and 6, respectively. It is observed that the completely medullated fibres are more common in case of local and crossbred goats while in case of Angoras, the percentage of total medullation is hardly 1.93 as against 91.23 and 73.20 in local and crossbred (50%), respectively.

It is encouraging to note from the results presented in Table 6 that the percentage of total medullated fibres had come down from 91.23 in local goats to 73.2 in crossbred (50%). Similar trend was observed in case of partially and completely medullated fibres. This gives a ray of hope that there is a scope to bring improvement in crossbred (50%) progeny if the advantage of selection differential is taken while planning for research. The results for total medullation in Angora are in close agreement with those reported by Von Bergen (1963). Pant (1969), however, reported higher medullation in Angoras. At

the same time, be reported markedly lower values for crossbred (50%) and Gaddi local goats. The results on medullation have also been shown graphically in Graph III and Plate IV(a) and IV(b) and V(a).

The observations regarding the tensile strength of Mohair as observed in Angora goats are given in Table 7. The average tensile strength was 18.892 gm with a range of 14.32 to 23.62. The variation shown in tensile strength of Mohair fibres indicated that the Mohair fibres were having more or less similar tensile strength. The findings of this investigation more or less agree with Guillani (1967) and Cosy (1968) for South African Mohair. However, the results of Turkish Mohair reported by him are lower than latter samples as well as the experimental Angoras.

The data regarding grease content in Mohair/hair as observed in goats under study are given in Table 8. The average grease content in Angora was 6.4 per cent as against 0.857 per cent in local goats while in crossbreds, it was 1.722 per cent. It is evident from the studies that with fine fibre, grease content also increases. This is also observed by Von Bergen (1963). The data obtained for grease content in Mohair of Angoras, closely resemble that reported by Van Wyk (1958) for South African Mohair. The grease content in the 3 experimental groups studied is shown graphicall in Graph IV.

The data in regard of Moisture content of Mohair/hair are presented in Table 9. The average moisture contents in Angora, crossbred (50%) and local goats were 8.6, 6.2 and 6.3 per cent, respectively. This shows that moisture content in Mohair fibre

was more than in hair fibres of crossbred and local goats. However, the latter 2 did not differ in moisture content. These results are graphically shown in Graph V.

The observations on suint content in Mohair/hair as observed in goats under study are shown in Table 10. The average suint content in Angora, crossbred (50%) and local goats were 2.528, 2.846, and 4.633 per cent, respectively, indicating that the suint content in local goat was significantly higher than Angora and crossbreds while the difference in suint contents in Mohair from Angora and hair fibre from crossbreds was not significant. The results for Angora as regards suint content are slightly higher than those reported by Van Wyk et al. (1958). This can, however, be attributed to the environment of Rahuri which has rather dry climate. The variation in suint content amongst the 3 experimental groups is shown graphically in Graph VI.

The data on nitrogen content in Mohair/hair as observed in Angora, crossbred (50%) and local goats are given in Table 11. The average nitrogen content in Angora, crossbred (50%) and local goats were 16.037, 16.774 and 16.473 per cent, respectively indicating that there was no difference in nitrogen content. The observations on nitrogen content are in agreement with Ward et al. (1955) and Von Bergen (1963) who found Mohair to resemble wool in its chemical composition and figures obtained for all the 3 experimental groups are in confirmation with nitrogen contents reported by various authors for wool, viz., Geiger (1944), Simmonds (1954), Von Bergen (1954),

Simmonds (1956), Patil (1966), Ghanekar and Hantwadekar (1973).

The observations made on sulphur content in Mohair/hair as observed in goats under study are presented in Table 12. The average sulphur contents in Angora, crossbreds (50) and local, were 3.59, 2.28 and 2.42 per cent, respectively. It is observed that the difference in sulphur content in Angora Mohair is significantly higher than the sulphur content in hair of crossbred and local goats. However, the difference in sulphur content in hair of local and crossbred goats is not significantly different. The sulphur content of Mohair from Angora goats included in the study are in close agreement with those reported for Turkish Mohair fleeces by Von Bergen (1963). They are, however, more than those of Texas Kid Mohair reported by the same authority. The local and crossbred (50%) had lower sulphur content. This could be attributed to the higher suint contents which according to Nandurkar et al. (1975) are responsible for damaging the Mohair thereby reducing the sulphur content. The variation in sulphur content of Mohair/hair is shown in Graph VII.

