UNIVERSITI PUTRA MALAYSIA

EFFECT OF CORN SUBSTITUTION AS ENERGY SOURCE IN PALM KERNEL CAKE AND UREA TREATED RICE STRAW- BASED DIET IN DORPER CROSSBRED LAMBS

OSAMA ANWER SAEED

FP 2018 33

EFFECT OF CORN SUBSTITUTION AS ENERGY SOURCE IN PALM KERNEL CAKE AND UREA TREATED RICE STRAW- BASED DIET IN DORPER CROSSBRED LAMBS

By

OSAMA ANWER SAEED

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

February 2018

COPYRIGHT

DEDICATION

This work is dedicated to the memory of Commander Ayman Ahmad Saeed and Bassam Jubair; those who lost their lives to light up our road to freedom. The gratitude has finally conquered the loss. Today my city has been retaken and we will rebuild it with pride and gratitude in memory of their sacrifices.

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

EFFECT OF CORN SUBSTITUTION AS ENERGY SOURCE IN PALM KERNEL CAKE AND UREA TREATED RICE STRAW- BASED DIET IN DORPER CROSSBRED LAMBS

By

OSAMA ANWER SAEED

February 2018

Chairman : Associate Professor Anjas Asmara @ Ab. Hadi Bin Samsudin, PhD
Faculty : Agriculture

Modern ruminant production has become increasingly affected by current economic trends. In recent years, dramatic increases in the price of feedstuffs caused by competition for human consumption. Feed accounts for 50% to 75% of total production costs in the livestock industry, making it one of the largest expenses for producers. As the land available for agricultural production is decreasing, and the price of feed inputs increasing, it has become more important for producers to understand the potential value of utilizing byproducts as part of a feeding program.

This study investigated corn substitution and its effect on PKC and urea-treated rice straw-based diet on the rumen fermentation, biohydrogenation and growth performance of Dorper crossbred lambs. Apart from that, hematological and biochemical profile of blood serum; carcass characteristics and quality of meat were also examined in this study. Two experiments involving *in vitro* rumen fermentation and *in vivo* feeding trials were conducted.

For the *in vitro* rumen fermentation analysis, three treatment groups with different level of corn were used; namely T1 = basal diet (control); T2 = basal diet + 5% corn and T3 = basal diet +10% corn. In this study, corn was used as a source of energy. The T1, T2 and T3 were incubated from 0 h until 72 h to determine the fermentation profiles, fatty acid biohydrogenation and also rumen microbial population.
The second experiment involved 27 Dorper crossbred lambs (initial b/w 15 + 0.59 Kg) that individually kept in single pens and were randomly divided into 3 formulated dietary group consisting of T1 = 75.3% PKC + 0% corn; T2 = 70.3% PKC + 5% corn and T3 = 65.3% PKC + 10% corn. Feed intake and refusal were recorded on a daily

basis. Blood samples for hematological and biochemical tests were collected from all the lambs at days 0, 40, 80, 120 of the experiment periods.

The results of the *in vitro* study demonstrated that production of gas increased from 0 h until 9 h with T2 having the highest gas production during this phase. After 48 h, the gas production began to decrease gradually with increase in incubation time. No significant differences ($P>0.05$) were observed in the *in vitro* dry matter digestibility (IVDMD), in vitro organic matter digestibility (IVOMD), NH_3-N, and pH at 72 h. However, significant production of methane gas levels was noted in T3 which showed the highest CH_4 concentration in comparison with the control group (T1) and T2. The population of microbials revealed that number of total methanogenic archaea increased at 24 h with T1 having the highest number followed by T3 and T2. However, no significant differences were observed between treatment groups for total bacteria, *F. succinogenes* and *R. flavefaciens*. The mean concentration of protozoa at 24 h revelated that T2 had the highest number of protozoa than others ($P<0.001$).

Results of the *in vivo* feeding study demonstrated that diets substituted with corn were nearly similar in DM, CP, EE, and ash contents. Significant different were observed on the final body weight among the different treatment diets. Furthermore, significant different were observed for ADG in T3 than the other two treatments while the average daily feed intake was significant ($P<0.05$) for lambs fed on diet substituted 10% corn and 65.3% PKC was higher than the control lambs. It was found that lambs fed on diet substituted with 5% and 10% corn had highest ($P<0.05$) DMI than those substituted 0% corn. Moreover, biological values and protein efficiency ratios were significantly raised in lambs fed on diet contain 10% corn than those contain with 0% and 5% corn. However, significant differences in the number of protozoa demonstrated with T3 followed by T2 and T1 ($P<0.05$) but no differences of total bacteria, *F. succinogenes*, *R. albus* and methanogenic archaea. The number of *R. flavefaciens* was highest in T2 and T3 compared with T1.

Substitution 5% and 10% corn as source of energy on the hematological and biochemical parameters in lambs has no effect on the serum appeared to be within a normal range. The serum antioxidant enzyme (GPx) demonstrates a reduction of GPx in T3 at day 120, but not in T2 where the GPx concentration in serum increased. The MDA was not affected by supplements within the same period. Feeding PKC significantly increased Cu retention by 2.06, 4.19, and 4.14 mg/d respectively in the body. Zinc concentration in the serum, liver, and kidney also increased slightly when corn is added as an energy source in the diet. Serum Cu, Se, Fe, and Zn did not differ ($P>0.05$) between treatment groups, but Se and Fe were higher ($P<0.05$) at day 120, especially in T3 compared to T1. The concentration of serum Zn was lower (2.27 ppm) in T2 and T3 within the same period. The real-time PCR analyses revealed significant ($P<0.01$) up-regulation of ATP7A and MT-Ia genes in T3 while, hepatic Cu/Zn SOD and GPx4 mRNA were high expression in lamb hepatocytes in T3 compared with T1.

The smallest hot carcass weight (10.15 kg) was seen in lambs fed on the control diet, whereas lambs fed diet has 10% corn has the highest hot carcass weight (11.46 kg). Hot and cold dressing percentages on slaughter weight of lambs fed on 5% and 10% corn shows no significantly ($P>0.05$) different with the control group. The highest pH value of *supraspinatus* and *longissimus lumborum* muscles were influenced by supplement treatment T2 and T3 (5.76, 6.11, and 5.76) and (5.63, 6.15, and 5.85) respectively. Further, the L* value (lightness index) of the same muscle differed ($P<0.001$) among all three treatments and the a* (redness index) and b* (yellowness index) values were not significant in the treatment groups.

Dietary substitution of corn into the PKC-based diet can be used to enhance the useful fatty acids in muscles and offal without having to compromise the rumen microbial metabolism, growth performance, serum biochemistry, carcass traits, and meat quality in lambs.

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

KESAN MENAMBAH TENAGA KE DALAM DIET ISIRONG KELAPA SAWIT DAN JERAMI PADI DIRAWAT UREA BAGI ANAK BIRI-BIRI DORPER

Oleh

OSAMA ANWER SAEED

Februari 2018

Pengerusi : Profesor Madya Anjas Asmara @ Ab Hadi Bin Samsudin, PhD
Fakulti : Pertanian

Kajian ini menyiasat kesan diet suplemen tenaga PKC dan jerami dirawat urea pada fermentasi rumen, biohidrogenasi dan prestasi pertumbuhan. Selain itu, profail hematologi dan biokimia serum darah, ciri-ciri karkas dan kualiti daging turut diperhatikan. Dua eksperimen yang melibatkan fermentasi *in vitro* rumen dan dalam ujian makan *in vivo* telah dilakukan.

Untuk analisis fermentasi *in vitro* rumen, tiga kumpulan rawatan dengan tahap tenaga yang berbeza telah digunakan; iaitu T1 = diet basal (kawalan); T2 = diet dasar + 5% tenaga dan T3 = diet dasar + 10% tenaga. Dalam kajian ini, jagung digunakan sebagai sumber tenaga. Kumpulan rawatan telah diinkubasikan dari 0 jam hingga 72 jam untuk menentukan profil fermentasi, biohidrogenasi asid lemak dan juga populasi mikroorganisma rumen.

Eksperimen kedua melibatkan sebanyak 27 anak biri-biri Dorper (awal b/w 15 + 0.59 Kg) yang disimpan secara individu dalam petak individu dan dibahagikan secara rawak kepada 3 kumpulan diet yang dirumuskan secara isokolorik dan isonitogenik konsisten dengan T1 = 75.3% PKC + 0% tenaga, T2 = 70.3% PKC + 5% tenaga, dan T3 = 65.3% PKC + 10% tenaga. Pengambilan dan lebihan makanan dicatat setiap hari. Sampel darah untuk hematologi dan biokimia dikumpulkan dari semua anak biri-biri pada hari 0, 40, 80, 120 tempoh percubaan.

Hasil kajian *in vitro* menunjukkan peningkatan produksi gas secara linear dari 0 jam hingga 9 jam dengan T2 mempunyai pengeluaran gas tertinggi selama fasa ini. Selepas 48 jam, pengeluaran gas mula berkurangan secara perlahan seiring dengan peningkatan masa inkubasi. Tiada perbezaan ketara ($P>0.05$) dalam pencernaan bahan kering *in vitro* (IVDMD), bahan organik *in vitro* (IVOMD), NH_3-N, dan pH pada 72 jam. Bagaimanapun, pengeluaran yang signifikan pada tahap gas metana dicatat pada T3 yang mempunyai kepekatan tertinggi CH_4 berbanding dengan kumpulan kawalan (T1) dan T2. Populasi mikroorganisma menunjukkan jumlah arkea metanogenik meningkat pada 24 jam dengan T1 mempunyai bilangan tertinggi diikuti oleh T3 dan T2. Bagaimanapun, tidak terdapat perbezaan yang signifikan antara kumpulan rawatan untuk jumlah keseluruhan bakteria, *F. succinogenes* dan *R. flavefaciens*. Purata populasi protozoa pada 24 jam menunjukkan bahawa T2 mempunyai bilangan protozoa tertinggi berbanding yang lain ($P<0.001$).

