



A COMPARATIVE STUDY OF THE ENERGETICS, FAT METABOLISM AND  
COMPOSITION OF PLASMA FATTY ACIDS IN GROWING GOATS AND LAMBS

by

Abiliza E. Kimambo, B.Sc.(Agric.) Univ. of Dar es Salaam

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Department of Animal Physiology,  
University of Adelaide,  
South Australia.

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## SUMMARY

1) This work studied the effect of feeding patterns on growth and body composition of goats from 9 days to 5 months and sheep from 1 month to 6 months of age.

In addition, the effects of age and feeding frequency on patterns of fat mobilization and plasma fatty acid composition were determined at monthly intervals. Diurnal variation in plasma FFA and triglycerides over a 24-hour period was examined in 7 week-old goats. The response to infusion of a lipolytic agent, adrenaline, was examined when animals were 7 months old.

Body composition and water turnover rates were estimated using the dilution of injected tritiated water of a known radioactivity every 4 weeks.

Fasting metabolic rate was estimated at monthly intervals by measuring the rate of oxygen consumption using an open circuit metabolimeter.

After extraction of plasma lipids and separation into FFA and triglycerides, quantitation of their individual long chain fatty acids was achieved by GLC.

2) During milk feeding, goats gained relatively more body weight/day than after weaning. Goats fed twice daily had slightly higher growth rate both before and after weaning than those fed once daily.

Between 2 and 7 months of age, a linear relationship existed between food consumption and age; lambs consumed 15% more than goats fed the same diet at the same age. Goats, although smaller than lambs between 2 and 7 months, grew 21% faster, ate relatively more feed/kg Bwt and had higher feed conversion efficiency. Goats and lambs had similar efficiency in the digestibility of nitrogen and energy, and utilization of dietary energy as metabolizable energy,

but goats retained more of the dietary protein than lambs (35.8% and 27% respectively).

3) Three major body components, fat, protein and water, increased as the animals grew. The proportion of fat increased with age in both species, but declined slightly immediately after weaning. Lambs were found to be slightly fatter than goats at the same age. The increase in body fat per increase in body weight was significantly higher in lambs (270g/kg) than in goats (218g/kg). Multiple regression analyses showed that body weight had a greater influence on body fat than did age in lambs, while in goats, age had a greater influence than body weight. Lambs fed twice daily deposited more fat than the other two groups but this difference was not observed in goats.

Although total body water increased with age, its proportion to body weight declined.

Body protein increased with age and was significantly correlated to body weight in both species. The proportion of body protein to body weight was relatively constant with age and showed a slight decline at the age of 6 months in lambs and 5 months in goats.

Plasma protein in both species increased significantly with age to near adult values at 3 and 4 months. Lambs grazing in the paddocks had higher plasma protein than pen fed groups.

4) Higher fasting metabolic rates were observed during milk feeding in both species, and this decreased significantly at weaning. Goats generally had lower fasting metabolic rates than lambs. Feeding patterns had no significant effect on fasting metabolic rates in both species.

5) Water turnover rates were higher during milk feeding, decreasing significantly at 1 month of age in goats. Immediately after weaning, there was a decrease in water turnover, followed by a subsequent increase.

Grazing lambs had significantly higher water turnover during winter and early spring. Goats had lower water turnover rates than lambs.

6) The fasting plasma FFA concentration in goats and lambs was high during the first 2 months of life, reaching a peak after weaning. This was followed by a significant decrease from 3 months of age onwards. Feeding patterns had no significant effect on the concentration of plasma FFA in goats or lambs fed in pens, while the grazing lambs had a higher concentration of plasma FFA at 4 months which was coupled with a decrease in feed availability in the paddock. Lambs were found to mobilize more fat than the goats at all times.

The concentration of oleic acid was highest at 2 months of age followed by a decline in subsequent months. Its proportion to total FFA in both species declined with age, while that of stearic acid increased. This inverse relationship is associated with functional rumen development. Palmitic acid was highest during milk feeding, decreased immediately after weaning, then increased as the animals grew older. Palmitoleic and myristic acids were also higher during milk feeding and decreased with age. Linoleic acid did not change significantly with age in lambs, while it was highest in goats at 2 months of age. Goats were found to have lower saturated to unsaturated fatty acids ratios and lower stearic to oleic acid ratios than lambs.

Feeding once daily was found to increase the proportion of plasma unsaturated free fatty acids in the two species.

7) Fasting plasma triglyceride changed little with age in goats, while in lambs the concentration was significantly higher at 1 and 2 months and then decreased.

The individual triglyceride fatty acids in both species showed a close similarity to the fatty acid composition of plasma FFA.

8) Little diurnal variation in plasma FFA was observed in the two groups of goats. Feeding milk twice daily resulted in two peaks of plasma FFA. Individual plasma fatty acids also showed no diurnal variation. A steady increase in the concentration of plasma triglyceride to a peak 14 hours after feeding was observed in the group of goats fed milk once daily. Feeding milk twice daily resulted in the formation of two triglyceride concentration peaks resulting from the absorption of morning and evening feeds, but there was no variation in the concentration of individual triglyceride fatty acids at these times.

9) Saline infusion induced a slight increase in the concentration of plasma FFA in lambs and a significant increase in goats.

Adrenaline infusion (10 µg/kg body weight) for 30 min. increased the concentration of plasma FFA significantly in both species. Lambs showed a higher response to adrenaline infusion than goats.

A decrease in plasma FFA concentration 30 min. after cessation of adrenaline infusion was observed in the two species. The decline was faster in goats than in lambs.

At rest and during saline infusion, the highest proportion of the total FFA in lambs was stearic acid, whereas in goats it was oleic acid. Goats had a higher proportion of unsaturated fatty acids than lambs.

Adrenaline infusion in both species produced a significant increase in the concentration of five of the main fatty acids, in the following order:- oleic > stearic > palmitic > linoleic > and palmitoleic. Some minor fatty acids also increased.

The proportion of stearic acid to total plasma FFA decreased with adrenaline infusion, while that of oleic acid increased in both species. The proportion of palmitic acid increased in lambs and

decreased in goats. The ratio of total saturated to unsaturated fatty acids decreased significantly during adrenaline infusion.

The concentration of each fatty acid decreased significantly on the termination of adrenaline infusion with the exception of stearic acid, which increased in lambs. The proportion of oleic acid to total fatty acids decreased rapidly to pre-adrenaline infusion levels, while that of stearic acid increased to pre-adrenaline infusion levels in goats, but was found to be even higher in lambs.

The proportion of saturated fatty acids increased in both species to pre-adrenaline infusion levels, while that of unsaturated fatty acids decreased.

Feeding patterns had no effect on the response to adrenaline infusion in the two species.

DECLARATION

I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any university, and that to the best of my knowledge and belief it does not contain any material previously published or written by another person, except where due reference is made in the text.

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ABBREVIATIONS

FFA - Free fatty acids

TG - Triglycerides

GLC - Gas liquid chromatography

TLC - Thin layer chromatography

Cyclic AMP - Cyclic adenosine monophosphate