final report

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Alternative methods of Applying Extra Low Voltage Electrical Stimulation

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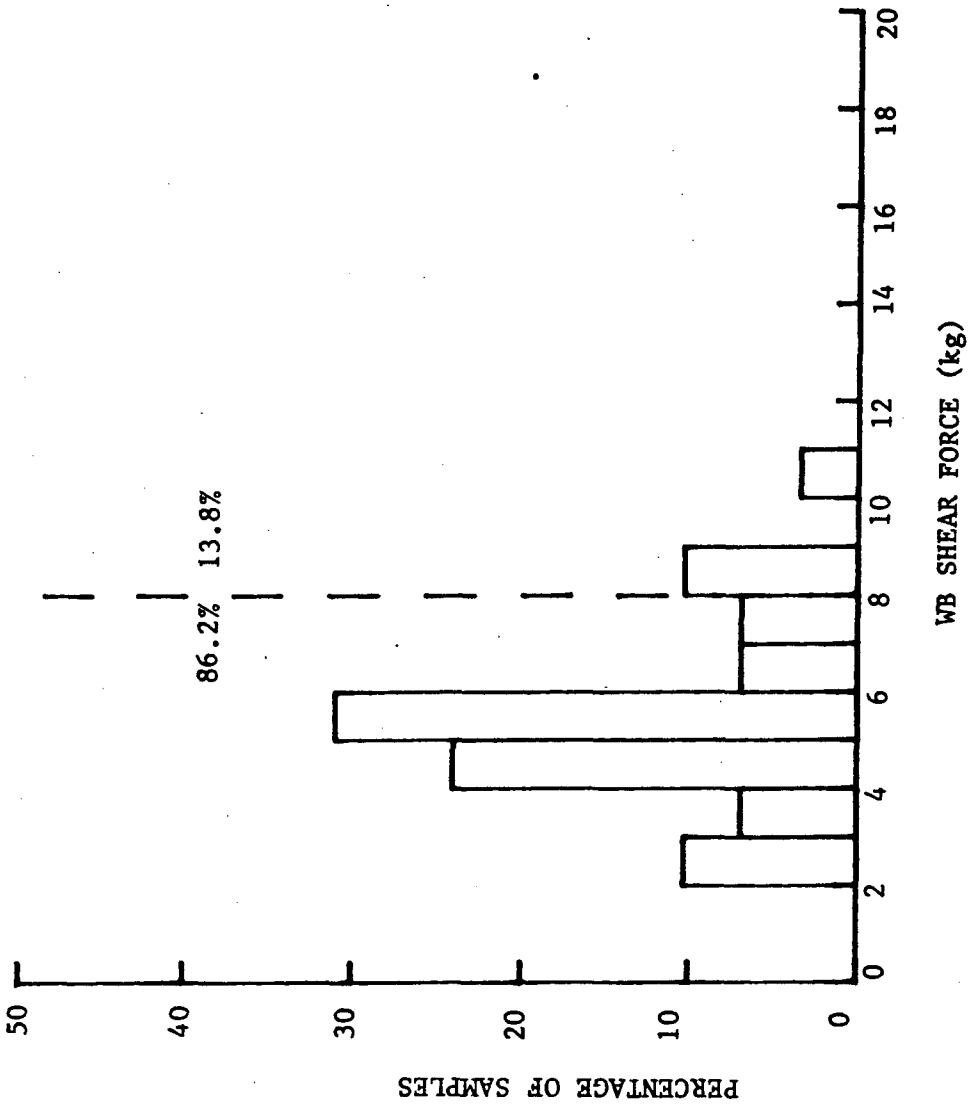
The attached Figure should be inserted in Meat Research Report 4/85 "Alternative Methods of Applying Extra Low Voltage Electrical Stimulation" by V.H. Powell, P.V. Harris, W.R. Shorthose, N.G. McPhail & R.F. Dickinson

FIGURE 1(C) T3 NOSE TO ANUS E.S. -
HALAL (N=29)



SUMMARY

Cattle are slaughtered for the Muslim market by a transverse cut severing the throat. The head hangs lower, making insertion of the extra low voltage electrical stimulation nostril electrode difficult, in some plants. Alternative methods of applying the electrodes were evaluated.