Dari hasil kajian pemakanan *in vivo* menunjukkan bahawa diet yang mengandung tenaga merekodkan DM, CP, EE, dan kandungan abu yang hampir serupa. Perbezaan diperhatikan pada berat badan terakhir di kalangan diet rawatan yang berbeza. Di samping itu, terdapat perbezaan yang ketara bagi ADG di T3 berbanding dengan dua rawatan lain manakala pengambilan makanan harian purata adalah signifikan ($P<0.05$) untuk biri-biri yang diberi makan 10% tahap tenaga dan 65.3% PKC berbanding dengan anak biri-biri kawalan. Didapati bahawa kambing yang diberi makan dengan 5% dan 10% tenaga mempunyai DMI tertinggi ($P<0.05$) dari yang diberi makan 0% tenaga. Lebih-lebih lagi, nilai biologi dan nisbah kecekapan protein jauh lebih tinggi pada kambing yang diberi 10% jagung daripada yang diberi makan 0% dan 5% jagung. Bagaimanapun, perbezaan yang signifikan terdapat dalam bilangan menunjukkan dengan T3 diikuti oleh T2 dan T1 ($P<0.05$) tetapi tiada perbezaan pada jumlah total bakteria, *F. succinogenes, R. albus* and methanogenic archea. Bilangan *R. flavefaciens* adalah tertinggi di T2 dan T3 berbanding dengan T1.

Penambahan jagung sebanyak 5% dan 10% sebagai sumber tenaga pada hematologi dan biokimia pada anak biri-biri tidak mempunyai kesan dan kedua-dua profil hematologi dan biokimia dan berada dalam lingkungan yang normal. Enzim serum antioksidan (GPx) menunjukkan pengurangan GPx dalam T3 pada hari 120, tetapi tidak di T2 di mana kepekatan GPx dalam serum meningkat. TBARS tidak terjejas oleh makanan tambahan dalam tempoh yang sama. Memberi makan PKC dengan ketara meningkatkan pengekalan Cu sebanyak 2.06, 4.19, dan 4.14 mg/d dalam tubuh. Kepekatan zink dalam serum, hati, dan buah pinggang juga meningkat sedikit apabila tenaga ditambah dalam diet. Serum Cu, Se, Fe, dan Zn tidak berbeza ($P>0.05$) antara kumpulan rawatan, tetapi Se dan Fe lebih tinggi ($P<0.05$) pada hari 120, terutamanya dalam T3 berbanding dengan T1. Kepekatan serum Zn lebih rendah (2.27 ppm) dalam T2 dan T3 dalam tempoh yang sama. Analisis PCR masa nyata menunjukkan peningkatan ATP7A dan MT-Ia gen di T3, manakala Cu/Zn SOD, GPx1 dan GPx4 mRNA hepatic adalah tinggi dalam hepatosit kambing di T3 berbanding dengan T1 (kumpulan kawalan).

Berat karkas panas terkecil (10.15 kg) dilihat pada anak biri-biri yang diberi makan diet kawalan, manakala anak biri-biri yang diberi makan dengan 10% tenaga mempunyai berat badan panas tertinggi (11.46 kg). Peratusan berpakaian panas dan dingin pada berat penyembelihan tidak signifikan ($P>0.05$) pada anak biri-biri yang ditambah. Nilai pH tertinggi *supraspinatus* dan otot *lumborum longissimus* dipengaruhi oleh rawatan tambahan T2 dan T3 (5.76, 6.11, dan 5.76) dan (5.63, 6.15 dan 5.85) masing-masing. Selanjutnya, nilai L* pada otot yang sama berbeza ($P<0.001$) di antara ketiga-tiga rawatan dan nilai a* dan b* tidak signifikan dalam kumpulan rawatan.

Suplemen tenaga makanan kedalam diet berasaskan PKC boleh digunakan untuk meningkatkan asid lemak berfaedah dalam otot dan asali tanpa mengorbankan metabolisme mikroba rumen, prestasi pertumbuhan, biokimia serum, sifat karkas, dan kualiti daging anak biri-biri.

ACKNOWLEDGEMENTS

My sincere thanks to the Almighty Allah for blessing me the health and patience to complete this work. The Prophet Muhammad, peace be upon him, said: He has not thanked Allah who has not thanked people.

First, and foremost, it is my greatest pleasure to thank my supervisor, Assoc. Prof. Dr. Anjas Asmara @ Ab Hadi Bin Samsudin, who has given me the strength each day to pursue this degree. His kindness and constant encouragement and invigorating talks rejuvenated my spirits during this entire period. To him I am and will always be most grateful.

Also, I want to thank the members of my supervisory committee: Assoc Prof Dr. Awis Qurni Bin Sazili, and Dr. Henny Akit, for their guidance and support throughout this research. I want to express my appreciation to Prof Abdul Razak Alimon for his constant motivation and technical support throughout this research. I am thankful to have been able to learn from these exceptional educators and hope that one day I will be able to pass on what I have learned from them to others.

My sincere gratitude goes to Prof Loh Teck Chwen and all the staff of the Department of Animal Science, Faculty of Agriculture, UPM for assisting in teaching me how to use their equipment. And to the staff of ruminant farm of the Department of Animal Science, Faculty of Agriculture, UPM, I say a big thank you for your cooperation and assistance to me while carrying out my experiments.

I would like to thank the Ministry of Higher Education and Scientific Research of Iraq for funding my study. Special gratitude goes to the University of Al Anbar and special thanks to the Deputy Dean of the Faculty of Agriculture, UPM, for all their help and encouragement throughout this academic journey.

To my family, words will always be inadequate to express my gratitude for their love and unending support. To my father may, Allah make Jannatul Firdaus your resting place; to my mother, brother and sister, your love, support and encouragement will always be remembered and appreciated.

I would like to thank Shuye Lim, through good times and bad, your kindness and extensive support have been ever present in this important time of my life, for which I am eternally grateful.

I am grateful to Stephini Jotham for her help and support throughout this research. I have no words to extend my heartiest thanks to Dr Azad Sabow, Dr Mahdi Ebrahimi, Dr Zeaid Agwani, Dr Adeyemi Kazeem Dr Ahmed Khalaf and to Dr Kifah Odhaib, Mrs Dalia Abdullah, Mr Mohamad Farooq, Mr Humam Ali, Mr Amar Iberahim for their great cooperation whenever it was needed. I am also thankful to all my friends, Dr Leo Teik Kee, Dr Atique Behan, Mr Muideen Ahmed, Mr Suni Umar, Mr Hamid, Mr Abu Baker Sadeq, Ahmed Shawky, Mr Sani Garba, and Dr Tanber Ahmed for having a nice time with me during my study. I'm grateful to my colleagues, Izudden, Nabiala, Nadirah and Lyana. It is also with much gratitude that I thank my little family here: Mr Ayman, Mr Hazim, Mr Talal and finally to my inspiration, our little girl, Laujin.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Anjas Asmara @ Ab. Hadi Samsudin, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Awis Qurni Sazili, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Henny Akit, PhD
Senior Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

_____
ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No: Osama Anwer Saeed, GS41617

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature:	_____
Name of Chairman of Supervisory Committee:	Associate Professor Dr. Anjas Asmara @ Ab. Hadi Samsudin
Signature:	_____
Name of Member of Supervisory Committee:	Associate Professor Dr. Awis Qurni Sazili
Signature:	_____
Name of Member of Supervisory Committee:	Dr. Henny Akit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ADF	Acid detergent fiber
ADL	Acid detergent lignin
ANOVA	Analysis of variance
AST	Aspartate Aminotransferase
BH	Biohydrogenation
cal	Calorie
CETAB	Cetyltrimethylammonium bromide
CF	Crude fiber
CLA	Conjugated linoleic acid
CP	Crude protein
CPOB	Palm oil blend
Cu	Copper
d	Day
DE	Digestible energy
DM	Dry matter
DMD	Dry matter digestibility
DMI	Dry matter intake
DOMI	Digestibility organic matter intake
DOMR	Digestible organic matter in the rumen
EE	Ether extraction
Emns	Efficiency of microbial nitrogen supply
FA	Fatty acid
Fe	Iron
FAME	Fatty acid methyl esters

g	Gram
GLM	Generalized linear model
GP_X	Glutathione peroxidase
GPx1	Glutathione peroxidase 1 gene
GPx4	Glutathione peroxidase 4 gene
h	Hour
IVDMD	*In vitro* dry matter digestibility
L	Litre
LDH	Lipoprotein density high
LW	Live weigh
LWG	Live weight gain
LL	*Longissimus lumborum* muscle
m	Meter
MDA	Malondialdehyde
ME	Metabolizable energy
min	Minute
µL	Microliter
ml	Millilitres
mm	Millimetre
mmol/L	Millimoles per liter
MN	Microbial nitrogen
MNPD	Daily duodenal flow of microbial N
MT-Ia	Metallothionein - Ia gene
MTP	Microbial true protein
MUFA	Monounsaturated fatty acid
N	Nitrogen

NDF	Neutral detergent fiber
^{o}C	Degrees centigrade
OM	Organic matter
OMD	Organic matter digestibility
PD	Purine derivative
PDa	Microbial purine absorbed
PDe	Total purine excreted in urine
pH	Potential Hydrogen
PKC	Palm kernel cake
PKM	Palm kernel meal
POR	Pleurotusostreatus
PPR	Pleurotuspulmonarius
PTR	Pleurotus tuber-regium
PUFA	Polyunsaturated fatty acid
Se	Selenium
SEM	Mean of standard error
SOD	Cu/Zn Superoxide Dismutase gene
SS	*Supraspinatus* muscle
ST	*Semitendinosus* muscle
TMR	Total mixed ration
VFA	Volatile fatty acid
Zn	Zinc

CHAPTER 1

GENERAL INTRODUCTION

The livestock industry is one of important component of the Malaysian agricultural sector which mainly comprises of buffalo, cattle, goats, sheep, swine and poultry which represent 0.04%, 0.24%, 0.14%, 0.05%, 0.75% and 98.78% respectively among others (DVS, 2016). However, while the sheep industry is progressively growing, it faces some challenges such as scarcity of feed source, low returns and competition between local meat production versus meat importation (Chen, 1984). The total number of sheep in Malaysia is estimated to be at 145,999 head (DVS, 2016). The current self-sufficient level for sheep and goat production in Malaysia is estimated to be around 30% (Hashim, 2015). The per capita intake of mutton in year 2015 is estimated to be around 1.25 kg/year/person (DVS, 2016). Sheep vary in fat deposition presumably due to their adoption of various adaptation strategies. Unlike goats which tend to set aside more internal fat that is not related to the carcass, sheep have more subcutaneous and intramuscular fat from excess energy. Sheep make a significant contribution to the household economy in areas where carcass fat is a delicacy and fetches a higher price (Hirpa & Abebe, 2008). The shortage and higher prices of livestock feedstuff in Malaysia and other countries has affected its availability especially in areas where it competes with human on cereal consumption needs.

