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## SUMMARY OF DOCTORAL THESIS

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Title: The Nutritive Value of Tree and Shrub Forages as Supplements to Low Quality Basal Diets for Ruminants in Kenya  
(ケニアにおける低品質反芻家畜基礎飼料に補給する木本類茎葉部の栄養価)

In arid and semi-arid areas, the quality and quantity of forages varies appreciably with seasonal variations in rainfall and often leads to nutritional inadequacy. Use of browse forages as supplements is an alternative strategy that is gaining ground in research and development especially among the small-holder farmers in the tropics. This approach has tremendous potential for application with ruminants, especially where animals are abundant and managed under extensive conditions as in the arid and semi-arid region of Kenya. Therefore the overall objective of this study was to evaluate the nutritive value of leguminous tree and shrub forages from semi-arid zone of Kenya as ruminant feeds.

Four experiments were therefore conducted to evaluate the nutritive value of the browse forages as ruminant feeds:

The first experiment was conducted to determine the chemical composition content. The forages were analyzed for their content of dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL). The contents of Ca, P, Mg, S, Fe, Zn, Mn and Cu were also analyzed. The total phenolics, tannins and condensed tannin flavonoids contents were analyzed. The results from these experiment showed that the browse forages evaluated had higher mean CP content (184.8 g/kg DM) than the minimum required for both adequate rumen function and animal production (80 g/kg DM). The browse forages had low to moderate content of fiber (NDF; 189.5 – 570.4 g/kg DM). The tannins content varied from low to moderate except in *Acacia brevispica*, *Acacia nilotica*, *Calliandra calothyrsus*, *Grewia bicolor* and *Terminalia brownii* that had tannin contents of more than 100 mg/g DM. Condensed tannin (CT) fractions showed that most of the forages contain a prevalence of procyanidins. The forages had adequate quantities of macro-elements except P but were deficient in micro-elements except Fe.

The second experiment was conducted to determine the rumen DM and CP degradation characteristics of the forages as well as their *in vitro* gas production characteristics. The effect of tannins present in the browse forages on rumen fermentation was also assessed. Most of the browse forages had high potential DM degradability of over 700.0 g/kg DM except such species as *Boscia angustifolia*, *C. calothyrsus*, *Pappea capensis*, *T. brownii* and *Tamarindus indica*. The DM effective degradability (ED) range was 366.4-710.8 g/kg DM while CP ED range was 189.1-730.5 g/kg DM. The gas production potential ranged from

87.8 to 251.6 ml gas/g DM. Addition of PEG-6000 significantly increased gas production in all the species except in *Acacia mellifera*, *Balanites aegyptica*, *B. angustifolia*, *M. angolensis* and *Olea europaea*. The increase in gas production was higher in species with TET levels of more than 70 g/kg DM. However, addition of PEG-6000 had mixed effects on DM and OM *in vitro* degradability. Addition of PEG-6000 significantly decreased the partitioning factor (PF) in all the species except *B. aegyptiaca*, *B. angustifolia*, *M. angolensis* and *O. europaea*. Based on the chemical composition, *in situ* degradation and *in vitro* gas production and degradability, the browse forages have high potential nutritive value especially as protein supplements to poor quality forages. However, the anti-nutritive activity of tannins present in some of the forages may adversely affect their nutritive value. The third experiment was conducted to evaluate the palatability rating of various browse forages using goats and sheep. Five browse species were selected from those evaluated in experiments 1 and 2 and that had high potential nutritive value. Five Small East African goats and five Corriedale sheep were used in this experiment. The animals were maintained on Rhodes grass (*Chloris gayana*) hay and provided with the browse forages simultaneously free-choice for six hours. The rank order of preference (highest to least) for goats was: *A. brevispica*, *Z. mucronata*, *B. discolor*, *A. mellifera* and *M. angolensis* while the rank order of preference for sheep was: *A. brevispica*, *B. discolor*, *A. mellifera*, *Z. mucronata* and *M. angolensis*. The goats had higher intakes of all the browse forages than the sheep. The result of this study highlights the higher feeding value of the browse species as supplemental feed with low quality basal diet with both of animal species except *M. angolensis*.

The fourth experiment was conducted to investigate the effect of supplementing Rhodes grass (*C. gayana*) hay with either *Berchemia discolor* or *Zizyphus mucronata* forages on intake, digestibility and growth performance of growing goats in Kenya. Twenty growing Small East African goats were used in this experiment. Five experimental diets including Rhodes grass hay *ad libitum* plus 60g maize bran – control (T1), control plus 15% *B. discolor* (T2), control plus 30% *B. discolor* (T3), control plus 15% *Z. mucronata* (T4) and control plus 30% *Z. mucronata* (T5) were fed to the animals. The results from the growth trial showed that goats in the supplemented groups with either of the browse forages had higher total DMI (561.1, 639.1 and 595.4 g/d for T1, T3, and T5 respectively) and body weight gains (4.6, 28.1, 63.6, 24.3 and 38.0 g/d for T1, T2, T3, T4 and T5 respectively) than the unsupplemented group. The digestibility of DM and OM was not affected by supplementation but the CP digestibility increased (834.8, 884.8, 920.2, 886.8 and 923.4 g/kg DM for T1, T2, T3, T4 and T5 respectively) with supplementation. Browse forage supplementation did not adversely affect the rumen pH but increased the rumen ammonia nitrogen. The use of the browse forages as supplements for goats fed on poor quality basal diets would enhance the performance of the animals.