A COMPARATIVE STUDY OF THE THICKNESS OF THE TUNICA MUSCULARIS IN THE FORESTOMACH AND ABOMASUM OF GREY, WHITE AND BLACK KARAKUL LAMBS

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ABSTRACT


Homozygous grey Karakul lambs are born with a lethal genetic factor responsible for death and weaning age. When put on a high roughage diet under field conditions they develop distended, thin-walled rumens and sand impacted abomasas. Homozygous white Karakul lambs have a similar factor but survive for a longer period. Black Karakul lambs are not affected. The present study was undertaken to compare by image analysis the thickness of the tunica muscularis of the forestomach and abomasum of 24-hour old grey, white and black Karakul lambs. One square centimetre samples were taken from equivalent areas in each case of the rumen, reticulum, omasum and abomasum of 38 embalmed Karakul lambs. Haematoxylin and eosin stained histological sections of each sample were studied with a Vids 2 Image Analyzer and the thickness of the circular and longitudinal muscle layers was measured.

An analysis of variance indicated a significant difference between the groups in the thickness of the tunica muscularis of the rumen, reticulum and abomasum; the grey group displaying the thinnest and the black group the thickest. The omasa were not affected. The study indicates a reduction in thickness of the tunica muscularis of the homozygous grey and white lambs when compared to normal black lambs.

INTRODUCTION

Homozygous grey Karakul lambs are born with a lethal genetic factor responsible for death at weaning age (Nel & Louw, 1953). When put on a high roughage diet under field conditions they develop distended thin-walled rumens and sand impacted abomasas (Nel, 1965). These lambs have a potbelly appearance, become emaciated and die. Homozygous white Karakul lambs are born with the same genetic factor and they show the same clinical signs as the homoyzgous grey lambs, but they survive for a longer period. Black Karakul lambs are unaffected. The homozgyous grey lambs die before they reach sexual maturity, resulting in a scarcity of grey lambs and consequently a scarcity in grey pelts. Homozygous grey and white Karakul lambs can be identified at birth by the lack of pigmentation of the tongue, palate and ears (Nel & Louw, 1953). Previous studies in 24-hour-old grey, white and black Karakul lambs (Groenevald & Booth, 1989), showed a significant difference ($P<0.05$) in the length and width of the rumen and in the volume of the rumino-recticum between the three groups, the grey group displaying the largest organ and the black group the smallest. The walls of the rumen appeared thinner in the grey and white lambs. Milk filled rumens were observed in the homozgyous grey and white lambs.

The present study was undertaken to determine whether the apparent thinning of the walls of the fore-stomach and abomasum of the grey and white lambs was due to a decrease in the thickness of the tunica muscularis.

The results showed a significant decrease in the thickness of the tunica muscularis in the grey and white lambs when compared to the black lambs.

MATERIALS AND METHODS

Thirteen grey, fifteen white, and ten black 24-hour-old Karakul lambs were embalmed with 10% formalin via the left common carotid artery immediately after they had been slaughtered and skinned. Grey and white lambs with unpigmented tongues, palates, and ears were selected. Black lambs were randomly selected and served as the control group.

A 1 cm$^2$ sample was taken from an equivalent area of the rumen, reticulum, omasum and abomasum in each of the 38 embalmed lambs. The samples of the rumen were taken from the middle of the left and right side of the dorsal sac, and the left and right side of the ventral sac. The other samples were taken from the right surface of the reticulum, the parietal surface of the omasum and the greater curvature of the abomasum. Histological sections were prepared from each sample and stained with the standard haematoxylin and eosin technique. All measurements of the tunica muscularis were performed using a Vids 2 Image analyzer.

The thickness of the circular and longitudinal layers of the tunica muscularis was measured on the left, middle and right third of each section and the mean thickness of each layer for the rumen, reticulum, omasum and abomasum as well as the total thickness of the tunica muscularis was calculated. The thickness of the tunica muscularis in the rumen was calculated from the mean of the left and right side of the dorsal sac and the left and right side of the ventral sac measured.

One way analysis of variance was implemented to determine whether significant differences exist in the thickness of the tunica muscularis between the three groups of lambs.

RESULTS

There was a significant difference between the groups in the total thickness of the tunica muscularis of the rumen ($F$ ratio = 2.19) (Fig. 1), reticulum ($F$ ratio = 7.25) (Fig. 2), and abomasum ($F$ ratio = 5.75)
A COMPARATIVE STUDY OF THE THICKNESS OF THE TUNICA MUSCULARIS

FIG. 1 Thickness of the tunica muscularis of the rumen

Grey White Black
Circular layer Longitudinal layer Total

FIG. 3 Thickness of the tunica muscularis of the abomasum

Grey White Black
Circular layer Longitudinal layer Total

FIG. 2 Thickness of the tunica muscularis of the reticulum

Grey White Black
Circular layer Longitudinal layer Total

FIG. 4 Thickness of the tunica muscularis of the omasum

Grey White Black
Circular layer Longitudinal layer Total

FIG. 5 Thickness of the tunica muscularis of the omasum

Grey White Black
Circular layer Longitudinal layer Total

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Circu...
Embryologically the inner circular layer of the tunica muscularis develops first (Bryden et al., 1972; Duncan & Phillipson, 1951), followed by the nervous layer and finally the outer longitudinal layer (Duncan & Phillipson, 1951). Duncan & Phillipson (1951) observed contractions of the smooth muscle of the inner circular layer of the tunica muscularis before the development of the nervous layer. The smooth muscle therefore has an intrinsic ability to contract. The reduction in the thickness of the tunica muscularis in the affected lambs could thus lead to an abatement of the movement of the rumen, reticulum and abomasum causing insufficient digestion and absorption of nutrients. This could lead to starvation and death.

Nerve supply plays a major role in the movement of the forestomachs and abomasum of ruminants (Habel, 1956). Vagal stimulation in the foetus causes movement of all the stomachs (Duncan & Phillipson, 1951). Both the intrinsic ability of the smooth muscle to contract and a functional nerve supply are thus essential for the movement of the stomachs, and there is a possibility that a defective nerve supply may play a role in the lethal condition described. This would be supported by the fact that the outer longitudinal muscle layer appeared to be more affected than the inner layer, possibly due to defective nerve supply causing atrophy. It also seems possible that the distension of the rumen with milk described by Groenewald & Booth (1989) is due to failure of the oesophageal reflex caused by inadequate nerve supply.

It is concluded that the reduction in the thickness of the tunica muscularis is one of the factors causing the lethal condition in homozygous grey lambs.

REFERENCES