The data presented in Table 13 give the consolidated statement showing the various physico-chemical attributes of Mohair/hair studied under this investigation. It is broadly observed that eventhough, fibres in crossbred (50%) did not show the transformation of hair from local goat into Mohair characters, it give the clear cut indication that the process of transformation of local goat hair towards the Mohair quality

had already started. It is just possible that sufficient percentage of Angora blood is not in the progeny which will bring the complete transformation of local goat hair into Angora fibre. Perhaps the 75 per cent Angora blood level may throw light on this.

The correlation coefficients for various physico-chemical attributes of Mohair/hair as observed in Angora local and crossbreds (50%) are reported in Table 14.

It is seen from the data that very few characters are significantly correlated with each other. There was a significantly negative correlation between medullation and sulphur content in all three groups. This could be explained by the observations made by Haritt and King (1928) and Larose and Tweddle (1937) who found that the medullae were absolutely free of sulphur. Hence, the higher the medullation, the lower the sulphur content. The medullation per cent was observed to be correlated only with fibre diameter. However, this relation was only true in crossbreds.

The characters studied only in Angora, viz., fibre density and tensile strength were observed to be significantly correlated only with medullation per cent and fibre diameter, respectively.

The tensile strength was observed to increase with increasing diameters. This is also observed by Guillermo (1946) for Angora goats, and by Kheera (1963). The latter reported this relationship in Deccani sheep.

The fibre density is negatively correlated with medullation. This could be explained by the fact that the medullated fibres are more often than not larger in diameter as compared with the non-medullated fine fibres of the Angora fleece. It is thus evident that the density which is represented by number of fibres per sq cm will be less with more number of medullated fibres.

The other correlations studied viz, fibre diameter and fibre density, fibre diameter and suint, fibre diameter and sulphur, fibre density and staple length, fibre density and tensile strength, fibre density and sulphur, tensile strength and medullation and tensile strength and sulphur. These correlations were observed not to be significant.

The fibre diameter is reported by Von Bergen (1963) to be correlated with grease. However, he mentioned that the relationship may not obtain over narrower ranges of diameter which is exactly the case in the present study.

CHAPTER VI

SUMMARY AND CONCLUSIONS

CHAPTER VI

SUMMARY AND CONCLUSIONS

The present investigation on the physico-chemical attributes of Mohair/hair from Angora, local and their crossbred (50%) goats was completed at the All India Co-ordinated Research Project on Goat for Mohair Production, Mahatma Phule Krishi Vidyapeeth, Rahuri. The data obtained on the physico-chemical attributes were analysed statistically for three treatment groups viz. Angora, local and crossbred (50%) goats. The results obtained are summarised below.

A. PHYSICAL ATTRIBUTES

1. Fibre Density

The fibre density was estimated in Angora goats only. The average fibre density was 1197 with the range of 670 to 1525 fibres per sq cm. Co-efficient of variation was 34.27 per cent.

2. Staple Length

The staple length of Mohair/hair varied from 8.7 to 10.4 cm in Angora, 2.63 to 3.15 in local goats and 2.0 to 3.5 cm in crossbreds (50%). There was no improvement in the staple length of crossbreds (50%) over local goats.

3. Fibre Diameter

The average fibre diameter in Mohair from Angora was

30.9 microns with the range of 25.33 to 34.24 as against 102.72, with the range of 75.01 to 110.92 microns in the hair of local goats and 89.74, with the range of 17.68 to 128.09 microns in crossbred (50%) goats. There was no significant difference between local and crossbred goats. However, a single crossbred (50%) was having fibre diameter of 17.68 microns which was even finer than the Angora of the experimental group. This shows that there are large variations in the fibre diameter of crossbred (50%) goats, indicating the potentiality for further work.

