



UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF DIETARY SUPPLEMENTATION OF VITAMINE E,
ANDROGRAPHIS PANICULATA NEES AND *CURCUMA LONGA* L. ON
GROWTH, CARCASS AND MEAT QUALITY OF GOATS**

MORTEZA KARAMI

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EFFECTS OF DIETARY SUPPLEMENTATION OF VITAMINE E, *ANDROGRAPHIS PANICULATA* NEES AND *CURCUMA LONGA* L. ON GROWTH, CARCASS AND MEAT QUALITY OF GOATS

By

MORTEZA KARAMI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

July 2010

DEDICATION

The logo of Universiti Putra Malaysia (UPM) is a shield-shaped emblem. It features a red and white color scheme. At the top left, the letters 'UPM' are written in white on a red rectangular background. In the center, there is a stylized white book with a red cover. Below the book, there are several vertical white lines of varying heights, resembling a barcode or a stylized 'M'. The entire emblem is set against a light gray background.

MY FATHER AND MOTHER,
MY WIFE AND CHILDREN

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

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Chairman: Professor Abdul Razak Alimon, PhD

Faculty: Agriculture

An investigation in the first experiment was carried out to determine the effects of dietary supplementation of *Andrographis paniculata*, *Curcumin longa* and vitamin E on growth performance, carcass characteristics, meat quality, antioxidant activity and fatty acid profiles of Kacang crossbred male goats. Thirty-two male goats (13.0±0.29kg) were assigned to four dietary treatments of eight goats each. The diets were basal – control (CN), and basal supplemented with 400 mg/kg vitamin E (VE), 0.5 percent turmeric powder (TU) or 0.5 percent *Andrographis paniculata* powder (AP). Feeding was *ad libitum* as a total mixed ration for 16 weeks (including two weeks adaptation). After 14 weeks, the goats were slaughtered according to the Halal method and the carcass split two parts (right and left). The *longissimus dorsi* (LD), *infraspinatus* (IS) and *biceps femoris* (BF) muscles were taken. The muscles were vacuum- packaged and conditioned for 0, 7 and 14 days in a chiller at 4°C. The feed intake was lower ($P<0.05$) for the AP than TU treatment, while the feed efficiency was higher ($P<0.05$) in the AP than the CN treatment, as well as total meat in the

carcass and the rib eye muscle area. The percentage of cooking loss in the AP treatment was lower than CN in the fresh IS muscle ($P < 0.05$). The Warner–Bratzler shear force (WBSF) value was reduced by the dietary supplementation in fresh LD ($P < 0.05$). The effects of post mortem aging periods on the WBSF values in BF and IS muscles of goats fed AP treatment were significant. The dietary antioxidant supplementation treatments had significant effects on the L^* (lightness), a^* (redness), b^* (yellowness) values, Chroma and Hue angle ($P < 0.05$) in the LD, IS and BF muscles at different post mortem periods. AP and TU supplemented diets significantly reduced the WBSF value in LD (0day) and AP effect on IS (7 and 14 days). The AP and TU treatment improved the tenderness of BF muscle in different post mortem aging periods. The dietary antioxidant supplementation had significant effects on 2-thiobarbituric acid reactive substance (TBARS) values at 7 days (LD and IS) and 14 days (LD, IS and BF). The unsaturated fatty acids (UFA) in BF and IS muscles were significantly higher ($p < 0.05$) in goats fed the AP diet compared to the other diets.

In the second experiment was conducted to examine the effect of varying levels of AP and TU on the growth performance, carcass characteristics and meat quality of goats. Each treatment received one of the five diets based on the diet formulation in the first experiment. The diets were basal – control (CN), and basal supplemented with 0.25% AP (AP0.25), 0.75% AP (AP0.75), 0.25% TU (TU0.25) and 0.75% TU (TU0.75). Goat slaughtering and muscle sampling procedures were as in the first experiment. The final weight, average daily weight gain, feed to gain ratio, gain to dry matter intake percent, hot and cold carcass weight, dressing out percentage, were not significantly ($P > 0.05$) affected by different levels of AP and TU supplemented

