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## Chiapas sheep - wool production and animal health in a unique sheep breed

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### ABSTRACT

In the Highlands of Chiapas, in southern Mexico, over 10,000 Indian families from the Tzotzil-speaking group manage small flocks of Chiapas sheep, a unique local breed. Sheep flocks are managed by the Indian women with all animal health care based on traditional herbal remedies. The University of Chiapas (UNACH) is conducting a research programme to investigate the biological basis of traditional sheep husbandry systems and to improve wool production.

Animal health research tested the effectiveness of some common herbal remedies. In 4 sheep flocks, garlic (*Allium sativum*) and Mexican tea epazote (*Chenopodium ambrosioides*) were administered orally either separately or together. The most effective treatment was the combined 5g garlic + 5g epazote, which significantly reduced ( $P < 0.01$ ) the number of eggs of gastrointestinal nematodes by  $66 \pm 8\%$  and  $61 \pm 28\%$  at 1 and 2 weeks after treatment. Reductions in *Eimeria spp.* oocysts by 43% in 2 different treatments (5g garlic at 3 weeks post-treatment and 5g garlic + 5g epazote at 2 weeks post-treatment) were just below the accepted 50% effectiveness level. These preliminary results have clarified the need for controlled research trials, testing dose rate and frequency of these herbal treatments.

Three colour phenotypes of Chiapas sheep have been identified: W-white, BL-black and BR-brown. Wool is subjectively graded by shepherdesses as good (G), medium (M) or poor (P) and 12 month fleece weights show differences between the wool grades - mean annual fleece weight (kg) was higher ( $P < 0.01$ ) for G ( $1.38 \pm 0.10$ ) than P ( $0.95 \pm 0.10$ ) with M intermediate ( $1.11 \pm 0.10$ ). Twenty-seven sheep were examined with the aim of determining which objective fibre characteristics were used in the subjective assessment of wool grade. Mean fibre diameter was coarse (35.7 microns) and did not differ between wool grade or colour phenotype. Staple length differences (mm) were highly significant ( $P < 0.001$ ) between G, M and P (97.3 vs 77.6 vs 63.4) but not colour phenotypes. Kemp levels (%) were higher ( $P < 0.001$ ) for BL ( $10.24 \pm 1.4$ ) vs W ( $2.32 \pm 1.4$ ) and BR ( $2.19 \pm 1.4$ ); and % medullation for BL was 12.14 ( $P < 0.02$ ) compared to 5.19 and  $2.77 \pm 1.87$  for W and BR respectively. These results show that the most consistent fibre characteristic distinguishing the different wool grades is staple length of the long fibres, which could be related to differences in seasonal fleece growing patterns. The results for fibre characteristics differences between colour phenotypes has helped to objectively characterise these phenotypes and provided a valuable insight into the general fibre characteristics of Chiapas sheep.

**Keywords:** gastrointestinal parasites; wool; Chiapas sheep; herbal treatments; animal health; fibre characteristics.

### INTRODUCTION

In the Highlands of Chiapas, in Southern Mexico, there are several Indian groups from Mayan origin. They have their own languages, culture and traditions and interesting agricultural strategies that have survived over centuries. One of those strategies, designed by Indian women from the Tzotzil group, deals with sheep husbandry and production activities associated with this net up to 40% of their annual income. Small flocks of sheep (mean size is 12 animals) are cared for by Indian shepherdesses using a traditional management system consisting of: extensive grazing on native grasses, regular rotation of wooden shelters where sheep are confined every night and winter supplementation with corn fodder. Rams remain with the flock all year round with a concentration of lambing in winter (November-December). Killing or consumption of sheep is prohibited by Tzotzil religion, so wool becomes the single most important product within the traditional management system (Perezgrovas, 1990). Traditional sheep husbandry combines Spanish pastoral practices with

ancient Indian traditions, such as the use of herbs for animal healthcare. The University of Chiapas is conducting two research projects which aim to improve the productivity of sheep flocks and thus the living standards of Tzotzil Indians. The first one deals with the study of the animal health practices designed by Indian shepherdesses, characterised by the use of herbs and plants in the treatment of several sheep diseases (Perezgrovas, 1990). The other aims to improve wool production in Chiapas sheep. This paper presents basic information related to the efficacy of herbal treatment for parasite control and characterisation of fleece type.

### ANIMAL HEALTHCARE

Previous studies (Perezgrovas, 1990) have shown that Indian shepherdesses have comprehensive empirical knowledge regarding common sheep diseases and the use of plants to treat sick animals. Some illnesses which result in significant losses in sheep flocks have been clinically associated with gastrointestinal parasites. These illnesses are traditionally

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treated with garlic (*Allium sativum*) and Mexican tea epazote (*Chenopodium ambrosioides*). The present study was a preliminary evaluation of the effectiveness of 3 simple herbal treatments on reducing the level of eggs of gastrointestinal nematodes (GN) and coccidia oocysts (*Eimeria* spp.) in the faeces.