4. Medullation

The per cent of medullated fibres ranged from 0.33 to 4.66 in Angora, 82.33 to 97.33 in local goats and 15.00 to 88.66 in crossbred (50%) goats. The Angora is having significantly lower percentage of medullation than crossbred and local goats, while medullation per cent of crossbred is significantly lower than local goats. The large variations in medullation per cent in the hair of crossbred shows the potentiality for the further work. The medullated fibres were of two types, partially medullated and completely medullated. The later showed a similar trend as was noticed in total medullation. However, there was no significant difference between crossbred and local goats as regards partially medullated fibre per cent.

5. Tensile Strength

The tensile strength was only measured in Angora fleeces. It averaged 18.89 gms and ranged from 14.32 to 23.62 gms. The fibres of the crossbred and local goats were too short to be mounted on the tensile strength measuring apparatus, hence, their tensile strength could not be determined.

B. CHEMICAL ATTRIBUTES

1. Grease

The average percentage of grease in the Mohair from Angora was 6.4 with the range of 5.5 to 7.2, as against 0.86 per cent with the range of 0.37 to 2.6 in hair of local goats. In case of hair of crossbred (50%) the average percentage of grease was 1.72 with the range of 1.02 to 3.33. This shows that grease percentage increases in crossbreds as compared to local goats, but it is considerably less as compared to Angora.

2. Moisture

The average percentage of moisture in Angora Mohair was 8.6 per cent with the range of 8.1 to 9.4 as against 6.3 per cent with the range of 5.6 to 7.4 in the hair of local goats. The average moisture percentage in the hair of crossbreds was 6.16 with the range of 5.65 to 6.64. This shows that there is no difference in moisture content of the hair of local and crossbred goats.

3. Suint

The average percentage of suint in case of Mohair from Angora was 2.52 with the range of 1.23 to 3.23 as against 4.63 with the range of 3.12 to 7.94 in the hair of local goats. The average suint percentage in hair of crossbreds was 2.85 with the range of 2.15 to 3.85. This shows that there is no difference in the suint content of Angora and crossbred, while their is significant difference in the suint content of local goats over crossbred and Angora.

4. Nitrogen

The average nitrogen contents in Angora, local and crossbred goats were 16.03, 16.47 and 16.77 per cent, respectively. The nitrogen content does not show any appreciable difference in the Mohair and hair of Angora, local and crossbred goats.

5. Sulphur

The average sulphur per cent in Angora Mohair was 3.6 with the range of 2.85 to 4.47, while in hair of local goats it was 2.43 with the range of 1.96 to 2.95. In case of crossbreds it was 2.29 with the range of 1.9 to 2.62. This shows that the difference in sulphur content of Mohair was significant over the hair of local and crossbred goats, while there was no difference between the later two.

C. CORRELATION STUDIES

Significant correlations were observed between medullation per cent and sulphur content in all three groups. However, the correlation of fibre diameter and medullation was observed to be significant only in crossbred goats. Tensile strength and fibre density, which was studied in Angoras only, were observed to be highly significantly correlated with fibre diameter and medullation, respectively.

No definite conclusions can be drawn from this study as the physico-chemical characters studied do not show any conspicuous difference in the hair of local and crossbred (50%) goats. It is, however, felt that there is a gradual change in crossbred hair towards Mohair characters. The further increase of exotic blood level in local goats may reveal, whether it is possible to get Mohair of desired quality. It is suggested that the work on 62.5 and 75 per cent blood level be undertaken to find the answer to this problem.

LITERATURE CITED

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Aljaev, G.V.

1965 Mohair goats in Siberia.
A.B.A. Vol. 34, 222.

Al'Meev, I.A.

1973 New type of down goat from the Dzhangi-Bzhol State Farm.
A.B.A. Vol. 41 (10), 502.

Al'Meev, I.A. and Ermeeva, T.S.