To overcome this challenge, palm kernel cake (PKC) has been used as animal feedstuff in countries like Malaysia. Palm kernel cake, which is extracted from palm oil, is a potential feedstuff for ruminants in Malaysia due to its availability and comparatively lower price than the other concentrate – based diet (Okeudo *et al.*, 2006; Adesehinwa, 2007). Palm kernel cake has a moderate crude protein content of between 16-18% (Alimon, 2004). Although, it is abundant and been widely used as ruminant feed, sheep is the only ruminant species that are peculiarly sensitive to Cu toxicity in their diets. The copper (Cu) concentration in the PKC is estimated about 28.5 mg kg^{-1}. Sheep liver cells have a high affinity for Cu which are excreted into the bile in small doses and lead to an eventual build-up of liver Cu concentrations (Jaiswal *et al.*, 2015).

There have been some extensive studies on the effects of reducing Cu toxicity involving the use of chelating agents such as sodium sulfate, ammonium molybdate, zinc sulfate, and sodium molybdate according to studies reported by Hair Bejo & Alimon, (1992), Rahman *et al.* (1989), Yusoff *et al.* (1995) and Hair Bejo *et al.* (1995). However, most of the currently used chelating agents have serious adverse effects and associated risks such as heart disease and autism in human (Angle, 1996; Flora & Pachauri, 2010; Mandal, 2014). Earlier studies on Cu toxicity therapy have not dealt with natural protection that could allow for it elimination through the production of compounds that would prevent Cu uptake. Rumen protozoa have been implicated in Cu toxicity. Where the protozoas decrease Cu solubility in the rumen and its concentration in the livers of sheep when different feed formulations such as 2%

bentonite + PKC or corn silage with or without soybean meal were employed (Ivan *et al.*, 1986; Abdullah *et al.*, 1995; Ivan *et al.*, 1999).

Ebrahimi *et al.* (2007) reported that increasing energy levels in a PKC-based diet enhances feed intake and the average daily gain in sheep. Enriching diets with energy allows the protozoa to assimilate soluble sugars and preserve some of them in reserve polysaccharides which can reduce the risk of acidosis after feed consumption with high concentrations of easily digestible sugars (Van Zwieten *et al.*, 2008).

There is a need to understand how energy can be enhanced in conventional PKC diets in sheep at low cost without compromising their rumen metabolism, blood parameters, and meat quality. This study examines the effects of substitution of corn as source of energy into PKC as a basal diet on the rumen metabolism, growth performance, blood profiles, carcass traits and meat quality in sheep. The current research will contribute to the efforts of producing healthier Dorper lambs to meet the enhanced expectations of consumers as well as provide value-added economic benefits to them.

It was hypothesized that substition corn into PKC-urea treated rice straw diet will provide sufficient energy requirement in lambs which may improve the growth rate and overall performance. This study sought to establish the optimum level of PKC-urea treated rice straw substituted with different levels of corn as source of energy required to enhance the growth performance, rumen ecology, and digestibility, as well as the antioxidant capacity and physiological performances of Dorper crossbred sheep. To materialize these, the study was done and put focus on several specific objectives such as:

i. to determine the effect of PKC-urea-treated rice straw substituted with different levels of corn on biohydrogenation and *in-vitro* rumen fermentation profiles.
ii. to determine the effect of PKC-urea-treated rice straw substituted with various levels of corn on feed intake, growth performance, digestibility and rumen metabolism in Dorper crossbred sheep.
iii. to determine the optimal level of corn into PKC-urea-treated rice straw based diet on hematology, biochemistry, mineral metabolism and antioxidant capacity.
iv. to determine the use of PKC-urea-treated rice straw substituted with various corn levels on carcass characteristics and meat quality.

Hypothesis

i. Feeding sheep on the PKC substituted with different levels of corn together with urea-treated rice straw as a source of roughages will improve growth performance, and may effect on the rumen microbial population, mineral metabolism and antioxidant capacity.
ii. Substitution of different levels of corn with PKC and urea-treated rice straw based diet will affect on the fat deposition in the carcass and the fatty acid profile in the muscles.

REFERENCES

Aaslyng, M. D., Bejerholm, C., Ertbjerg, P., Bertram, H. C., & Andersen, H. J. (2003). Cooking loss and juiciness of pork in relation to raw meat quality and cooking procedure. *Food Quality and Preference, 14*(4), 277-288.

Abdelrahman, M. M., Aljumaah, R. S., Alyemni, A. H., Ayadi, M., Metwally, H., & Al-Saiady, M. Y. (2014). Effect of palm kernel cake and trace minerals on performance of growing Naemi lambs. *Research Opinions in Animal & Veterinary Sciences, 4*(5), 268-272.

Abdullah, N., & Hutagalung, R. I. (1988). Rumen fermentation, urease activity and performance of cattle given palm kernel cake-based diet. *Animal Feed Science and Technology, 20*(1), 79-86.

Abdullah, N., Hanita, H., Ho, Y. W., Kudo, H., Julaludin, S., & Ivan, M. (1995). The effects of bentonite on rumen protozoal population and rumen fluid characteristics of sheep fed palm kernel cake. *Asian Australasian Journal of Animal Sciences, 8*(3), 249-254.

Abubakr, A. R., Alimon, A. R., Yaakub, H., Abdullah, N., & Ivan, M. (2013). Digestibility, rumen protozoa, and ruminal fermentation in goats receiving dietary palm oil by-products. *Journal of the Saudi Society of Agricultural Sciences, 12*(2), 147-154.

Abubakr, A., Alimon, A. R., Yaakub, H., Abdullah, N., & Ivan, M. (2015). Effect of feeding palm oil by-products based diets on muscle fatty acid composition in goats. *PloS One, 10*(3), e0119756.

Abubakr, A., Alimon, A. R., Yaakub, H., Abdullah, N., & Ivan, M. (2014). Effect of feeding palm oil by-products based diets on total bacteria, cellulolytic bacteria and methanogenic archaea in the rumen of goats. *PloS One,* 9(4), e95713.

AbuGhazaleh, A. A., Riley, M. B., Thies, E. E., & Jenkins, T. C. (2005). Dilution rate and pH effects on the conversion of oleic acid to trans C 18: 1 positional isomers in continuous culture. *Journal of Dairy Science, 88*(12), 4334-4341.

Adesehinwa, A. O. K. (2007). Utilization of palm kernel cake as a replacement for maize in diets of growing pigs: effects on performance, serum metabolites, nutrient digestibility and cost of feed conversion. *Bulgarian Journal of Agricultural Science, 13*(5), 591-600.

Adeyemi, K. D., Ebrahimi, M., Samsudin, A. A., Alimon, A. R., Karim, R., Karsani, S. A., & Sazili, A. Q. (2015). Influence of Carotino oil on *in vitro* rumen fermentation, metabolism and apparent biohydrogenation of fatty acids. *Animal Science Journal, 86*(3), 270-278.

Adeyemi, K. D., Sabow, A. B., Aghwan, Z. A., Ebrahimi, M., Samsudin, A. A., Alimon, A. R., & Sazili, A. Q. (2016). Serum fatty acids, biochemical indices and antioxidant status in goats fed canola oil and palm oil blend. *Journal of Animal Science and Technology*, *58*(1), 6.

Adeyemi, K. D., Sabow, A. B., Shittu, R. M., Karim, R., & Sazili, A. Q. (2015). Influence of dietary canola oil and palm oil blend and refrigerated storage on fatty acids, myofibrillar proteins, chemical composition, antioxidant profile and quality attributes of semimembranosus muscle in goats. *Journal of Animal Science and Biotechnology*, *6*(1), 51.

Adeyemi, K. D., Sabow, A. B., Shittu, R. M., Karim, R., Karsani, S. A., & Sazili, A. Q. (2016). Impact of chill storage on antioxidant status, lipid and protein oxidation, colour, drip loss and fatty acids of semimembranosus muscle in goats. *CyTA-Journal of Food*, *14*(3), 405-414.

Aditia, M., Sunarso, S., Sevilla, C. C., & Angeles, A. A. (2014). Growth performance and mineral status on goats (*Capra hircus Linn*.) supplemented with zinc proteinate and selenium yeast. *International Journal of Science and Engineering*, *7*(2), 124-129.

AFRC, E. (1993). Protein Requirements of Ruminants. *An Advisory Manual Prepared by the AFRC Technical Committee on Responses to Nutrients, CAB international, Wallingford*.

Aghwan, Z. A. (2013). Effects of iodine and selenium supplementation on growth, carcass characteristics and meat quality of crossbred Kacang goats (Doctoral dissertation, PhD thesis. Serdang: Univeristi Putra Malaysia).

Aghwan, Z. A., Sazili, A. Q., Alimon, A. R., Goh, Y. M., & Hilmi, M. (2013). Blood haematology, serum thyroid hormones and glutathione peroxidase status in Kacang goats fed inorganic iodine and selenium supplemented diets. *Asian-Australasian Journal of Animal Sciences*, *26*(11), 1577-1582.

Ahmadi, A. S., Golian, A., Akbarian, A., Ghaffari, M. H., Shirzadi, H., & Mirzaee, M. (2010). Effect of extruded cotton and canola seed on unsaturated fatty acid composition in the plasma, erythrocytes and livers of lambs. *South African Journal of Animal Science*, *40*(4), 311-318.

Akinfemi, A., & Ogunwole, O. A. (2012). Chemical composition and *in vitro* digestibility of rice straw treated with *Pleurotus ostreatus, Pleurotus pulmonarius* and *Pleurotus tuber-regium*. *Slovak Journal of Animal Sciences*, *45*(1), 14-20.

Akpan, H. D., Udosen, E. O., Udofia, A. A., Акран, E. J., & Joshua, A. A. (2005). The effect of phytase and zinc supplementation on palm kernel cake toxicity in sheep. *Pakistan Journal of Nutrition*, *4*(3), 148-153.

Akpanabiatu, M. I., Ekpa, O. D., Mauro, A., & Rizzo, R. (2001). Nutrient composition of Nigerian palm kernel from the dura and tenera varieties of the oil palm (*Elaeis guineensis*). *Food Chemistry, 72*(2), 173-177.

Al-Dabeeb, S. N. (2005). Effect of feeding low quality date palm on growth performance and apparent digestion coefficients in fattening Najdi sheep. *Small Ruminant Research, 57*(1), 37-42.

Alimon, A. R. (2004). The nutritive value of palm kernel cake for animal feed. *Palm Oil Development, 40*(1), 12-14.

Alimon, A. R., Ivan, M., & Jalaludin, S. (2011). Effects of different levels of dietary sulfur and molybdenum on concentrations of copper and other elements in plasma and liver of lambs fed palm kernel cake diets. *British Journal of Nutrition, 106*(08), 1224-1230.