## Materials and Methods

### Animals and Treatments

Forty-eight mixed age ewes in 4 flocks, were allocated to one of three groups (n=16). Flocks were run separately but managed similarly (by shepherdesses) and 4 animals from each flock constituted one group, though numbers were too small for flocks to act as replicates. Each group was given one of the following treatments: (1) 5g garlic cloves, (2) 5g epazote or (3) 5g garlic + 5g epazote. Each treatment was prepared (mashed and mixed with approximately 250 ml of water) and administered by the shepherdesses. Faecal samples from each sheep were collected directly from the rectum, in plastic bags; pre-treatment faecal samples were taken 3 times at weekly intervals (days 14, 7 and 0 prior to treatment); and the herbal remedies were given immediately after the last sampling. Post-treatment faecal samples were taken weekly for 4 weeks. Effectiveness of treatment was assessed on the basis of a 50% or more reduction in faecal egg count. This level of effectiveness is lower than the 90% recommended for measuring biological significance of commercial drenches; however, herbal treatments such as those in this study are highly unlikely to ever achieve 90% reduction and a 50% reduction in egg count is considered effective within the village flock management system.

Faecal egg counts for GN and *Eimeria* spp. oocysts were carried out using the modified McMaster technique where 1 egg counted represents 100 eggs (Soulsby, 1974). As the slaughter of sheep was not possible due to strict cultural requirements, estimates of worm burdens could not be made.

### Statistical Analysis

Faecal egg counts vary widely between animals and within animals over time (Soulsby, 1974). In the present study, GN faecal egg count (eggs/gram) ranged from 11,000 ± 1970 (pre-treatment) and 3675 ± 1689 (post-treatment) in sheep #12, to 67 ± 94 (pre-treatment) and 60 ± 120 (post-treatment), in sheep #19. Similarly, variation in *Eimeria* spp. ranged from 42,000 ± 20,717 (pre-treatment) and 28,775 ± 23,976 (post-treatment) in sheep #7, to 300 ± 216 (pre-treatment) and 125 ± 109 (post-treatment) in sheep #25. Because of this, the variation (measured as % deviation) in the pre-treatment faecal egg counts was assessed and used to compare with the variation in faecal egg count between the day 0 pre-treatment value and each post-treatment value (1,2,3 or 4 weeks). Thus, the pre-treatment counts for each animal were its own control. The average of the 14 day and 7 day pre-treatment counts were considered as the basal pre-treatment level (Pre-T I) and were compared to the day 0 pre-treatment value (Pre-T II), calculating for each animal the percent deviation (Pre-T % deviation = {Pre-T II x 100 / Pre-T I} - 100) from its own basal level. In the same way, the post-treatment egg counts were compared with the day 0 egg

counts and % deviation calculated for each of the sampling times post-treatment (Post-T % deviation = {Post-T x 100 / Pre-T II} - 100). Mean Pre-T % deviation was then compared to mean Post-T % deviation for each treatment group, using Student's *t* test, to examine whether treatments affected the % deviation in faecal egg counts taken after treatment.

It is important to note that "a significant deviation" of egg count from pre-treatment levels, did not necessarily mean that the treatment was effective. Effectiveness in this study was evaluated as a 50% or more significant reduction in egg count, as explained in Materials and Methods.

## Results

Used alone, an infusion of 5g epazote significantly reduced (P<0.05) GN faecal egg count by 33% and 5g garlic resulted in a 35% reduction (P<0.05) at 2 weeks post-treatment (Table 1). However, these treatments did not significantly reduce GN egg count at any other time. Overall, the most consistent reduction in GN faecal egg count was achieved with 5g garlic + 5g epazote, which resulted in significant reductions (P<0.05) of 66%, 61% and 37% at 1, 2 and 3 weeks post-treatment, respectively. By 4 weeks post-treatment, GN egg counts were not significantly different from the pre-treatment values (Table 1).

**TABLE 1:** Mean percent deviations between pre-treatment levels ({Pre-T II x 100/Pre-T I} - 100) and between pre- and post-treatment levels ({Post-T x 100/Pre-T I} - 100) of gastrointestinal nematodes from sheep treated with garlic (G) and Mexican tea epazote (E).

Treatment	Post-Treatment Period			
	1 week	2 weeks	3 weeks	4 weeks
<b>5g G</b>				
% deviation				
Pre-T @	26±30	23±32	27±34	28±29
Post-T	-17±53	-35±25*	-23±28	10±19
(Range)#	(0-70)	(22-56)	(0-57)	
<b>5g E</b>				
% deviation				
Pre-T @	32±36	30±31	30±34	37±37
Post-T	-30±23	-33±27*	-23±23	24±19
(Range)#	(0-50)	(10-49)	(0-50)	
<b>5g G + 5g E</b>				
% deviation				
Pre-T @	33±41	31±33	33±34	28±31
Post-T	-66±8**	-61±28**	-37±28*	-2±6
(Range)#	(61-67)	(28-96)	(13-77)	(0-6)

@ = Pre-treatment values include only those animals that were present at the post-treatment sampling times (some animals were missing) consequently the pre-T deviations are not always exactly the same.