1974 Fur qualities of Kirgiz goats.
A.B.A., Vol. 42 (6), 267.

Anonymous,

1952 Wool preparation and marketing.
Regional report, Wyoming Agricultural Experimental Research Station, Bulletin No. 316.

Anonymous,

1965 Indian Standard - "Method for determination of per cent of medullated fibres in wool".
I.S.I. Bull. No. 2099.

Anonymous,

1966 Indian Standard - "Method for determination of wool fibre diameter (projection microscope method)".
I.S.I. Bull. No. 744.

Anonymous,

1971 News and Notes.
A.B.A., Vol. 39, 617.

Anonymous,

1972 Indian Standard - "Method for determination of staple length of Greasy wool.
I.S.I. Bull. No. 6653.

Anonymous,

1974 Topics for the month - New Mohair body formed.
Wools and woolens of India,
Vol. 11 (12), 9.

Anonymous,

1976 Agresco Report, Department of Animal Science and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra).

Baker, S.G.

1931 Wool Quality, H.M. Stationery Office, London, p. 20.

Barrit, J. and King, A.T.

1926 The sulphur content of wool. Inherent variations according to type of wool. J. Text. Inst. 17-T 396.

Barrit, J. and King, A.T.

1931 The sulphur contents of wool III Note on the sulphur free nature of medullae in black face wool. Biochem. J. Vol. 25, 1075.

Batu, S. and Okaner, H.

1947 Investigations on the morphological and physical qualities of Angora wool. A.B.A. 16, No. 574, 135.

Bhatia, H.M.

1960 Co-ordination of Animal Husbandry Research in India, Sheep and Goat breeding and wool technology, Vol. 2- No.3.

Brehmer,

1965 Total nitrogen. "Methods of soil analysis" C.A. Black (ed) Amer. Soc. Agron. Inc. Madison, Wisc.

Cerenceau, D.

1967 Development in the breeding of goats for Mohair. A.B.A., Vol. 36 - 523.

Chagarov, S.U. and Zaporozhtsev, I.B.

1974 Acclimatisation of Mohair goats in Korochaev-Cherkess mountains. A.B.A., Vol. 42 , No. 12, 615.

Cozzi, F.

1968 An investigation of the physical and chemical characteristics of wool and hair production of animals reared in tropical and sub-tropical environments. 2. Some physical characteristics of Mohair fibres.

Devendra, C. and Marca Burns,

Goat Production in the Tropics. Commonwealth Agril. Bureaus, Farnham Royal, Bucks, England.

Fremy, M.E.

1940 Australian Commonwealth, Council of Scientific and Industrial Research, Bull. No. 130.

Gee, E. and Hobie, G.J.

1974 Objective evaluation of the S.A. Mohair Clip. Part 2. Winter clip.
A.B.A., Vol. 42, No. 11, 562.

Geiger, W.B.

1944 Textile Research Journal, 14-82.

Ghanekar, V.M. and Bhatvadekar, S.D.

1973 Physical and chemical characters of wool in Deccani x Patanwadi sheep.
I.V.J., Vol. 50, 676-680.

Ghani, A. and Ishaq, S.M.

1965 Angora goat breeding in West Pakistan.
A.B.A., Vol. 35, 107.

Giulliani, F.

1967 A study of some physical characteristics of Mohair samples from Angora goats reared in Madagascar.
A.B.A., Vol. 36, 623.

Gribovskii, V.A. and Zanderkin, A.I.

1963 Results of crossing local goats with Angoras.
A.B.A., Vol. 32, 505.

Gribovskii, V.A. and Kosova, R.C.

1967 The inheritance of economic traits in breeding of the Soviet Mohair Goat.
A.B.A., Vol. 36, 454.

Guillermo, L.

1949 The production of Mohair in Madagascar.
A.B.A., Vol. 19, No. 226.

Ineryus, F. and Sincer, N.

1967 The effects of twice yearly shearing on Mohair quality and productions at after ages in Angora goats.
A.B.A. Vol. 36, 263.

Ineryus, F., Muftuoglu, S., Sincer, N. and Ogmecar, K.