If nostril application is impractical (e.g. when the head is removed), then equivalent results could be obtained by placing an active electrode into the anus and earthing through a rubbing bar contacting the neck or through a spear probe pushed into the severed neck muscles.

With the nostril probe as the active electrode, severing of either the throat (Halal slaughter) or the spinal cord (pithing) had no effect on the efficacy of extra low voltage electrical stimulation.

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INTRODUCTION

When cattle are slaughtered for the Muslim market the neck is almost completely severed. The head hangs lower, making insertion of the nostril probe of the extra low voltage electrical stimulation (ELV ES) system difficult in some plants. The probe may also contact grating or work platforms, possibly causing dislodgment or a short circuit.

It was shown previously (Powell et al, unpublished data 1983) that incorrect insertion of the nostril probe in either the tip of the nose or the stick wound resulted in ineffective ES. Preliminary experiments also indicated that once the animal's throat was cut for Halal slaughter, nostril to anus or nostril to leg ES was ineffective. Morton and Newbold (1982) demonstrated that a functional nervous system was necessary for ELV ES to be effective.

In some smaller plants the head is removed in the bleeding area, making use of a nostril probe impratical. It was therefore desirable that effective, alternative application point(s) for the electrode be found.

PROCEDURE

Electrical Stimulation System

Carcasses were electrically stimulated in two meatworks (plants A and B), one to four minutes (plant A) or four to nine minutes (plant B) after stunning, using a Koch-Britton 150LV stimulator operating at 45V for 44 seconds. The ES system was part of the meatworks' normal operations.

Materials and Design

The bodies of 175 cattle (carcass dressed weight 96-403 kg, and 0-33 mm fat depth) were assigned to the following treatments:

T1 nostril to anal earth ES

T2 " " " " " - pithed

T3 " " " " " - Halal slaughter

T4 anus to nostril " "

T5 " " back of neck earth ES

T6 non-ES control

T1 ES was applied by the normal method of inserting an active hook electrode deep into the nostril and an earthed probe into the anus.

T2 The electrodes were attached as in T1, but the spinal cord was severed prior to ES by inserting a knife between the skull and the first cervical vertebra.

T3 The animals were slaughtered by the Halal method of a transverse knife cut, severing the trachea, oesophagus, arteries and veins of the neck. The electrodes were attached as in T1.

T4 The electrodes were again attached as in T1, but the polarity was reversed so that the anal probe became the active electrode.

T5 Again the anal probe was the active electrode, but the earthed nostril probe was manually held firmly against the back of the neck.

T6 The carcasses of the control animals were not stimulated, pithed or Halal slaughtered (except in plant B, where control animals were Halal slaughtered).

Muscle Sampling

On completion of slaughter and dressing, the carcasses were chilled for approximately 20 hours at an air temperature of 7-8°C, which reduced the loin centre temperature to below 10°C within 15 hours. After chilling, the sides were quartered between the 12th and 13th ribs, and approximately 50 mm of striploin (Longissimus dorsi - LD) was removed from the hindquarter and transported to the laboratory for tenderness evaluation.

pH Measurement and Cooking Treatment

At the laboratory the muscle pH was measured using a probe type combined glass pH electrode (Philips C63/1) with a digital meter (Watson Victor Model 5004). The results from muscles with pH values $\geq$ 5.8 were excluded.

A sample weighing 140-160g was removed from each muscle, placed in a polyethylene bag which was fastened with a metal clip, and cooked totally immersed in water controlled at 80±0.5°C for one hour. After cooking, the samples were cooled in running water for at least 30 minutes before drying and storage overnight in polyethylene bags at 0-1°C.

Warner Bratzler Shear Measurement

The WB shear device used and the parameters measured from the shear force deformation curves have been described in detail elsewhere (Bouton et al 1978). The cooked samples were cut to give five to six subsamples, each about 4-6 cm long, of rectangular cross section (15 x 7 mm) with the muscle fibres lying parallel to the greatest length.

RESULTS AND DISCUSSION

The results of the WB shear force measurements for the six treatment groups are given in Table 1.

TABLE 1: WB INITIAL YIELD FORCE MEASUREMENTS (KG) OBTAINED FOR LD MUSCLE SAMPLES

T1 (n=21) *	T2 (n=22)	T3 (n=29)	T4 (n=14)	T5 (n=8)	T6 (n=34)
6.3	5.8	5.6	5.9	6.0	11.4

* Number of animals per group (ultimate pH <5.8)

The mean shear values for each ES treatment were similar and were significantly lower than the mean of the unstimulated control (T6).

