

**EFFECTS OF KENAF (*Hibiscus cannabinus*) AS A SUBSTITUTIVE FEED
ON LACTATING DAIRY CATTLE**

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DEDICATION

*To my late father Mr. Songkiat Chantiratikul,
who is my inspiration forever*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Doctor of Philosophy

EFFECTS OF KENAF (*Hibiscus cannabinus*) AS A SUBSTITUTIVE FEED ON LACTATING DAIRY CATTLE

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Improvement of ruminant feeding system by using locally grown fodder has received much attention in the tropics. Recently, kenaf has been shown to be a valuable fodder for beef cattle and small ruminants, but information on its use for dairy cow is scanty. Hence, the overall objective of the thesis was to examine the potential of using kenaf as a substitute for alfalfa hay (AH) and soybean meal (SBM) in dairy cow rations. Three experiments were carried out to achieve the above objective.

Experiment 1 consisted of two studies. In the first, yield and chemical composition of kenaf at different harvesting ages were determined. Kenaf showed a favorable potential yield and chemical composition as fodder. Dry matter (DM), crude protein (CP) and amino acid (AA) degradability and digestibility of kenaf were measured and compared to AH and SBM in the second trial. Dry matter, CP and AA of kenaf were largely degraded in the rumen, resulting in low ruminal undegradable nutrient and absorbable AA. Nutrient degradability and digestibility of 6 weeks old kenaf were comparable to AH. Nutrient availability of kenaf was less than SBM.

The optimum level of substituting AH and the CP from SBM with kenaf in diets and its effect on growth performance and nutrient utilization of growing dairy heifers were examined in Experiment 2 which also consisted of two studies. In the first, four crossbred dairy heifers were randomly fed four diets which AH were substituted with kenaf at 0, 33, 66 and 100% in a 4 x 4 Latin square design of 21d periods. Total substituting AH with kenaf had a significant negative impact ($P<0.05$) on feed intake, digestibilities of DM, organic matter (OM), fiber components and microbial protein synthesis (MPS). In the second trial, another group of four crossbred dairy heifers were used to determine effect of substitution of the CP from SBM with the CP of kenaf at 0, 33, 66 and 100% in a 4 x 4 Latin square design. The results showed that nutrient digestibility and MPS were markedly affected ($P<0.05$) when one to two-thirds of the CP from SBM was substituted with the CP of kenaf. Therefore, kenaf can substitute AH or the CP from SBM up to about 66% in dairy heifer diets.

Experiment 3 involved substituting AH and/or the CP from SBM with kenaf in lactating dairy cow diets. Eight lactating crossbred Sahiwal-Friesians were used in a 4 x 3 incomplete Latin square design with 15d periods. The diets were T1=control, T2=AH was substituted with kenaf, T3=the CP from SBM was substituted with the CP of kenaf, and T4=AH and the CP from SBM were substituted with kenaf and the CP of kenaf respectively. Feed intake, nutrient digestibility, milk yield and milk composition were significantly affected ($P<0.05$), and AA availability to the mammary gland tended to decrease with substitution of kenaf. Lysine or methionine was the first or second limiting AA for milk protein synthesis. Leucine and phenylalanine ranked third and fourth respectively with increasing levels of inclusion of kenaf in the diets of lactating dairy cow.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat keperluan untuk Ijazah Doktor Falsafah

KESAN KENAF (*Hibiscus cannabinus*) KE ATAS PENCERNAAN, FUNGSI RUMEN DAN PENGGUNAAN NITROGEN DALAM LEMBU TENUSU

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Kemajuan sistem pemberian makanan ruminan menggunakan foder tempatan telah mendapat banyak perhatian di kawasan tropika. Masa kini, kenaf telah ditunjukkan sebagai foder yang bernilai untuk lembu pedaging dan ruminan kecil, tetapi maklumat keatas penggunaannya keatas lembu tenusu sangat terhad. Oleh tu, objektif umum tesis ini adalah untuk mengkaji potensi penggunaan kenaf sebagai pengganti kepada alfalfa kering (AH) dan mil kacang soya (SBM) dalam rangsum lembu tenusu. Sebanyak tiga eksperimen telah dijalankan bagi mencapai objektif tersebut.