1969 Effects of twice yearly shearing on Mohair quality and various production characters from birth to maturity in Angora goats.
A.B.A., Vol., 38, 452.

Kastornova, E.K.

1969 Seasonal changes in the skin and fleece of Don goats.
A.B.A., Vol. 39 (1), 112.

Kastornova, E.K.

1971 Some laws of inheritance of economic traits in Don Mohair goats.
A.B.A., Vol. 40(4), 738.

Khadzhiev, D.S.

1974 Shearing goats 2 yearly, increased Mohair production.
A.B.A., Vol. 42 (6) : 2219.

Khosla, H.C.

1965 Co-ordination of Animal Husbandry Research in India.
Sheep and Goat Breeding and Wool Technology,
Publication of ICAR, New Delhi, Vol. I I-No. 3.

Kosova, R.C.

1963 Data on the physical characters of the Mohair of a new breed of Mohair goat.
A.B.A., Vol. 32, 506.

Kuyanova, A.D.
1970 Production in Black Down goats from Uzbekistan, A.B.A., Vol. 40 (1), 101.

Lall, H.K.
1968 Crossbreeding for Indian type Angora goat. Indian Farming, Vol. 12 (12), 45-47.

Larose and Tweddle,
1937 The variations of sulphur contents of wool. Canadian J. of Research, Vol. I-15, 124.

Lemaitre, Y.
1969 The Angora goat and Mohair production in Tulear province. A.B.A., Vol. 38, 276.

Levi, M.I.
1946 Crossing coarse wooled goats of the Caucasus and Central Asia with Angora goats. A.B.A., Vol. 12, 42.

Levi, M.I.
1954 A new breed of goat. A.B.A., Vol. 23, 397.

Lifschuetz, J.I.
1924 Physical chemistry, Vol. 141, 146.

Lipson, M.
1965 Fleece properties and textile processing. Wool Technology and Sheep Breeding, Vol. 12, No. II, 51-52.

Margolena, L.A.
1966 Lock type, follicular characteristics and medullation in Texas and South African Angora does. A.B.A., Vol. 34, 378.

Marston
1928 Quoted from P.J.Reis (1965)

Misarev, S.S., Magomedov, M.M. and Kiselev, .F.
1968 Mohair goats are profitable.
A.B.A., Vol. 36, 455.

Misarev, S.S.
1969 Results of crossing Bashkir and Don goats.
A.B.A., Vol. 39(1), 113.

Misarev, S.S.
1969 The caucasian fur and its hybrid with Domestic goats.
A.B.A., Vol. 39(1), 113.

Musaliev, Kh.
1972 Age changes in and inheritance of the skin and coat of the goat.
A.B.A., Vol. 40(4), 737.

Myers, B.J.
1959 A semi micro method of high accuracy for the determination of sulphur in wool.
J. of Textile Inst., Vol. 50(8), T 494-503.

Nikitenkov, V.A. and Zaporozhtsev, E.B.
1973 White crossbred goats from Zhdanov collective farm.
A.B.A., Vol. 41 (2), 74.

O'Connel, R.A. and Lundgreen, H.P.
1954 Textile Research Journal, Vol. 24, 677.

O'Kenner, H.
1945 Investigations on the morphological and physical qualities of wool of the Angora goat.
A.B.A., Vol. 17, 43.

Panse, V.G. and P.V. Sukhatme,
1961 Statistical Methods for Agricultural Workers.
(2nd Enlarged Edn.), ICAR, New Delhi.

Pant, K.P. and Kapri, B.D.

1968 Fineness of Mohair fibres of Angora, Gaddi and their crossbred goats. Indian J. Vet. Sci., Vol. 38, 112-116.

Pant, K.P.

1969 Medullated Mohair fibres of Angora, Gaddi and their crossbred goats. Indian Vet. J., Vol. 46, 125-132.

Patil, R.B.,

1966 Nitrogen and sulphur contents of wool. Indian J. of Vet. and Ani. Hus., Vol. 32(3), 172-175.

Pohle, L.M., Keller, H.R., Ray, H.D., Lineberry, C.T. and Real, H.C.