Figures 1(a)-1(f) show histograms of the WB shear force measurements for the six treatments. The histograms show the percentage of samples in each shear force range (i.e. 2-3 kg, 3-4 kg, 4-5 kg, etc.). Samples with a shear force value of <8 kg are considered acceptably tender (Powell et al 1984). The percentage of samples classified as acceptably tender ranged from 79% for anus to nose ES, to 100% for anus to neck. Only 14% of the control samples were deemed tender.

All ES application methods produced acceptable results. Preliminary results which indicated that after Halal slaughter, nose application of ES was ineffective, were not reproduced in the present experiment. Severing the spinal cord by pithing did not alter the effectiveness of ELV ES when conventional sticking was employed. This demonstrates that pathways other than the spinal cord must exist for transmission of the ELV electrical signals.

If the nostril electrode for nose to leg or anus ES is difficult to apply, the current path may be reversed by inserting the active electrode into the anus and returning through either a rubbing bar contacting the back of the neck or shoulder, or a spear probe in the severed neck area.

CONCLUSIONS

Severing the neck (Halal slaughter) or the spinal cord (pithing) failed to reduce the effectiveness of ELV ES in the nostril/leg configuration. If the normal nostril to leg or nostril to anus method of applying ELV is unsuitable, the anal probe may be made active with the current return path via either a rubbing bar contacting the neck or shoulder, or a probe inserted in the severed neck area.

REFERENCES

Bouton, P.E., Ford, A.L., Harris, P.V., and Shaw, F.D. (1978), "Effect of low voltage stimulation of beef carcasses on muscle tenderness and pH", J. Food Sci. 43, 1392.

Morton, H.C., and Newbold, R.P. (1982), "Pathways of high and low voltage electrical stimulation in sheep carcasses", Meat Science 7, 285-97.

Powell, V.H., Dickinson, R.F., McPhail, N.G., Bouton, P.E., and Harris, P.V. (1984), "Evaluation of extra low voltage electrical stimulation systems for bovine carcasses", J. Food Sci. 49, 363.

FIGURE 1(A) T1 NOSE TO ANUS ES (N=21)