Eksperimen 1 melibatkan 2 kajian. Kajian pertama, hasil dan komposisi kimia kenaf pada umur tuai yang berbeza telah dikaji. Kenaf telah menunjukkan potensi hasil dan komposisi kimia yang menggalakkan sebagai foder. Penurunan dan penghadaman bahan kering (DM), protein kasar (CP) dan asid amino (AA) kenaf telah diukur dan dibandingkan dengan AH dan SBM didalam kajian kedua. Sebahagian besar bahan

kering, CP dan AA kenaf didapati telah didegradasi di dalam rumen, mengakibatkan penurunan kandungan nutrient tak cerna dan AA terserap dalam rumen. Degradasi dan pencernaan nutrien kenaf berumur 6 minggu adalah setanding dengan AH. Kedapatan nutrien kenaf adalah kurang berbanding dengan SBM.

Tahap optima penggantian AH dan CP daripada SBM dengan kenaf didalam diet dan kesannya keatas prestasi pertumbuhan dan penggunaan nutrien oleh lembu dara telah dikaji dalam eksperimen 2 yang juga terdiri daripada 2 kajian. Dalam kajian pertama, empat lembu dara kacukan telah diberi makan secara rawak dengan empat diet dimana AH telah digantikan dengan kenaf pada 0, 33, 66 dan 100% dalam rekebentuk segiempat Latin 4 X 4 bagi jangkamasa 21 hari. Jumlah penggantian AH dengan kenaf mempunyai kesan negatif yang bererti ($P < 0.05$) ke atas pengambilan makanan, penghadaman DM, bahan organik (OM), komponen serat dan sintesis protein mikrobial (MPS). Dalam kajian kedua, sekumpulan lembu dara kacukan tenusu telah digunakan untuk mengenalpasti kesan penggantian CP SBM dengan CP kenaf pada 0, 33, 66 dan 100% dalam rekabentuk segiempat Latin 4 X 4. Keputusannya menunjukkan pencernaan nutrien dan MPS adalah sangat bererti ($P < 0.05$) apabila satu hingga dua-pertiga daripada CP daripada SBM digantikan dengan CP daripada kenaf. Justeru itu, kenaf boleh menggantikan AH atau CP daripada SBM sehingga 66% di dalam diet lembu dara tenusu.

Eksperimen 3 melibatkan penggantian AH dan/atau CP SBM dengan kenaf dalam diet lembu tenusu. Lapan ekor lembu tenusu kacukan Sahiwal-Friesian telah digunakan dalam 4 X 3 segi empat Latin tak lengkap untuk jangkamasa 15 hari. Diet yang digunakan adalah T1= kawalan, T2 = AH digantikan dengan kenaf, T3 = CP

SMB digantikan dengan CP kenaf dan T4 = AH dan CP SBM masing-masing digantikan dengan kenaf dan CP kenaf. Pengambilan makanan, pencernaan nutrisi, hasil susu dan komposisi susu adalah terkesan dengan bererti ($P < 0.05$), dan kepadatan AA dalam kelenjar mamari cenderung untuk menurun dengan penggantian kenaf. Lysin atau methionin adalah AA yang pertama dan kedua yang menghadkan sintesis protein susu. Leusin dan fenilalanin masing-masing menduduki tempat ketiga dan keempat dengan peningkatan tahap pemasukan kenaf di dalam diet lembu tenusu.

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I certify that an Examination Committee met on date month 2004 to conduct the final examination of Anut Chantiratikul on his Doctor of Philosophy thesis entitled “Effects of Kenaf (*Hibiscus cannabinus*) on the Digestion, Rumen Function and Nitrogen Utilisation in Dairy Cattle” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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