1974 Physical properties of greasy Mohair and related hill products (storing and fall clips). Marketing Research Report, Agricultural Marketing Service, U.S.D.A., No. 994, 15.

Pretorius, P.J.

1970 Effect of aggressive behaviour on production and reproduction in the Angora goat. A.B.A., Vol. 40(2), 314.

Rahimov, A.A.

1957 Breeding wool goats at the collective farm 'Komsomol' in the Samarkand Province. A.B.A., Vol. 25, No. 1955.

Ramchandran, K.N. and Yeri, P.N.

1954 Methods of analysis of wool fibre for dimensional attributes. Indian J. Vet. Sc. Vol. 24(3), 151-162.

Reis, P.J. and Schinckell, P.G.

1962 Some effects of sulphur containing amino-acids on the growth and composition of wool. Aust. J. Biol. Sci., Vol. 16, 218-230.

Reis, P.J. and Schinckel, P.G.
1964 Growth and composition of wool, II. The effect of casein, gelatin and sulphur containing amino acids given per abomasum.
Aust. J. Biol. Sci. Vol. 17, 532-547.

Reis, P.J.
1965 Growth and composition of wool - variations in the sulphur content of wool.
Aust. J. Biol. Sci. Vol. 18, 671-687.

Reis, P.J.
1969 The influence of dietary protein and methionine on the sulphur content and growth rate of wool in milk fed lambs.
Aust. J. Biol. Sci., Vol. 23, 193-200.

Reis, P.J.
1969 The influence of abomasal supplements of some amino acids and sulphur containing compounds on wool, growth.
Aust. J. Biol. Sci., Vol. 23, 441-446.

Ross, D.A.
1957 New Zealand 48's quality wool. Wool 38-43.

Simmonds, D.H.
1954 Amino acid content of 64's Virgin Merino wools.
Aust. J. of Biol. Sci. Vol. 2, 98.

Simmonds, D.H.
1956 Proceeding of International wool Textile Research Conference, Australia.
Vol. C, C-65.

Siskin, Ju. N.
1950 Breeding Nazangan fleece goats.
A.B.A., Vol. 18, 298.

Snedecor, G.W. and Cochran, W.G.
1967 Statistical Methods 6th Edition. Oxford and IBH publishing Company Calcutta, Bombay, New Delhi.

Spencer, D.A., Hardy, J.J. and Branden, M.J.

1928 Factors that influence wool production with Range Rambouillete sheep. U.S.D.A., Technical Bulletin-65, Washington, D.C., U.S. Govt. Printing Office.

Tatarenko, I.T., Orljanskii, V.A., Kirsanova, V.M., Misarev, S.S., Kastornova, E.K. and Saporozcev, L.D.

1970 Heritability of Down production in Don goats. A.B.A., Vol. 39 (1), 115.

Usha Nandurkar, C.A. Chetty and Bhailendra Kumar.

1975 Studies in the chemical characteristics of various Indian wools. Part II - Sulphur and cystine contents of various Indian wools. "Wool and Woolens of India", Vol. 12(1), 41-46.

Utkanlav, N., Imeryuz, F., Ozmacar, K. and Muftuoglu, S.

1963 Studies on the fineness and colour characteristics of the Turkish Hairy Coat Wool and their composition with those of Cashmere, Ilama, Vicuna and Guanaco wools. A.B.A., Vol. 32, 51.

Van Rensburg, S.T.

1964 Possible endocrine mechanisms in gestational failure. A.B.A., Vol. 33, 375.

Van Wyk, T.P., Kritzinger, C.C. and Veldsman, D.P.

1958 Studies on summer and winter Mohair clips. South African Wool Textile Research Institute, Technical Report No. 14.

Veitch, F.P. and Benedict, L.C.

1924 Trans. Am. Inst. Chem. Engrs. Vol. 16, 259.

Venter, J.J.