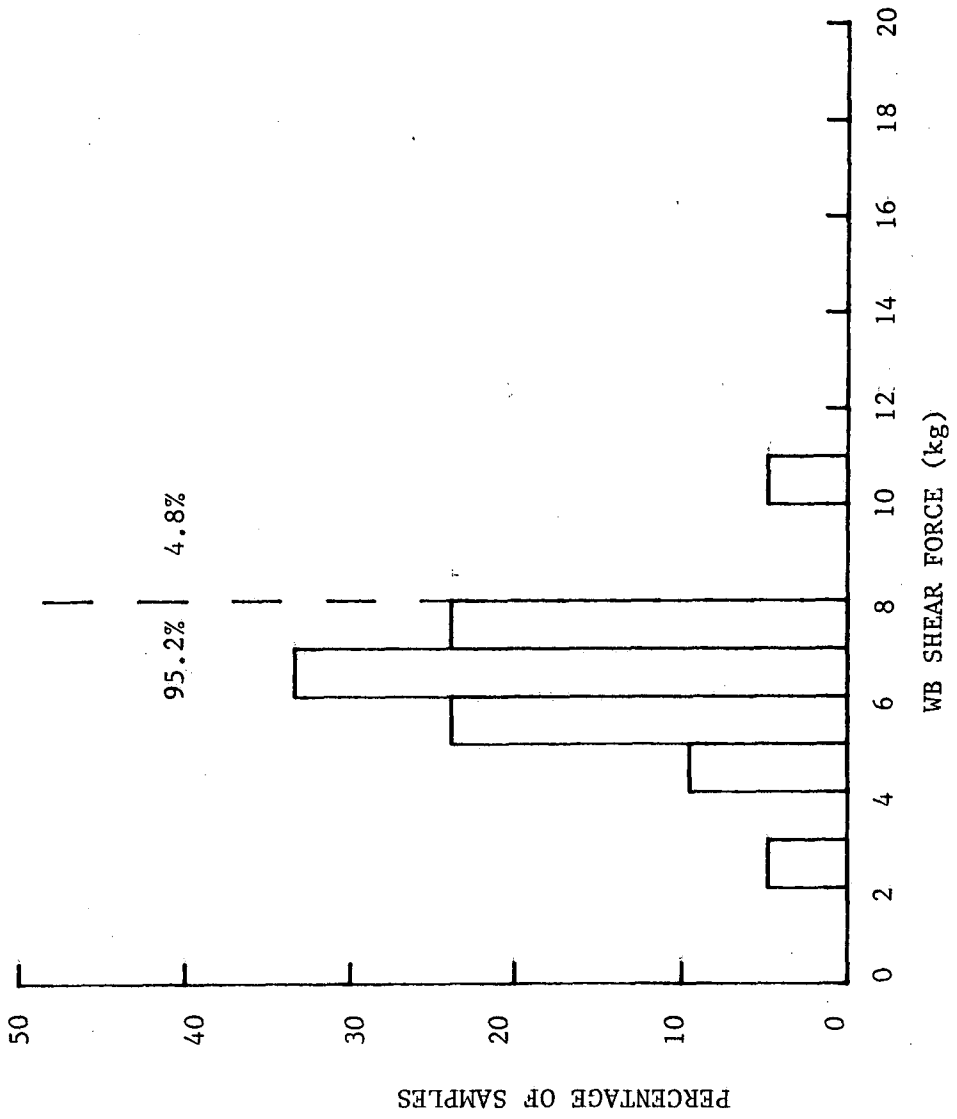

FIGURE 1(B) T2 NOSE TO ANUS ES - PITHED (N=22)