diets. The goats fed the AP 0.75% supplemented diet had a higher feed efficiency than the goats fed the basal diet ($P>0.05$), apparently due to a decreased feed intake. The AP0.75 treatment produced a more desirable leaner carcass with a higher proportion of meat and lower weight of subcutaneous fat and a bigger rib eye muscle area than the CN treatment ($P<0.05$) which is related to the lower back fat adipose and internal body fat ($P<0.05$). The AP and TU levels significantly affected the L^* , b^* , chroma value and Hue angle at different post mortem aging periods in the LD, IS and BF muscles ($P<0.05$). Different dietary levels of AP and TU significantly ($P<0.05$) improved tenderness of the muscles and post mortem aging periods significantly ($P<0.05$) reduce the WBSF value of chevon. Results of a sensory panel evaluation showed that AP and TU levels significantly ($P<0.05$) affected the aroma, tenderness, juiciness and overall acceptability of the chevon. All the experimental diets reduced the TBARS value in all the three muscles. The different levels of AP and TU also reduced ($P<0.01$) the TBARS value in the blood plasma of goats. It can be concluded that supplementing basal diets with herbs and spices containing antioxidants resulted in a general improvement of meat quality and retardation of lipid oxidation compared to the control diet. Some polyunsaturated fatty acids (PUFA) especially PUFA n-3, in BS, IS and LD and also in blood plasma, tended to increase with increasing AP supplementation.

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

**KESAN-KESAN SUPPLEMEN DIET DENGAN VITAMIN E, HEMPEDU BUMI,
DAN KUNYIT PADA PERTUMBUHAN, KARKAS DAN
KUALITI DAGING KAMBING**

Oleh

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Satu kajian telah dijalankan untuk meneliti kesan suplementasi diet dengan sumber antioksidan, *Andrographis paniculata*, *Curcumin longa* and vitamin E, keatas prestasi pertumbuhan, ciri-ciri karkas, kualiti daging, aktiviti antioksidan dan profil asid lemak, pada kambing kacukan Kacang. Tiga puluh dua ekor kambing jantan ($13.0 \pm 0.29\text{kg}$) dibahagikan kepada empat diet rawatan dengan lapan ekor kambing dalam setiap rawatan. Diet itu ialah asas - kumpulan kawalan (CN), dan asas ditambah dengan 400 mg/kg Vitamin E (VE), 0.5% serbuk kunyit (TU) atau 0.5% serbuk *Andrographis paniculata* (AP). Pemberian makanan adalah secara *ad libitum* berterusan selama 16 minggu (termasuk dua minggu penyesuaian) dengan jumlah ratio yang dicampur. Selepas 14 minggu, haiwan kajian disembelih berdasarkan kaedah Halal dan pemotongan karkas kepada dua bahagian (kanan dan kiri). Otot-otot longissimus dorsi (LD), Infraspinatus (IS) dan biceps femoris (BF) diambil. Sampel otot tersebut disimpan secara vakum – bungkus untuk selama 0, 7 dan 14 hari dalam penyejuk pada suhu 4 °c. Pengambilan makanan adalah lebih rendah

($P < 0.05$) untuk rawatan AP berbanding rawatan TU, manakala efisiensi makanan (FE) rawatan AP secara signifikan lebih tinggi daripada rawatan CN. Peratusan jumlah daging pada karkas dan tempat otot mata tulang rusuk adalah lebih tinggi ($P < 0.05$) untuk rawatan AP berbanding rawatan CN. Peratus kehilangan memasak pada otot segar IS menurun secara signifikan pada rawatan AP berbanding CN ($P < 0.05$). Nilai gaya ricih Warner-Bratzler pada otot segar LD adalah menurun ($P < 0.05$) dengan penambahan antioksidan dalam makanan. Kesan penuaan waktu posmortem untuk kambing yang diberi rawatan AP pada nilai WBSF dalam otot BF dan IS adalah signifikan. Penambahan antioksidan dalam diet rawatan itu memberi kesan signifikan ke atas L^* (ringan), a^* (kemerahan), b^* (kekuningan) dan juga sudut "Chroma and Hue" ($P < 0.05$) dalam otot TD, IS dan BF pada penuaan waktu posmortem yang berlainan. Nilai WBSF dalam otot LD (0day) menurun signifikan dengan pemberian diet supplemen AP dan TU dan kesan AP pada otot IS (7 and 14 days). Rawatan AP dan TU meningkatkan tegangan otot BF pada berlainan waktu penuaan posmortem. Diet rawatan dengan penambahan antioksidan mempunyai kesan yang signifikan pada nilai substansi reaktif asid thiobarbituric (TBARS) pada 7 hari (LD and IS) dan 14 hari (LD, IS and BF). Kandungan asid lemak taktepu dalam otot BF dan IS adalah lebih tinggi signifikan ($p < 0.05$) pada kambing dalam rawatan diet AP berbanding dengan kambing dalam rawatan yang lain.