1959 A study of Mohair classing. A.B.A., Vol. 28, 160.

Von Bergen,

1937 Wool and Mohair, Animal Dyestuff Reporter, 26, 271.

Von Bergen,

1954 Wool chemical nature and properties in H.R. Mauers' berger,'Mathew's Textile Fibres', 6th Edn., Wiley, New York,Chapter XII.

Von Bergen,

1963 'Wool Handbook' J.P. Stevens and Co., Inc., Third enlarged Edn., Interscience publishers, and division of John Wiley and Sons, New York, London.

Ward, W.H., Blankley, C.H.and Shell, H.S.

1955 Amino acid composition of normal wools, wool fractions, Mohair, feathers and feather fractions. Textile Research Journal, 25, 314.

Zelenskii, G.G.

1950 Improving the fleece qualities in Goats. A.B.A., Vol. 19, No. 227.

APPENDIX

A P P E N D I X A

STRENGTH OF GOATS MAINTAINED AT THE GOAT FLOCK IN MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI

As on 10-9-1975

Breed & Type	Adult stock		Young stock		Total
	Male	Female	Male	Female	
GOAT					
Angora (Pure)	17	29	3	3	52
Angora (50%)	-	20	70	83	173
Angora (75%)	-	-	-	1	1
Other graded	2	12	1	4	19
Local	2	207	5	24	238
Total	21	268	79	115	483

A P P E N D I X D

INFORMATION ABOUT GOATS INCLUDED IN EXPERIMENTAL GROUPS

Tag No.	Date of Birth	Age as on 10-9-75 Y.M.D.	Body weight as on 10-9-75
		ANGORA	
P.A.-8	2-5-71	4-4-8	31.00
P.A.- 5	16-4-72	3-4-24	32.60
P.A-19	18-3-70	5-5-22	36.80
P.A-13	19-4-72	3-4-21	35.00
P.A.18	17-4-72	3-4-23	32.60
P.A-7	28-2-70	5-6-12	32.40
P.A-11	22-3-70	5-5-18	33.80
P.A.-22	10-4-72	3-5-00	39.40
P.A.-12	24-3-71	4-5-26	29.40
P.A.-2	8-4-70	5-5-2	40.20
		CROSSBRED (50 %)	
C-1	12-10-73	1-10-28	26.60
C-2	8-11-73	1-10-2	21.80
C-3	12-11-73	1-9-28	29.40
C-4	13-11-73	1-9-27	24.40
C-5	13-11-73	1-9-27	23.00
C-6	13-11-73	1-9-27	20.60
C-7	17-11-73	1-9-23	18.00
C-8	3-1-74	1-8-7	18.60
C-9	16-1-74	1-7-24	20.00
C-22	10-11-73	1-10-00	19.00
		LOCAL	
L-109	24-5-73	2-3-16	25.80
L-165	23-5-73	2-3-17	30.00
L-172	3-5-73	2-4-7	20.20
L-79	4-4-73	2-5-6	24.00
L-54	11-5-73	2-3-29	27.40
L-59	20-4-73	2-4-20	24.20
L-16	15-5-73	2-3-25	30.60
L-58	9-5-73	2-4-1	20.60
L-146	13-5-73	2-3-27	21.20
L-63	15-5-73	2-3-25	22.60

A P P E N D I X C

NUMBER AND RELATIVE PROPORTIONS OF CATTLE, SHEEP AND GOATS IN VARIOUS COUNTRIES (Thousands)

Countries	Population numbers			Ratio between species Cattle:Sheep:Goats
	Cattle	Sheep	Goats	
Australia	17936	157563	80	224.2:1969.4:1
Denmark	3374	112	6	562.3:18.7:1
New Zealand	7218	57343	32	225.6:1792.0:1
United Kingdom	12206	29957	20	610.0:1498.5:1
Brazil *	90505	22312	14253	6.3:1.6:1
China *(main land)	62800	68400	55000	1.1:1.2:1
India *	188800	44410	67200	4.2:1.0:3.0
Nigeria *	7518	5070	20550	1.5:1.0:4.0
Mexico *	33092	6376	12532	5.2:1:2.0
Turkey *	13203	33382	20805	1:2.5:1.6

* Indicate countries of the world which possess the largest goat population.