# = range of % Post-T deviations are presented for the negative deviation values only.

\* = % Post-T deviations marked with an asterisk are significantly different from the % Pre-T deviations at the P<0.05 (\*) and P<0.01 (\*\*) levels.

Garlic, used alone, significantly reduced (P<0.05) oocyst counts of *Eimeria* spp. (Post-T deviation = 33±4% and 43±14% at 1 and 3 weeks respectively). The 5g epazote treatment was not effective at reducing *Eimeria* spp. oocysts at any time and only at 2 weeks post-treatment did the combined garlic and epazote

treatment reduce ( $P < 0.05$ ) *Eimeria* spp. oocysts (Post-T deviation =  $43 \pm 29\%$ ). By 4 weeks post-treatment, oocyst counts were not significantly different from the pre-treatment values in any of the 3 treatments.

## Discussion

This study has provided a preliminary indication of the effectiveness of 3 simple herbal treatments. On the basis of a 50% or more significant reduction in faecal egg count, only the combined 5g garlic plus 5g epazote treatment appeared to produce a synergistic effect and effectively reduced GN egg count for up to 2 weeks after treatment.

None of the treatments reduced *Eimeria* spp. oocyst counts by 50% or more, though the 43% reduction seen in both the 5g garlic treatment and the combined garlic and epazote treatment (at 3 and 2 weeks post-treatment respectively) would suggest that further trial work comparing dose rate and treatment frequency may result in an effective reduction in oocysts. The different responses of GN compared to *Eimeria* spp. egg counts indicates that infestations of *Eimeria* spp. may need to be treated differently from GN burdens.

In the absence of post-mortem examination, these results suggest that either GN parasite burdens or parasite egg production were effectively but temporarily controlled for up to 2 weeks after treatment, after which time effective reductions in egg count weren't achieved.

These results support ethnoveterinary studies carried out in Peru, where common herbal remedies using plants from related families (*Chenopodiaceae* and *Astereaceae*) reduced the number of eggs of *Strongylus* and *Nematodirus* by 35-49%, when used alone, and by 55% when used in combination with other herbs (Bazalar and McCorkle, 1989).

Further trial work needs to be undertaken in a more controlled environment (eg. at the research farm) on larger numbers of sheep, if possible, testing a wider spectrum of dose rates and different dosing frequencies of garlic and epazote. The results suggest that a blanket treatment for all intestinal parasites is not advisable. Instead, the frequency of illnesses which can be clinically related to gastro-intestinal nematodes or to *Eimeria* spp. should be determined and a suitable herbal treatment regime decided upon for specific illnesses. Subsequent to further controlled trials, these treatments need to be tested and monitored on village sheep flocks to establish their longer term effectiveness in maintaining low faecal egg counts and flock health status.

## WOOL PRODUCTION

The Chiapas sheep is a double-coated sheep (Parry et al. 1994) which generally has a primary coat of long coarse fibres and an undercoat of short finer fibres. Visual assessment of the fleece suggests that the coarse fibres are approximately twice to 3 times the length of the undercoat (A. Parry, unpublished) and their fleece is typical of a carpet-wool type (Wickham 1978). Using fleece and skin colour, (Peralta et al. 1993; Pedraza et al., 1994) Chiapas sheep can be categorised into 3 main colour phenotypes - black (BL), brown (BR) and white (W). Further classification of sheep is undertaken by shepherds and artisans who grade them into good (G),

medium (M) and poor (P) classes, according to wool quality preferences. Average wool production is 1.2 kg/year and there is a high local demand for increased production, particularly of the good quality wool. Examination of mean annual fleece weight data, collected 4 months prior to the present study, showed that G sheep had a heavier ( $P < 0.01$ ) fleece ( $1.38 \pm 0.1$  kg) than P ( $0.95 \pm 0.1$  kg) with M sheep intermediate ( $1.11 \pm 0.1$  kg). This prompted further investigation. The present study aimed (1) to provide some preliminary objective data on which to characterise Chiapas sheep and (2) to determine what objective characteristics were associated with the subjective grading of wool and whether these vary between colour phenotypes.