Al-Jasass, F. M. (2013). Assessment of the microbial growth and chemical changes in beef and lamb meat collected from supermarket and shop during summer and winter season. *Research Journal of Recent Sciences, 2*(4), 20-27.

AL-Kirshi, R. A. (2004). Effect of supplementing molybdenum, molybdenum and sulphur, and zinc on mineral excretion of sheep fed with palm kernel cake. M. Sc. thesis. Universti Putra Malaysia.

Al-Kirshi, R. A., Alimon, A. R., & Ivan, M. (2011). Effects of dietary molybdenum, sulfur and zinc on the excretion and tissue accumulation of trace elements in sheep fed palm kernel cake-based diets. *Animal: an International Journal of Animal Bioscience, 5*(10), 1539-1545.

Allen, M. S. (1997). Relationship between fermentation acid production in the rumen and the requirement for physically effective fiber. *Journal of Dairy Science, 80*(7), 1447-1462.

Allen, M. S., Voelker, J. A., & Oba, M. (2006). Physically effective fiber and regulation of ruminal pH: More than just chewing. *Production Diseases in Farm Animals. NP Joshi and TH Herdt, ed. Wageningen Academic Publishers, Wageningen, the Netherlands*, 270-278.

Al-Saiady, M. Y., Abouheif, M. A., Aziz Makkawi, A., Ibrahim, H. A., & Al-Owaimer, A. N. (2010). Impact of particle length of alfalfa hay in the diet of growing lambs on performance, digestion and carcass characteristics. *Asian-Australasian Journal of Animal Sciences, 23*(4), 475-482.

Amata, I. A., & Adejumo, D. O. (2013). Palm oil inclusion in the diets of rabbits fed cholesterol and its effect on the peroxidation of lipids and the activity of glutathione peroxidase. *Journal of Chemical, Biological and Physical Sciences (JCBPS), 4*(1), 355.

Amine, E., Baba, N., Belhadj, M., Deurenbery-Yap, M., Djazayery, A., Forrester, T., Galuska, D., Herman, S., James, W., MBuyamba, J., & Katan, M. (2002). Diet, nutrition and the prevention of chronic diseases: report of a Joint WHO/FAO Expert Consultation. World Health Organization.

AMSA. (2012). AMSA Meat Colour and pH Measurement Guidelines. American Meat Science Association, Illinois, USA.

An, J. Y., Yong, H. I., Kim, S. Y., Yoo, H. B., Kim, Y. Y., & Jo, C. (2017). Quality of frozen pork from pigs fed diets containing palm kernel meal as an alternative to corn meal. *Korean Journal for Food Science of Animal Resources*, *37*(2), 191.

Anetta, L., Eva, T., & Jozef, G. (2013). Concentration of malondialdehyde (MDA) in meat products during production. *Animal Welfare, Ethology and Housing Systems*, *9*(3), 553-557.

Angle, C. R. (1996). Chelation therapies for metal intoxication. In: Chang LW, editor. Toxicology of Metals. CRC Press; Boca Raton, FL, USA. 487–504.

Antunović, Z., Novoselec, J., Sauerwein, H., Šperanda, M., Vegara, M., & Pavić, V. (2011). Blood metabolic profile and some of hormones concentration in ewes during different physiological status. *Bulgarian Journal of Agricultural Science*, *17*(5), 687-691.

Ao, A., Morrison, B. J., Wang, H., López, J. A., Reynolds, B. A., & Lu, J. (2011). Response of estrogen receptor-positive breast cancer tumorspheres to antiestrogen treatments. *PLoS One*, *6*(4), e18810.

AOAC. (2000). The Official Methods of Analysis. Association of Analytical Chemist, 15th Edition, Washington D.C

ARC. (1980). The nutrient requirements of ruminant livestock. technical review by agricultural research council working group. published on behalf of the agricultural research council by the common wealth agricultural bureaux, Famham Royal, England. pp. 114-151.

Atay, O. K. A. N., Gökdal, Ö., Eren, V., Çetiner, Ş., & Yikilmaz, H. (2009). Effects of dietary vitamin E supplementation on fattening performance, carcass characteristics and meat quality traits of Karya male lambs. *Arch Tierz*, *52*(6), 618-626.

Ayisi, C. L., & Zhao, J. L. (2014). Recent developments in the use of palm oil in aquaculture feeds: A review. *International Journal of Scientific and Technology Research*, *3*(6), 259-264.

Azizi-Moghadam, A. (2012). Metabolism of energy substrates of in vitro and *in vivo* derived embryos from ewes synchronized and super ovulated with norgestomet and porcine follicle stimulating hormone. *Journal of Animal Science and Biotechnology*, *3*(1), 37.

Badariah, S.N., Jamaluddin A.B., & Abdullah F.M. (1996). Management of smallholder sheep farms in P. Malaysia. In: *Proceedings 18th MSAP Annual Conference 27-30 May 1996*, Kuching, Sarawak, pp. 45-51.

Baker, R. L., Mugambi, J. M., Audho, J. O., Carles, A. B., & Thorpe, W. (2002). Comparison of Red Maasai and Dorper sheep for resistance to gastro-intestinal nematode parasites: Productivity and efficiency in a humid and a semi-arid environment in Kenya. In Proc. 7th World Congr. Genet. Appl. Livest. Prod., pp. 639–642. France: Montpellier.

Balcells, J., Guada, J. A., Peiró, J. M., & Parker, D. S. (1992). Simultaneous determination of allantoin and oxypurines in biological fluids by high-performance liquid chromatography. *Journal of Chromatography B: Biomedical Sciences and Applications, 575*(1), 153-157.

Baldwin, A. R. and Sniegowski, M. S. (1951), Fatty acid compositions of lipids from corn and grain sorghum kernels. *Journal of the American Oil Chemists' Society*, 28: 24–27. doi:10.1007/BF02639745

Baldwin, R. L. (1999). Sheep gastrointestinal development in response to different dietary treatments. *Small Ruminant Research, 35*(1), 39-47.

Balogh, K., Weber, M., Erdélyi, M., & Mezes, M. (2004). Effect of excess selenium supplementation on the glutathione redox system in broiler chicken. *Acta Veterinaria Hungarica*, *52*(4), 403-411.

Banskalieva, V., Sahlu, T. & Goetsch, A. L. (2000). Fatty acid composition of goat muscles and fat depots: a review. *Small Ruminant Research*, 37(3), 255-268.

Barbut, S. (1993). Colour measurements for evaluating the pale soft exudative (PSE) occurrence in turkey meat. *Food Research International, 26*(1), 39-43.

Barkrie, B. & Hogan, J. (1996). Ruminant nutrition and production in the tropics and subtropics. ACIAR Monograph series, Australia.

Basiron, Y. (2002). Palm oil and its global supply and demand prospects. *Oil Palm Industry Economic Journal, 2*(1), 1-10.

Bauman, D., Perfield, J., De Veth, M., & Lock, A. (2003). New perspectives on lipid digestion and metabolism in ruminants. *In Proceedings of Cornell Nutrition Conference* (65, pp. 175-189.

Beam, T. M., Jenkins, T. C., Moate, P. J., Kohn, R. A., & Palmquist, D. L. (2000). Effects of amount and source of fat on the rates of lipolysis and biohydrogenation of fatty acids in ruminal contents1. *Journal of Dairy Science, 83*(11), 2564-2573.

Beauchemin, K. A., & McGinn, S. M. (2005). Methane emissions from feedlot cattle fed barley or corn diets1. *Journal of Animal Science*, *83*(3), 653-661.

Belanche, A., De la Fuente, G., Pinloche, E., Newbold, C. J., & Balcells, J. (2012). Effect of diet and absence of protozoa on the rumen microbial community and on the representativeness of bacterial fractions used in the determination of microbial protein synthesis. *Journal of Animal Science, 90*(11), 3924-3936.

Benzie, I. F. F. (1996). Lipid peroxidation: a review of causes, consequences, measurement and dietary influences. *International Journal of Food Sciences and Nutrition, 47*(3), 233-261.

Beriain, M. J., Bas, P., Purroy, A., Treacher, T., Ledin, I., & Morand-Fehr, P. (2000). Effect of animal and nutritional factors and nutrition on lamb meat quality. *Ciheam-Iamz, 52*(1), 75-86.

Beriain, M. J., Horcada, A., Purroy, A., Lizaso, G., Chasco, J., & Mendizabal, J. A. (2000). Characteristics of Lacha and Rasa Aragonesa lambs slaughtered at three live weights. *Journal of Animal Science, 78*(12), 3070-3077.

Bhatta, R., Saravanan, M., Baruah, L., & Prasad, C. S. (2015). Effects of graded levels of tannin-containing tropical tree leaves on *in vitro* rumen fermentation, total protozoa and methane production. *Journal of Applied Microbiology*, *118*(3), 557-564.

Binnie, M. A., Barlow, K., Johnson, V., & Harrison, C. (2014). Red meats: Time for a paradigm shift in dietary advice. *Meat science, 98*(3), 445-451.

Boakye, K., & Mittal, G. S. (1996). Changes in colour of beef *M. longissimus dorsi* muscle during ageing. *Meat Science, 42*(3), 347-354.

Bodas, R., Giráldez, F. J., López, S., Rodríguez, A. B., & Mantecón, A. R. (2007). Inclusion of sugar beet pulp in cereal-based diets for fattening lambs. *Small Ruminant Research, 71*(1), 250-254.

Bodas, R., Prieto, N., Jordán, M. J., López-Campos, Ó., Giráldez, F. J., Morán, L., & Andrés, S. (2012). The liver antioxidant status of fattening lambs is improved by naringin dietary supplementation at 0.15% rates but not meat quality. *Animal Feed Science and Technology, 6*(5), 863-870.

Boeckaert, C., Fievez, V., Van Hecke, D., Verstraete, W., & Boon, N. (2007). Changes in rumen biohydrogenation intermediates and ciliate protozoa diversity after algae supplementation to dairy cattle. European *Journal of Lipid Science and Technology*, *109*(8), 767-777.

Bostwick, J. L. (1982). Copper toxicosis in sheep. *Journals - American Veterinary Medical Association, 180*, 386-387.

Bowen, R (2006). Pathophysiology of the Digestive System. http://www.vivo.colostate.edu/hbooks/pathphys/digestion/index.html.

Branscome J, Jesseman C.ArC Software Download and User Guide (1999). http://www.concentric.net/~Jbrans/ArC/download.htm. Assessed 21/10/2014

Branum, J. C., Carstens, G. E., McPhail, E. H., McBride, K. W., & Johnson, A. B. (1998). Effects of prenatal dietary copper level on immune function of calves at birth and 56 days of age. *Journal of Animal Science, 76*(1), 43.