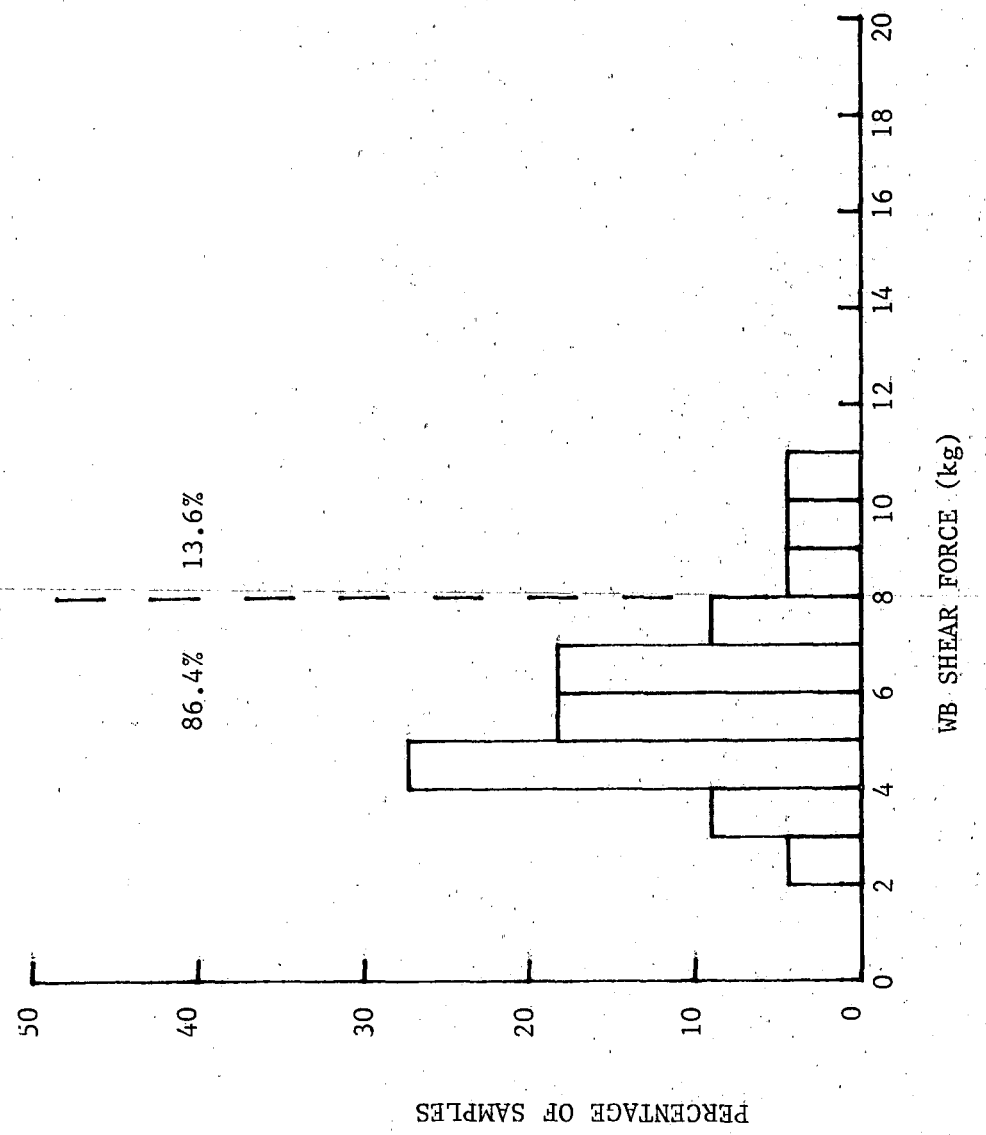

FIGURE 1(D) T4 ANUS TO NOSE E.S. (N=14)

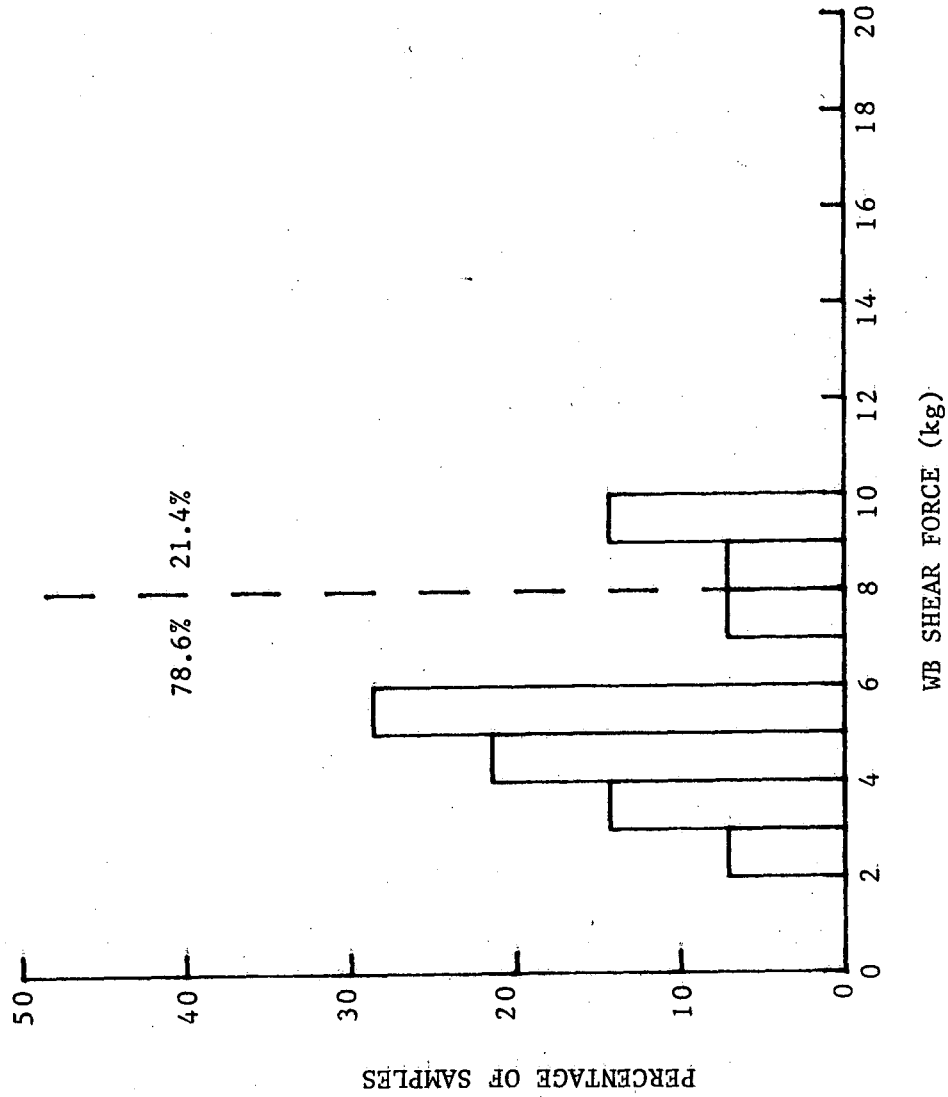

FIGURE 1(E) T5 ANUS TO NECK E.S. (N=8)