Experimen yang kedua telah dilaksanakan untuk menentukan kesan aras AP dan TU yang berbeza keatas prestasi pertumbuhan dan ciri-ciri karkas pada kambing Kacang. Tiga puluh ekor anak-anak kacukan kambing Kacang jantan (13.2 ± 0.4 kg) ditugaskan untuk lima rawatan makanan dengan enam ekor kambing setiap rawatan. Setiap rawatan menerima salah satu daripada lima diet berdasarkan padan formulasi

diet di experimen pertama. Rawatan diets adalah Basal - kontrol (CN), and Basal ditambah 0.25% AP (AP0.25), 0.75% AP (AP0.075), 0.25% TU (TU0.25) and 0.75% TU (TU0.75). Pada akhir percubaan kambing disembelih dan sample otot diambil mengikut kaedah yang dihuraikan dalam experimen pertama. Rawatan diets adalah Basal - kontrol (CN), and Basal ditambah 0.25% AP (AP0.25), 0.75% AP (AP0.075), 0.25% TU (TU0.25) and 0.75% TU (TU0.75). Pada akhir percubaan kambing disembelih dan sample otot diambil mengikut kaedah yang dihuraikan dalam experimen pertama. Berat badan terakhir, penambahan berat badan harian, nisbah makanan kepada penambahan, peratusan penambahan kepada pengambilan bahan kering, berat panas dan dingin berat karkas dan peratusan daging tidak dipengaruhi oleh penambahan diet pelbagai peringkat AP dan TU. Kambing yang diberi makanan dengan 0.75% AP mempamerkan efisien makanan yang lebih tinggi ($P > 0.05$) berbanding kumpulan diet asas, menunjukkan kesan pengurangan pengambilan makanan. Rawatan AP0.75 menghasilkan karkas yang lebih baik dengan peratusan daging yang lebih tinggi dan rendah lemak. Selain daripada itu, potongan otot longissimus (tempat otot mata tulang rusuk dan dept) lebih baik daripada rawatan CN ($P < 0.05$) dan ini berkaitan dengan lebih rendah lemak tubuh dalaman adipos bahagian bawah belakang dan lemak dalaman badan ($P < 0.05$). rawatan diet AP 0.75 dari diet CN dan TU0.75. Tahap TU dan AP memberi signifikan kesan pada L^* , b^* , nilai kroma dan sudut Hue pada berlainan waktu penuaan posmortem di otot LD, IS dan BF otot ($P < 0.05$). Tahap diet antioksidan suplemen AP dan TU yang berbeza mempunyai pengaruh signifikan ($P < 0.05$) pada kelembutan otot dan waktu penuaan posmortem memberi signifikan kesan mengurangkan nilai WBSF pada daging kambing. Keputusan bahawa kepekaan rasa panel evaluasi menunjukkan tahap AP dan TU signifikan mempengaruhi aroma,

kelembutan, juiciness, dan keseluruhan menerima daging kambing. melainkan rasa. Semua percubaan diet mempunyai kesan signifikan pada nilai dan mengurangkan TBARS lipid oxidation dalam otot berbeza. Berlainan tahap AP dan TU mengurangkan ($P < 0.01$) nilai TBARS dalam darah plasma darah kambing. Itu menyimpulkan bahawa suplemen diet asas dengan antioksidan umumnya meningkatkan kualiti daging dan kestabilan lemak oksidaan daging berbanding dengan kawalan makan diet. Sejumlah asid lemak tak tepu (PUFA) iaitu n-3 PUFA, dalam BS, IS and LD, dan juga dalam plasma darah, menunjukkan peningkatan dengan meningkatnya tambahan AP.

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I certify that a Thesis Examination Committee has met on 30 July 2010 to conduct the final examination of Morteza Karami on his Doctor of Philosophy thesis entitled “Effects of dietary supplementation of vitamin E, *Andrographis Paniculata* Nees and *Curcuma Longa* L. on growth, carcass and meat quality of goats” in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the degree of Doctor of Philosophy (PhD).

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DECLARATION

I hereby declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

MORTEZA KARAMI

Date: 30 July 2010



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5 EFFECTS OF DIFFERENT LEVELS OF *ANDROGRAPHIS PANICULATA* AND TURMERIC ON GROWTH, CARCASS AND MEAT QUALITY OF GOAT

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