Bremner, I. T., & Marshall, R. B. (1974). Hepatic copper–and zinc-binding proteins in ruminants. *British Journal of Nutrition, 32*(02), 283-291.

Bremner, I., Mehra, R. K., Morrison, J. N., & Wood, A. M. (1986). Effects of dietary copper supplementation of rats on the occurrence of metallothionein-I in liver and its secretion into blood, bile and urine. *Biochemical Journal, 235*(3), 735-739.

Bremner, I., Young, B. W., & Mills, C. F. (1976). Protective effect of zinc supplementation against copper toxicosis in sheep. *British Journal of Nutrition, 36*(03), 551-561.

Brewer, S. (2004). Irradiation effects on meat colour–a review. *Meat Science, 68*(1), 1-17.

Brigelius-Flohe, R. (2006). Glutathione peroxidases and redox-regulated transcription factors. *Biological Chemistry, 387*(10/11), 1329-1335.

Brockus, C. W. & Andreasen, C. B. (2003). Erythrocytes. 4th ed. In Duncan and Prasse's Veterinary Laboratory Medicine—Clinical Pathology, eds. K.S. Latimer, E. A. Mahaffey & K. W. Prasse, Iowa State University Press. Ames, pp. 3–45.

Burke, J. M., Apple, J. K., Roberts, W. J., Boger, C. B., & Kegley, E. B. (2003). Effect of breed-type on performance and carcass traits of intensively managed hair sheep. *Meat Science, 63*(3), 309-315.

Burrin, D. G., Britton, R. A., Ferrell, C. L., & Bauer, M. L. (1992). Level of nutrition and visceral organ protein synthetic capacity and nucleic acid content in sheep. *Journal of Animal Science, 70*(4), 1137-1145.

Calder, P. C. (2001). Polyunsaturated fatty acids, inflammation, and immunity. *Lipids, 36*(9), 1007-1024.

Çamaş, H., Bildik, A., & Gülser, F. (1994). Toprak, bitki ve koyunların kanında bazı iz elementlerle (Cu, Mo, Zn, Co, Mn) Sülfat (SO 4) miktarlarının araştırılması. *Pro. no: VHAG-966. Van*.

Campbell, T.W. (1996) Clinical pathology. *Reptile Medicine and Surgery* (ed. D.R. Mader), pp. 248–257. W.B. Saunders Company, Philadelphia,PA.

Caponio, F., Pasqualone, A., & Gomes, T. (2003). Changes in the fatty acid composition of vegetable oils in model doughs submitted to conventional or microwave heating. *International Journal of Food Science & Technology, 38*(4), 481-486.

Carcangiu, V., Vacca, G. M., Mura, M. C., Dettori, M. L., Pazzola, M., Fioro, M., & Bini, P. P. (2007). Blood parameters during lactation and dry period in sarda sheep breed. In *Proceed Atti XV Congresso Fe*. Me. SP Run (pp. 15-19).

Carulla, J. E., Kreuzer, M., Machmüller, A., & Hess, H. D. (2005). Supplementation of *Acacia mearnsii* tannins decreases methanogenesis and urinary nitrogen in forage-fed sheep. *Crop and Pasture Science*, *56*(9), 961-970.

Carvalho, G. G. P. D., Pires, A. J. V., Silva, F. F. D., Veloso, C. M., Silva, R. R., Silva, H. G. D. O., & Mendonça, S. D. S. (2004). Ingestive behavior of dairy goats fed on cocoa meal or palm cake. *Pesquisa Agropecuária Brasileira*, *39*(9), 919-925.

Carvalho, L. P. F., Cabrita, A. R. J., Dewhurst, R. J., Vicente, T. E. J., Lopes, Z. M. C., & Fonseca, A. J. M. (2006). Evaluation of palm kernel meal and corn distillers grains in corn silage-based diets for lactating dairy cows. *Journal of Dairy Science*, *89*(7), 2705-2715.

Carvalho, L. P. F., Melo, D. S. P., Pereira, C. R. M., Rodrigues, M. A. M., Cabrita, A. R. J., & Fonseca, A. J. M. (2005). Chemical composition, *in vivo* digestibility, N degradability and enzymatic intestinal digestibility of five protein supplements. *Animal Feed Science and Technology*, *119*(1), 171-178.

Casper, D. P., Maiga, H. A., Brouk, M. J., & Schingoethe, D. J. (1999). Synchronization of carbohydrate and protein sources on fermentation and passage rates in dairy cows1, 2, 3. *Journal of Dairy Science*, *82*(8), 1779-1790.

Castagnino, P. D. S., Messana, J. D., Fiorentini, G., De Jesús, R. B., San Vito, E., Carvalho, I. P. C., & Berchielli, T. T. (2015). Glycerol combined with oils did not limit biohydrogenation of unsaturated fatty acid but reduced methane production in vitro. *Animal Feed Science and Technology*, *201*, 14-24.

Chalabis-Mazurek, A., & Walkuska, G. (2014). Effect of different forms of selenium on trace elements in the blood serum and liver tissue of lambs. *Journal of Elementology*, *19*(1), 41–53.

Chanjula, P., & Pongprayoon, S. (2012). Effects of varying the levels of rubber seed kernel on feed intake, rumen ecology and blood metabolites in goats. *Proceedings of the 15th AAAP Animal Science Congress*.

Chanjula, P., Mesang, A., & Pongprayoon, S. (2010). Effects of dietary inclusion of palm kernel cake on nutrient utilization, rumen fermentation characteristics and microbial populations of goats fed *Paspalum plicatulum* hay-based diet. *Sonklanakarin Journal of Science and Technology*, *32*(6), 527-536.

Chanjula, P., Ngampongsai, W., & Wanapat, M. (2007). Effects of replacing ground corn with cassava chip in concentrate on feed intake, nutrient utilization, rumen fermentation characteristics and microbial populations in goats. *Asian Australasian Journal of Animal Sciences*, *20*(10), 1557-1566.

Chen, C. P. (1984). The research and development of pastures in Peninsular Malaysia. International Symposium on Pastures in the Tropics and Subtropics. Tropical Agriculture Research. Series No.18 p.33-51. Tropical Agriculture Research Center, Ministry of Agriculture, Forestry and Fisheries, Japan.

Chen, J., & Weimer, P. J. (2001). Competition among three predominant ruminal cellulolytic bacteria in the absence or presence of non-cellulolytic bacteria. *Microbiology, 147*(1), 21-30.

Chen, X. B., & Gomes, M. J. (1995). Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivatives-an overview of the technical details. International Feed Resources Unit. Rowett Research Institute. Bucsburn, Aberdeen, UK.

Chen, X. B., Hovell, F. D., Ørskov, E. R., & Brown, D. S. (1990). Excretion of purine derivatives by ruminants: effect of exogenous nucleic acid supply on purine derivative excretion by sheep. *British Journal of Nutrition, 63*(01), 131-142.

Cheng, J., Fan, C., Zhang, W., Zhu, X., Yan, X., Wang, R., & Jia, Z. (2008). Effects of dietary copper source and level on performance, carcass characteristics and lipid metabolism in lambs. *Asian Australasian Journal of Animal Sciences, 21*(5), 685-691.

Chilliard, Y., Glasser, F., Ferlay, A., Bernard, L., Rouel, J., & Doreau, M. (2007). Diet, rumen biohydrogenation and nutritional quality of cow and goat milk fat. *European Journal of Lipid Science and Technology, 109*(8), 828-855.

Choi, S. H., Wang, J. H., Kim, Y. J., Oh, Y. K., & Song, M. K. (2006). Effect of soybean oil supplementation on the contents of plasma cholesterol and cis9, trans11-CLA of the fat tissues in Sheep. *Asian Australasian Journal of Animal Sciences, 19*(5), 679-683.

Coleman, G. S. (1975). The interrelationship between rumen ciliate protozoa and bacteria. *Digestion and Metabolism in the Ruminant*, 149-164.

Colomer-Rocher, F., Kirton, A. H., Mercer, G. J. K., & Duganzich, D. M. (1992). Carcass composition of New Zealand Saanen goats slaughtered at different weights. *Small Ruminant Research, 7*(2), 161-173.

Combs Jr, G. F., & Combs, S. B. (1986). The role of selenium in nutrition. Academic Press, WC London.

Cornelius, J. A. (1977). Palm oil and palm kernel oil. *Progress in the Chemistry of Fats and other Lipids*, 15(1), 5-27.

Costa, D. A., Ferreira, G. D. G., Araujo, C. V., Colodo, J. C. N., Moreira, G. R., & Figueiredo, M. R. P. (2010). Intake and digestibility of diets with levels of palm kernel cake in sheep. *Revista Brasileira de Saude e Producao Animal, 11*(3), 783-792.

Cottyn, B.G. & Boucque, C.H.V. (1968). Rapid method for the gas-chromatographic determination of volatile fatty acids in rumen fluid. *Journal of Agricultural Food and Chemistry, 16*, 105-107.

Cousins, R. J. (1985). Absorption, transport, and hepatic metabolism of copper and zinc: special reference to metallothionein and ceruloplasmin. *Physiological Reviews, 65*(2), 238-309.

Cox, D. W., & Moore, S. D. (2002). Copper transporting P-type ATPases and human disease. *Journal of Bioenergetics and Biomembranes, 34*(5), 333-338.

Craddock, B. F., Field, R. A., & Riley, M. L. (1974). Effect of protein and energy levels on lamb carcass composition. *Journal of Animal Science, 39*(2), 325-330.

Cronje, P. B. (1992). Differences in nitrogen and urea metabolism between goats bred for fibre production (Angora goat) or meat production (Boer goat). *South African Journal of Animal Science, 22*(5), 143-148.

Dabiri, N., & Thonney, M. L. (2004). Source and level of supplemental protein for growing lambs. *Journal of Animal Science, 82*(11), 3237-3244.

Daramola, J. O., Adeloye, A. A., Fatoba, T. A., & Soladoye, A. O. (2005). Haematological and biochemical parameters of West African Dwarf goats. *Livestock Research for Rural Development, 17*(8), 3-8.

Das, A. (2011). Heat stress-induced hepatotoxicity and its prevention by resveratrol in rats. *Toxicology Mechanisms and Methods, 21*(5), 393-399.

Das, M., & Singh, M. (2000). Variation in blood leucocytes, somatic cell count, yield and composition of milk of crossbred goats. *Small Ruminant Research, 35*(2), 169-174.