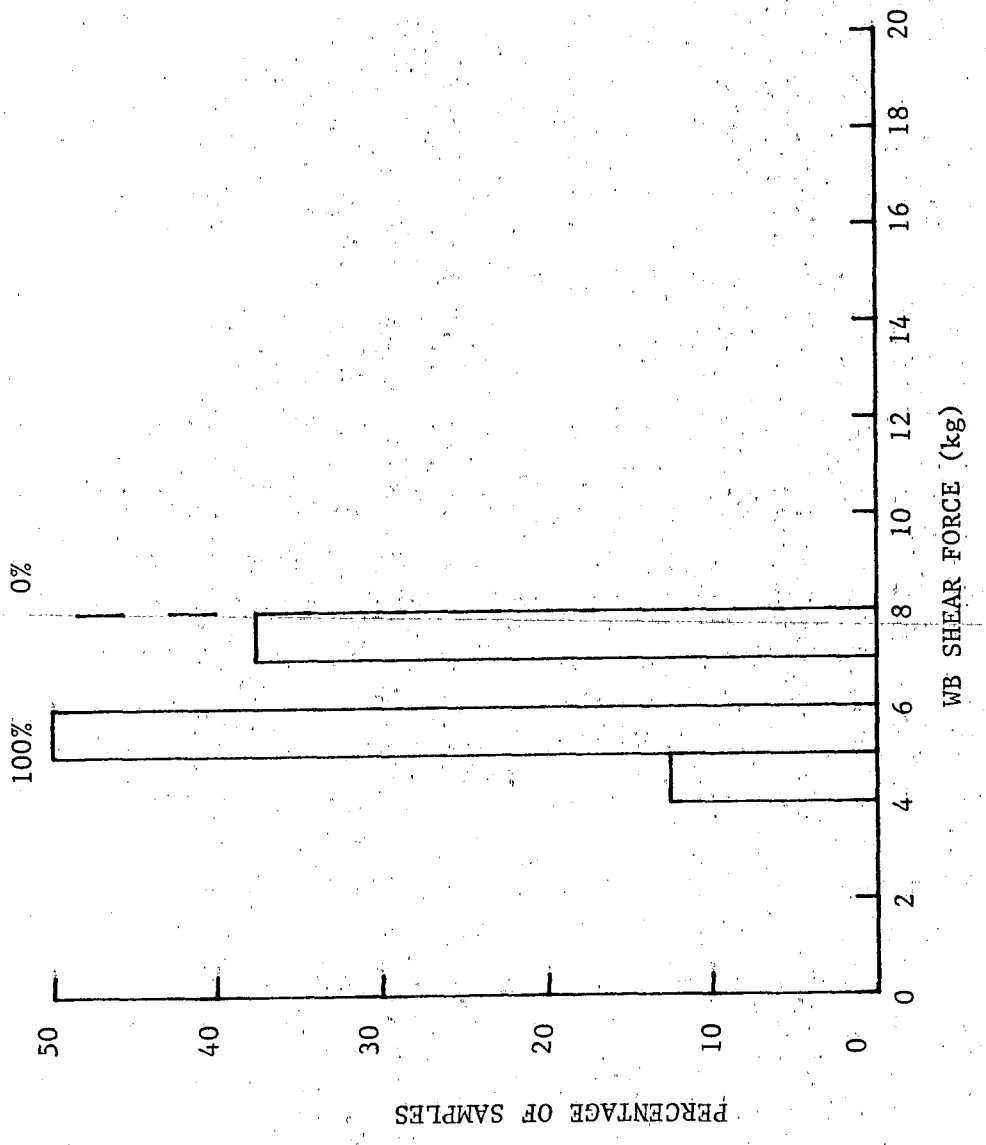

FIGURE 1(F) T6 NON E.S. CONTROL (N=34)