Source : FAO-Production Year Book, 1967, Vol.21, P. 291-327 Rome.

A P P E N D I X D

NUMBER OF ANGORA GOATS IN THE WORLD

COUNTRY	POPULATION IN MILLIONS
Turkey	4.1
U.S.A.	2.2
South Africa	0.9
Other countries*	0.7
TOTAL	7.9

* Includes mainly Lesotho & U.S.S.R.

Source : Common Wealth Secretariat (1971) according to the review of World Mohair situation.

A P P E N D I X - I

GOAT AND SHEEP POPULATION IN INDIA ACCORDING TO THE LIVESTOCK CENSUS 1972) (Thousands

State	Goat	Sheep
Andhra Pradesh	4,380	8,343
Assam	1,458	25
Bihar	7,364	983
Gujrat	3,210	1,722
Jammu & Kashmir	569	1,072
Kerala	1,468	10
Madhya Pradesh	6,167	1,009
Tamil Nadu	1,048	5,615
Maharashtra	5,911	2,128
Karnataka	3,789	4,287
Orissa	2,884	1,369
Punjab	890	436
Rajasthan	12,162	8,556
Uttar Pradesh	6,995	1,956
West Bengal	5,386	808
Hariana	478	459
Himachal Pradesh	906	1,040
Manipur	16	2
Meghalaya	96	18
Nagaland	18	less than 1,000
Tripura	104	2
Andaman & Nicobar	11	less than 100
Chandigarh	2	1
Total	68,024	40,395

Source : Directorate of Economics and Statistics, Ministry of Food and Agriculture, Department of Agriculture, New Delhi.

A P P E N D I X F

PHYSICAL ATTRIBUTES OF MOHAIR/HAIR AS OBSERVED IN DIFFERENT CLASS OF GOATS MAINTAINED AT MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI

Sr. No.	Class	No.	Av. staple length cm	Clean yield %	Fibre density No./sq cm	Fibre diameter µ	Hemp %	Crimp %	Total medullation %
				APRIL SHEARING					
1	Angora does	27	9.20±0.20	85.51±1.63	1173±55.72	30.55±0.73	3.45±0.51	13.99±1.04	2.25±0.27
2	Angora bucks	12	9.02±0.22	83.01±2.43	1077.10±8.36	34.46±1.80	3.29±0.49	15.33±1.58	1.72±0.72
3	Angora ♀ kids	4	7.85±2.00	84.12±5.63	2430±313.57	24.90±0.77	2.21±1.04	29.09±4.68	1.50±0.35
4	Angora ♂ kids	5	10.23±0.41 (4)	86.97±2.69	1800±203.75	25.19±0.72	1.67±0.50	17.21±1.30	1.53±0.89
				OCTOBER SHEARING					
1	Angora does	25	11.47±0.27	89.02±0.82	1218±55.87	32.66±0.97	3.11±0.50	16.63±0.81	2.59±0.29
2	Angora bucks	13	10.62±0.56	86.42±1.99	1159±117.17	35.56±1.94	1.94±0.47	13.53±1.31	1.87±0.60
3	Angora ♀ kids	5	11.02±0.51	87.55±2.25	2115±202.99	25.79±1.82	0.81±0.24	20.61±1.52	1.99±0.50
4	Angora ♂ kids	6	10.43±0.35	88.09±2.11	2034±142.66	24.84±2.26	1.21±0.12	12.33±1.51	1.83±0.38
5	75% Angora ♀ kid	1	10.52±0.00	92.96±0.00	2224±000.00	19.53±0.00	11.04±0.00	10.93±0.00	5.60±0.00
6	50% Angora ♀ kid	99	3.40±0.12	-	-	46.95±4.34	-	-	43.17±3.28
7	Local does	57	2.79±0.09	-	-	104.15±1.12	-	-	90.05±1.02