Davey, G. K., Spencer, E. A., Appleby, P. N., Allen, N. E., Knox, K. H., & Key, T. J. (2003). EPIC–Oxford: lifestyle characteristics and nutrient intakes in a cohort of 33 883 meat-eaters and 31 546 non meat-eaters in the UK. *Public Health Nutrition*, *6*(03), 259-268.

Davies, A., Titterington, A. J., & Cochrane, C. (1995). Who buys organic food? A profile of the purchasers of organic food in Northern Ireland. *British Food Journal*, *97*(10), 17-23.

Davis, A.K., Cook, K.C. & Altizer, S. (2004) Leukocyte profiles of House Finches with and without mycoplasmal conjunctivitis, a recently emerged bacterial disease. *Ecohealth*, 1, 362–373.

Davis, C. D., & Milner, J. (2004). Frontiers in nutrigenomics, proteomics, metabolomics and cancer prevention. *Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 551*(1), 51-64.

Davis, G.K., & Mertz, W. (1987). Copper. In: Trace elements in human and animal nutrition ñ Fifth edition, vol. 1. Ed.: W. Mertz, Beltsville Human Nutrition Center, Beltsville, Maryland. Academic Press, Inc., 301-364.

Dayani, O., Ghorbani, G. R., Alikhani, M., Rahmani, H. R., & Mir, P. S. (2007). Effects of dietary whole cottonseed and crude protein level on rumen protozoal population and fermentation parameters. *Small Ruminant Research*, *69*(1), 36-45.

Del Razo-Rodriguez, O. E., Ramirez-Bribiesca, J. E., Lopez-Arellano, R., Revilla-Vazquez, A. L., Gonzalez-Munoz, S. S., Cobos-Peralta, M. A., Hernandez-Calva, L. M., & McDowell, L. R. (2013). Effects of dietary level of selenium and grain on digestive metabolism in lambs. *Czech Journal of Animal Science, 58*(6), 253-261.

Delgado, M., Pérez-Miguelsanz, J., Garrido, F., Rodríguez-Tarduchy, G., Pérez-Sala, D., & Pajares, M. A. (2008). Early effects of copper accumulation on methionine metabolism. *Cellular and Molecular Life Sciences*, *65*(13), 2080-2090.

Denke, M. A., & Grundy, S. M. (1992). Comparison of effects of lauric acid and palmitic acid on plasma lipids and lipoproteins. *The American Journal of Clinical Nutrition*, *56*(5), 895-898.

Denman, S. E., & McSweeney, C. S. (2006). Development of a real-time PCR assay for monitoring anaerobic fungal and cellulolytic bacterial populations within the rumen. *FEMS Microbiology Ecology*, *58*(3), 572-582.

Department of Standards Malaysia (2009). MS1500: 2009 (1st revision) Halal foodproduction, preparation, handling and storage-general guideline (pp. 1–13).

Department of Statistics Malaysia, (2017). Selected Agricultural Indicators, Malaysia, 2017.

Devendra, C. (1997). Crop residues for feeding animals in Asia: Technology development and adoption in crop/livestock systems. *Crop Residues in sustainable mixed crop/livestock farming systems. CAB International, Wallingford, UK*, 241-268.

Devendra, C., & McLeroy, G. B. (1982). Goat and sheep production in the tropics. Longman, London and New York, 84p.

Devillard, E., McIntosh, F. M., Newbold, C. J., & Wallace, R. J. (2006). Rumen ciliate protozoa contain high concentrations of conjugated linoleic acids and vaccenic acid, yet do not hydrogenate linoleic acid or desaturate stearic acid. *British Journal of Nutrition*, *96*(04), 697-704.

Devine, C. E., Graafhuis, A. E., Muir, P. D., & Chrystall, B. B. (1993). The effect of growth rate and ultimate pH on meat quality of lambs. *Meat Science, 35*(1), 63-77.

Dias, F. N. (2010). *Supplementation of palm kernel expeller to grazing dairy farms in New Zealand*: a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Animal Science at Massey University, Palmerston North, New Zealand (Doctoral dissertation, Massey University).

Díaz, M. T., Alvarez, I., De la Fuente, J., Sañudo, C., Campo, M. M., Oliver, M. A., & Caneque, V. (2005). Fatty acid composition of meat from typical lamb production systems of Spain, United Kingdom, Germany and Uruguay. *Meat Science, 71*(2), 256-263.

Dıaz, M. T., Velasco, S., Caneque, V., Lauzurica, S., De Huidobro, F. R., Perez, C., Gonzáles, J., & Manzanares, C. (2002). Use of concentrate or pasture for fattening lambs and its effect on carcass and meat quality. *Small Ruminant Research, 43*(3), 257-268.

Dıaz, M. T., Velasco, S., Pérez, C., Lauzurica, S., Huidobro, F., & Cañeque, V. (2003). Physico-chemical characteristics of carcass and meat Manchego-breed suckling lambs slaughtered at different weights. *Meat Science, 65*(3), 1085-1093.

Dijkstra, J. (1994). Production and absorption of volatile fatty acids in the rumen. *Livestock Production Science, 39*(1), 61-69.

Dikeman, M. E., Reddy, G. B., Arthaud. V. H., Tuma, H. J., Koch, R. M., Mandigo, R. W., & Axe, J. B. (1986). Longissimus muscle, palatability and connective tissue histological characteristics of bulls and steers fed different energy levels and slaughtered at four ages. *Journal of Animal Science, 63*(1), 92-101.

Dincer, Z., Haywood, S., & Jasani, B. (1999). Immunocytochemical detection of metallothionein (MT1 and MT2) in copper-enhanced sheep brains. *Journal of Comparative Pathology, 120*(1), 29-37.

Dirksen, K., Spee, B., Penning, L. C., van den Ingh, T. S., Burgener, I. A., Watson, A. L., Koerkamp, M. G., Rothuizen, J., Frank G. Steenbeek, V., & Fieten, H. (2017). Gene expression patterns in the progression of canine copper-associated chronic hepatitis. *PloS One, 12*(5), e0176826.

Dogan, D., & Can, C. (2011). Hematological, biochemical, and behavioral responses of Oncorhynchus mykiss to dimethoate. *Fish Physiology and Biochemistry, 37*(4), 951-958.

Doreau, M., & Ferlay, A. (1994). Digestion and utilisation of fatty acids by ruminants. *Animal Feed Science and Technology, 45*(3-4), 379-396.

Dos Santos, R. D. C., Gomes, D. I., Alves, K. S., Mezzomo, R., Oliveira, L. R. S., Cutrim, D. O., Sacramento, S. B. M., Lima, E. M., & de Carvalho, F. F. R. (2017). Carcass characteristics and meat quality of lambs that are fed diets with palm kernel cake. *Asian Australasian Journal of Animal Sciences, 30*(6), 865-871.

Došen, R., Prodanov-Radulović, J., Pušić, I., Ratajac, R., Stojanov, I., & Grubač, S. (2014). The uncontrolled use of antibiotics in pig production-a threat to public health. *In XVI International Congress Feed technology* (pp. 20-24).

Doyle, P. T., Devendra, C., & Pearce, G. R. (1986). Rice straw as a feed for ruminants. *Rice straw as a feed for ruminants.* IDP. Canberra.

Duan, L., Cheng, Y. B., & Jin, Y. L. (2010). Effect of copper intake and copper-zinc ratio on rat lipid peroxidation in copper deficiency. Wei sheng yan jiu= *Journal of Hygiene Research*, *39*(1), 25-28.

Dunlap, F. G., White, P. J., Pollak, L. M., & Brumm, T. J. (1995). Fatty acid composition of oil from adapted, elite corn breeding materials. *Journal of the American Oil Chemists' Society*, 72(9), 981-987.

Dutta, T. K., Agnihotri, M. K., & Rao, S. B. N. (2008). Effect of supplemental palm oil on nutrient utilization, feeding economics and carcass characteristics in post-weaned Muzafarnagari lambs under feedlot condition. *Small Ruminant Research*, *78*(1), 66-73.

DVS. (2016). Department of veterinary services, ministry of agriculture, Malaysia.

Dworkin, M., & Foster, J. W. (1958). Experiments with some microorganisms which utilize ethane and hydrogen. *Journal of Bacteriology*, *75*(5), 592-603.

Eadie, J. M., & Gill, J. C. (1971). The effect of the absence of rumen ciliate protozoa on growing lambs fed on a roughage–concentrate diet. *British Journal of Nutrition*, *26*(02), 155-167.

Ebrahimi, M., Rajion, M. A., Goh, Y. M., & Sazili, A. Q. (2008). Carcass quality of Malaysian Kacang crossbred goats fed diets supplemented with oil palm fronds. *In Proceedings of the 29th Malaysian Society for Animal Production (MSAP) Annual Conference* (pp. 25-27).

Ebrahimi, R., Ahmadi, H. R., Zamiri, M. J., & Rowghani, E. (2007). Effect of energy and protein levels on feedlot performance and carcass characteristics of Mehraban ram lambs. *Pakistan Journal of Biological Science*, *15*(15), 1679-1684.

Egesel, Cem Ömer, Kahriman, Fatih, & Gül, Muhammet Kemal. (2011). Discrimination of maize inbreds for kernel quality traits and fatty acid composition by a multivariate technique. *Acta Scientiarum. Agronomy*, 33(4), 613-620. https://dx.doi.org/10.4025/actasciagron.v33i4.11031

EI-Saidy, B.E.I., Gabr, A.A., El-Shinnawy, M.M., & El-Badawy, M.M. (2008). Influence of diets supplemented with fish oil on productive and reproductive performance of growing male and female lambs. *Journal of Agriculture Science Mansoura University, 33* (2), 1009–1027.

Ekeocha, A. H. (2012). Nutritional composition and mineral profile of pregnant west african dwarf ewe fed mexican sunflower leaf mealbased diets. *Journal of Recent Advance in Agriculture*, 1(4): 135-145

Ekiz, B., Yilmaz, A., Ozcan, M., Kaptan, C., Hanoglu, H., Erdogan, I., & Yalcintan, H. (2009). Carcass measurements and meat quality of Turkish Merino, Ramlic, Kivircik, Chios and Imroz lambs raised under an intensive production system. *Meat Science, 82*(1), 64-70.

Elfadil, S. I. (1996). The effect of dietary energy levels on finishing goats. M. Sc. Thesis U of K.