## Material and Methods

Mixed age ewes from the University of Chiapas research flock were graded (by M. Peralta) as G, M and P on fleece quality and 3 ewes of each grade were randomly chosen from each of the BL, BR and W colour phenotypes, making a total of 27 ewes in this study. All sheep were grazed on pasture at the University of Chiapas research farm in the Highlands. Fleece samples, representing 4 months fleece growth, were taken in July 1993 from the right midside of each animal and approximately half was used for staple length measurements of the long, coarse fibres (the mean of 5 measurements per sample) and the remainder was solvent-scoured and conditioned. Fibre measurements were carried out at Flock House Agricultural Centre. Mean fibre diameter (of the fleece containing both long and short fibres) was measured on 250 fibres and kemp and medullation counts were carried out on 400 fibres using automated projection microscopy. Co-efficient of variation of fibre diameter distribution and standard deviation of mean fibre diameter were calculated. Differences in fibre characteristics, between colour phenotypes and wool grades, were examined using general linear models (GLM procedure, SAS Institute, Cary, USA).

## Results

Results are presented in Table 2. Mean fibre diameter was coarse (35.7 microns) and did not differ between wool grades or colour phenotype. Staple length differences were highly significant ( $P < 0.001$ ) between wool grades, but not colour phenotypes, and G sheep had a longer coarse fleece than P sheep, with M sheep intermediate. Kemp levels (%) were higher ( $P < 0.001$ ) for BL (10.24) than either W (2.32) or BR (2.19) sheep and percentage of fully medullated fibres was highest ( $P < 0.02$ ) for BL sheep but kemp and medullation did not differ significantly between wool grades. There was no effect of colour phenotype or wool grade on % of partially medullated fibres; and neither standard deviation nor coefficient of variation of mean fibre diameter, differed significantly between colour phenotype or wool grade.

## Discussion

The primary objective of the Batsi Chij wool research programme is to increase wool quantity and quality in Chiapas sheep, by using objective selection parameters (for wool) to establish an open nucleus breeding scheme accessible to local Indian communities. This study shows that the most consist-

**TABLE 2:** Least squares means for fibre characteristics for the 3 wool grades and colour phenotypes of Chiapas sheep. Abbreviated column headings are as follows: mfd = mean fibre diameter (microns); %K = %kemp fibres in sample; %FM = %fully medullated fibres in sample; %PM = %partially medullated fibres in sample; %CV = % coefficient of variation (fibre diameter distribution); SD = standard deviation of mean fibre diameter; SL = staple length (mm) of the coarse outer coat. Different letters indicate that values in columns are significantly different ( $P < 0.05$ ).

	mfd	%K	%FM	%PM	%CV	SD	SL
<b>Wool Grade</b>							
Good	35.3	5.4	9.3	14.1	49.8	17.3	97.3a
Medium	36.0	5.4	5.7	9.8	51.7	18.7	77.6b
Poor	35.9	4.0	5.1	13.8	42.9	15.6	63.4c
SEM	1.3	1.4	1.9	2.9	4.2	1.9	3.2
<b>Colour Phenotype</b>							
Black	35.9	10.2a	12.1a	15.5	48.4	17.4	77.2
Brown	33.9	2.2b	2.8b	10.3	48.7	16.6	76.2
White	37.2	2.3b	5.2b	11.8	80.7	17.5	85.0
SEM	1.3	1.4	1.9	2.9	4.2	1.9	3.2

ent fibre characteristic distinguishing the different wool grades is staple length of the long fibres. Staple length is directly related to the rate of wool growth and the length of the growing period. It may be that, poor sheep, for instance, have a slower wool growth rate and/or a shorter growing period compared to good sheep. Casual observations (A. Parry and R. Perezgrovas) of the fleeces of Chiapas sheep indicate that variable amounts of fleece shedding occur at certain times of year. There is some evidence from informal interviews with shepherdesses (R. Perezgrovas, unpublished) that the relative proportions of both long and short fibres, their respective lengths and the proportion of shed fibres in the fleece, are taken into account in the subjective grading of wool. It is therefore important to elucidate the degree to which these sheep are seasonal wool growers and to what extent this contributes to staple length differences. The wool improvement programme requires useful indicators such as staple length for selection of superior sheep for a breeding nucleus. A critical next step in the setting up of a breeding nucleus will be the measurement of fibre samples from larger numbers of ewes and rams in the same age class, at the traditional half-yearly and yearly shearing times.

High levels of kemp and fully medullated fibres in the black sheep would tend to suggest that the mean fibre diameter of black sheep would be higher than other phenotypes.

However, this was not the case. An explanation for this may partly lie in the results from recent histological observations (A.L. Parry, unpublished) which indicate that kemp and medullation occurs in primary follicles only. The results for fibre characteristics differences between colour phenotypes has helped to objectively characterise these phenotypes and have given a valuable preliminary insight into the general fibre characteristics of Chiapas sheep. Given that all fibre characteristics, except staple length, were measured on the total fleece, but showed no variability between wool grades, future studies should assess diameter, kemp and medullation separately for long and short fibres.

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