Emenalom, O. O., Okoli, I. C., & Udedibie, A. B. I. (2004). Observations on the pathophysiology of weaner pigs fed raw and preheated Nigerian Mucuna pruriens (*Velvet Bean*) seeds. *Pakistan Journal of Nutrition, 3*(2), 112-117.

Engle, T. E., Nockels, C. F., Kimberling, C. V., Weaber, D. L., & Johnson, A. B. (1997). Zinc repletion with organic or inorganic forms of zinc and protein turnover in marginally zinc-deficient calves. *Journal of Animal Science*, 75(11), 3074-3081.

Enser, M., Scollan, N., Gulati, S., Richardson, I., Nute, G., & Wood, J. (2001). The effects of ruminally-protected dietary lipid on the lipid composition and quality of beef muscle. *In International Congress of Meat Science and Technology* (Vol. 47, pp. 186-187). Japan Society for Meat Science and Technology.

Enyisi, I. S., Umoh, V. J., Whong, C. M. Z., Alabi, O., & Abdullahi, I. O. (2014). Chemical and nutritional values of maize and maize products obtained from selected markets in Kaduna. *Journal of Pharmaceutical and Allied Sciences*, *11*(2), 2106-2113.

Ermias, E., Yami, A., & Rege, J. E. O. (2006). Slaughter characteristics of Menz and Horro sheep. *Small Ruminant Research, 64*(1), 10-15.

Etim, N. N., Williams, M. E., Akpabio, U., & Offiong, E. E. (2014). Haematological parameters and factors affecting their values. *Agricultural Science, 2*(1), 37-47.

Fageer, A. S., Babiker, E. E., & El Tinay, A. H. (2004). Effect of malt pretreatment and/or cooking on phytate and essential amino acids contents and *in vitro* protein digestibility of corn flour. *Food Chemistry, 88*(2), 261-265.

Faixová, Z., Piešová, E., Maková, Z., Čobanová, K., & Faix, Š. (2016). Effect of dietary supplementation with selenium-enriched yeast or sodium selenite on ruminal enzyme activities and blood chemistry in sheep. *Acta Veterinaria Brno, 85*(2), 185-194.

FAO, (2015). FAOSTAT: FAO Statistical Database [online] Available from. Disponível em http://faostat3. fao. org/browse/Q/QC/E. Acessado em, 5.

Farrell, D. J. (1974). General principles and assumptions of calorimetry. Energy requirements of poultry, 1-24. Edinburgh, UK.

Faseleh, J. M., Liang, J. B., Mohamad, R., Goh, Y. M., Shokryazdan, P. & Ho, Y. W. (2013). Lovastatin-enriched rice straw enhances biomass quality and suppresses ruminal methanogenesis. *BioMed Research International.* http://www.hindawi.com/journals/bmri/2013/397934/abs/

Ferraretto, L. F. (2017). Impact of Starch Content and Digestibility in Dairy Cattle Diets. *In 28th Annual Florida Ruminant Nutrition Symposium* (Vol. 770, p. 112).

Ferreira, E. M., Pires, A. V., Susin, I., Gentil, R. S., Parente, M. O. M., Nolli, C. P., Meneghini, R. C. M., Mendes, C. Q., & Ribeiro, C. V. D. M. (2014). Growth, feed intake, carcass characteristics, and meat fatty acid profile of lambs fed soybean oil partially replaced by fish oil blend. *Animal Feed Science and Technology, 187*, 9-18.

Ferry, J. G. (1992). Methane from acetate. *Journal of Bacteriology*, *174*(17), 5489-5495.

Field, R. A. (1971). Effect of castration on meat quality and quantity. *Journal of Animal Science, 32*(5), 849-858.

Field, R. A., Maiorano, G., McCormick, R. J., Riley, M. L., Russell, W. C., Williams, F. L., & Crouse, J. D. (1990). Effect of plane of nutrition and age on carcass maturity of sheep. *Journal of Animal Science*, *68*(6), 1616-1623.

Finegan, E. J., Buchanan-Smith, J. G., & McBride, B. W. (2001). The role of gut tissue in the energy metabolism of growing lambs fed forage or concentrate diets. *British Journal of Nutrition, 86*(02), 257-264.

Firat, A., & Özpinar, A. (1996). The study of changes in some blood parameters (glucose, urea, bilirubin, AST) during and after pregnancy in association with nutritional conditions and litter size in ewes. *Turkish Journal of Veterinary and Animal Sciences, 20*(5), 387-393.

Firkins, J. L., Yu, Z., & Morrison, M. (2007). Ruminal nitrogen metabolism: perspectives for integration of microbiology and nutrition for dairy 1, 2. *Journal of Dairy Science, 90*, E1-E16.

Fishell, V. K., Aberle, E. D., Judge, M. D., & Perry, T. W. (1985). Palatability and muscle properties of beef as influenced by preslaughter growth rate. *Journal of Animal Science*, *61*(1), 151-157.

Fisher, L. J., Donnelly, P. E., Hutton, J. B., & Duganzich, D. M. (1975). Relationships between levels of feeding and certain blood metabolites in dairy cows in mid lactation. *The Journal of Agricultural Science*, *84*(01), 29-37.

Flachowsky, G., Wirth, R., Möckel, P., & Schneider, A. (1995). Influence of rumen protected fat on rumen fermentation, *in sacco* dry matter degradability and apparent digestibility in sheep. *Journal of Applied Animal Research*, *8*(1), 71-84.

Flora, S. J., & Pachauri, V. (2010). Chelation in metal intoxication. *International Journal of Environmental Research and Public Health*, *7*(7), 2745-2788.

Fluharty, F. L., & McClure, K. E. (1997). Effects of dietary energy intake and protein concentration on performance and visceral organ mass in lambs. *Journal of Animal Science*, *75*(3), 604-610.

Fluharty, F. L., McClure, K. E., Solomon, M. B., Clevenger, D. D., & Lowe, G. D. (1999). Energy source and ionophore supplementation effects on lamb growth, carcass characteristics, visceral organ mass, diet digestibility, and nitrogen metabolism. *Journal of Animal Science*, *77*(4), 816-823.

Folch, J., Lees, M. & Stanley, G. H. S (1957). A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry*, *226*(1), 497-509.

Forbes, G. B. (1988) Body composition: influence of nutrition, disease, growth and ageing. In: Shils, ME & Young VR (eds) Modern Nutrition in Health and Disease. Lea and Febiger, Philadelphia, p 533-556.

Foster, J. L., Adesogan, A. T., Carter, J. N., Blount, A. R., Myer, R. O., & Phatak, S. C. (2009). Intake, digestibility, and nitrogen retention by sheep supplemented with warm-season legume hays or soybean meal. *Journal of Animal Science*, *87*(9), 2891-2898.

Frei, B., & Gaziano, J. M. (1993). Content of antioxidants, preformed lipid hydroperoxides, and cholesterol as predictors of the susceptibility of human LDL to metal ion-dependent and-independent oxidation. *Journal of Lipid Research*, *34*(12), 2135-2145.

French, P., O'riordan, E. G., Monahan, F. J., Caffrey, P. J., Mooney, M. T., Troy, D. J., & Moloney, A. P. (2001). The eating quality of meat of steers fed grass and/or concentrates. *Meat Science*, *57*(4), 379-386.

Friedewald, W. T., Levy, R. I., & Fredrickson, D. S. (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*, *18*(6), 499-502.

Fulda, S., Gorman, A. M., Hori, O., & Samali, A. (2010). Cellular stress responses: cell survival and cell death. *International Journal of Cell Biology*, *2010*.

Gaili, E. S., & Ali, A. E. (1985). Meat from Sudan desert sheep and goats: Part 1—carcass yield, offals and distribution of carcass tissues. *Meat Science*, *13*(4), 217-227.

Galıp, N. (2006). Effect of supplemental yeast culture and sodium bicarbonate on ruminal fermentation and blood variables in rams. *Journal of Animal Physiology and Animal Nutrition*, *90*(11-12), 446-452.

Garrett, W. N. (1980). Factors influencing energetic efficiency of beef production. *Journal of Animal Science*, *51*(6), 1434-1440.

Gatenby, R. M. (1986). *Sheep production in the tropics and sub-tropics*. Longman.

Giesecke, D., Stangassinger, M., & Tiemeyer, W. (1984). Nucleic acid digestion and urinary purine metabolites in sheep nourished by intragastric infusions. *Canadian Journal of Animal Science*, *64*(5), 144-145.

Giraldo, L. A., Tejido, M. L., Ranilla, M. J., Ramos, S., & Carro, M. D. (2008). Influence of direct-fed fibrolytic enzymes on diet digestibility and ruminal activity in sheep fed a grass hay-based diet 1. *Journal of Animal Science*, 86(7), 1617-1623.

Gimenez Jr, D. M. (1994). Nutrient requirements of sheep and goats. Circular ANR (USA). ANR-812.

Goh, Y. M., Rajion, M. A., Dahlan, I., & Salam, A. A. (2001). Rumen fluid pH and plasma fatty acid profile changes in sheep fed different levels of concentrate feeds and oil palm frond pellets. *Journal Veterinary Malaysia. 13* (1&2), 15-18.

Gohl, B. (1981). In tropical feeds: feed information summaries and nutritive values. FAO Animal Production and Health Series No. 12. Food and Agriculture Organization of the United Nations, Rome, pp. 364-366.

Gómez-Cortés, P., Tyburczy, C., Brenna, J. T., Juárez, M., & de la Fuente, M. A. (2009). Characterization of cis-9 trans-11 trans-15 C18: 3 in milk fat by GC and covalent adduct chemical ionization tandem MS. *Journal of Lipid Research*, *50*(12), 2412-2420.

Griinari, J. M., & Bauman, D. E. (1999). Biosynthesis of conjugated linoleic acid and its incorporation into meat and milk in ruminants. Advances in Conjugated Linoleic Acid Research, (1), (Ed. M. P. Yurawecz, M. M. Mossoba, J. K. G. Kramer, M. W. Pariza and G. J. Nelson). AOCS press, Illinois, Chapter 13, pp. 180-200.

Grundy, S. M. & Denke, M. A. (1990). Dietary influences on serum lipids and lipoproteins. *Journal of Lipid Research*, *31*(7), 1149-72.

Grünwaldt, E. G., Guevara, J. C., Estevez, O. R., Vicente, A., Rousselle, H., Alcuten, N., guerregaray, D., & Stasi, C. R. (2005). Biochemical and haematological measurements in beef cattle in Mendoza plain rangelands (Argentina). *Tropical Animal Health and Production, 37*(6), 527-540.

Gunter, S. A., Beck, P. A., & Phillips, J. M. (2003). Effects of supplementary selenium source on the performance and blood measurements in beef cows and their calves. *Journal of Animal Science, 81*(4), 856-864.

Gupta, R. S., Desai, M. C., Talpaba, P. M., & Shukla, P. C. (1990). Effect of corn steep liquor feeding on growth of cross-bred calves. *Indian Journal of Animal Nutrition, 7*(4), 279-282.

Guyton, A. C., & Hall, J. E. (2000). The microcirculation and the lymphatic system: capillary fluid exchange, interstitial fluid, and lymph flow. *Textbook of Medical Physiology*, *10*, 83-197.

Ha, Y. L., Grimm, N. K., & Pariza, M. W. (1987). Anticarcinogens from fried ground beef: heat-altered derivatives of linoleic acid. *Carcinogenesis, 8*(12), 1881-1887.

Hadjipanayiotou, M., Koumas, A., Hadjigavriel, G., Antoniou, I., Photiou, A., & Theodoridou, M. (1996). Feeding dairy ewes and goats and growing lambs and kids mixtures of protein supplements. *Small Ruminant Research, 21*(3), 203-211.

Hair-Bejo, M., & Alimon, A. R. (1992). Hepatic damages and the protective role of zinc and molybdate in palm kernel cake (PKC) toxicity in sheep. In *Proceedings of the 15th Malaysian Society of Animal Production Conference, Malaysia* (pp. 93-95).

Hair-Bejo, M., & Alimon, A. R. (1995). The protective role of zinc in palm kernel cake (PKC) toxicity in sheep. *Malaysian Journal of Nutrition, 1*(1), 75-82.

Hair-Bejo, M., Davis, M. P., Alimon, A. R., & Moonafizad, M. (1995). Chronic copper toxicosis: utilization of palm kernel cake in sheep fed solely on concentrate diets. In Y. W. Ho, M. K. Vidyyadaran, & M. D. Sanchez (Eds.), *Proceedings of the First Symposium on Integration of Livestock to Oil Palm Production, MSAP* (pp. 155-159).

Hall, J. B., Seay, W. W., & Baker, S. M. (2009). Nutrition and feeding of the cow-calf herd: essential nutrients, feed classification and nutrient content of feeds. Publication 400-011.

Hamliri, A., Johnson, D. W., Kessabi, M., & Olson, W. G. (1990). The evaluation of selenium status of sheep from the major production areas of Morocco. *In Annales de Recherches Vétérinaires, 21*(2), 137-142.

Han, H., Archibeque, S. L., & Engle, T. E. (2009). Characterization and identification of hepatic mRNA related to copper metabolism and homeostasis in cattle. *Biological Trace Element Research, 129*(1-3), 130-136.

Hanan, Z., Ibrahim, N. H., Donia, G. R., Younis, F. E., & Shaker, Y. M. (2014). Scrutinizing of trace elements and antioxidant enzymes changes in Barki ewes fed salt-tolerant plants under South Sinai conditions. *Journal of American Science, 10*(2), 241-249.

Hansen, S. L., Ashwell, M. S., Moeser, A. J., Fry, R. S., Knutson, M. D., & Spears, J. W. (2010). High dietary iron reduces transporters involved in iron and manganese metabolism and increases intestinal permeability in calves. *Journal of Dairy Science*, 93(2), 656-665.

Hansen, S. L., Schlegel, P., Legleiter, L. R., Lloyd, K. E., & Spears, J. W. (2008). Bioavailability of copper from copper glycinate in steers fed high dietary sulfur and molybdenum. *Journal of Animal Science, 86*, 173–179.

Harfoot, C. G., & Hazlewood, G. P. (1997). Lipid metabolism in the rumen. In P. N. Honson & C. S. Stewart (Ed.), *The Rumen Microbial Ecosystem* (pp. 382-426). Netherlands: Springer

Harper, G. C., & Makatouni, A. (2002). Consumer perception of organic food production and farm animal welfare. *British Food Journal, 104*(3/4/5), 287-299.

Harrell, R. A., Bidner, T. D., & Icaza, E. A. (1978). Effect of altered muscle pH on beef tenderness. *Journal of Animal Science, 46*(6), 1592-1596.

Hartmann, F., & Van Ryssen, J. B. J. (1997). Metabolism of selenium and copper in sheep with and without sodium bicarbonate supplementation. *The Journal of Agricultural Science, 128*(03), 357-364.

Hashim, F. A. H. (2015). Strategies to Strengthen Livestock Industry in Malaysia. Economic and Social Science Research Centre. Malaysian Agricultural Research and Development Institute (MARDI). http://ap.fftc.agnet.org/ap_db.php?id=477&print=1.

Haywood, S., Simpson, D. M., Ross, G., & Beynon, R. J. (2005). The greater susceptibility of North Ronaldsay sheep compared with Cambridge sheep to copper-induced oxidative stress, mitochondrial damage and hepatic stellate cell activation. *Journal of Comparative Pathology, 133*(2), 114-127.

Hegde, R. S., & Kang, S. W. (2008). The concept of translocational regulation. *The Journal of Cell Biology, 182*(2), 225-232.

Helander, C. (2014). Forage feeding in intensive lamb production (Vol. 2014, No. 37).

Henderson, C. (1973). The effects of fatty acids on pure cultures of rumen bacteria. *The Journal of Agricultural Science, 81*(01), 107-112.

Hidiroglou, M., & Williams, C. J. (1982). Trace elements status of fetuses from ewes fed a copper-deficient ration. *American Journal of Veterinary Research, 43*(2), 310-313.

Hidiroglou, M., Heaney, D. P., & Hartin, K. E. (1984). Copper poisoning in a flock of sheep. Copper excretion patterns after treatment with molybdenum and sulfur or penicillamine. *The Canadian Veterinary Journal, 25*(10), 377-382.

Higgs, J. D. (2000). The changing nature of red meat: 20 years of improving nutritional quality. *Trends in Food Science & Technology, 11*(3), 85-95.

Hirpa, A., & Abebe, G. (2008). Economic significance of sheep and goats. In: A. Yami, and R.C. Merkel (eds), Sheep and goat production handbook for Ethiopia. Ethiopian Sheep and Goat Productivity Improvement Programme (ESGPIP), 1–4.

Hoffmann, P. R. (2007). Mechanisms by which selenium influences immune responses. *Archivum Immunologiae et Therapiae Experimentalis, 55*(5), 289-297.

Honikel, K. O. (1987). How to measure the water-holding capacity of meat? Recommendation of standardized methods. In *Evaluation and Control of Meat Quality in Pigs* (pp. 129-142). Springer Netherlands.

Honikel, K. O. (1998). Reference methods for the assessment of physical characteristics of meat. *Meat Science, 49*(4), 447-457.

Hoover, W. H. (1986). Chemical factors involved in ruminal fiber digestion1. *Journal of Dairy Science*, *69*(10), 2755-2766.

Horton, T.H., & Rowsemitt, C.N. (1992). Natural selection and variation in reproductive physiology. In: Tomasi T.E. and Horton T.H. (eds). Mammalian Energetics: Interdisciplinary Views of Metabolism and Reproduction. Ithaca, NY, USA: Comstock Pub. Associates. p. 160-185.

Hosseini, S. M., Akbary, S. M., Maheri-Sis, N., & Aghsaghali, A. M. (2008). Effect of Different Energy Levels of Diet on Feed Efficiency, Growth Rate and Carcass Characteristics of Fattening Bahmaei Lambs. *Journal of Animal and Veterinary Advances, 7*(12), 1551-1554.

Hristov, A. N., Vander Pol, M., Agle, M., Zaman, S., Schneider, C., Ndegwa, P., Vaddella, V. K., Johnson, K., Shingfield, K. J., & Karnati, S. K. R. (2009). Effect of lauric acid and coconut oil on ruminal fermentation, digestion, ammonia losses from manure, and milk fatty acid composition in lactating cows. *Journal of Dairy Science*, *92*(11), 5561-5582.

Huang, J. Q., Li, D. L., Zhao, H., Sun, L. H., Xia, X. J., Wang, K. N., Luo, X., & Lei, X. G. (2011). The selenium deficiency disease exudative diathesis in chicks is associated with downregulation of seven common selenoprotein genes in liver and muscle. *The Journal of Nutrition, 141*(9), 1605-1610.

Huerta, M., Kincaid, R. L., Cronrath, J. D., Busboom, J., Johnson, A. B., & Swenson, C. K. (2002). Interaction of dietary zinc and growth implants on weight gain, carcass traits and zinc in tissues of growing beef steers and heifers. *Animal Feed Science and Technology*, *95*(1), 15-32.

Hugejiletu, H., Bobe, G., Vorachek, W. R., Gorman, M. E., Mosher, W. D., Pirelli, G. J., & Hall, J. A. (2013). Selenium supplementation alters gene expression profiles associated with innate immunity in whole-blood neutrophils of sheep. *Biological Trace Element Research*, 154(1), 28-44.

Humphries, W. R., Phillippo, M., Young, B. W., & Bremner, I. (1983). The influence of dietary iron and molybdenum on copper metabolism in calves. *British Journal of Nutrition*, *49*(01), 77-86.

Hungate, R. E., Smith, W., Bauchop, T., Yu, I., & Rabinowitz, J. C. (1970). Formate as an intermediate in the bovine rumen fermentation. *Journal of Bacteriology*, *102*(2), 389-397.

Hurrell, R. F. (2002). Fortification: overcoming technical and practical barriers. *The Journal of Nutrition*, *132*(4), 806S-812S.

Ibrahim, C. E. (1996). Priority in small ruminant development in Malaysia. In *Sustainable parasite control in small ruminants: An international workshop sponsored by ACIAR and held in Bogor, Indonesia, 22-25 April 1996.* (pp. 86-91). Australian Centre for International Agricultural Research (ACIAR).

Ijabadeniyi, A. O., & Adebolu, T. T. (2005). The effect of processing methods on the nutritional properties of ogi produced from three maize varieties. *Journal of Food, Agriculture Environment*, *3*(1), 108-109.

Iluyemi, F. B., Hanafi, M. M., Radziah, O., & Kamarudin, M. S. (2006). Fungal solid state culture of palm kernel cake. *Bioresource Technology*, *97*(3), 477-482.

Ivan, M. (1988). Effect of faunation on ruminal solubility and liver content of copper in sheep fed low or high copper diets. *Journal of Animal Science*, *66*(6), 1496-1501.

Ivan, M. (1989). Effects of faunation and type of dietary protein on gastric solubility and liver content of copper in sheep. *Journal of Animal Science*, *67*(11), 3028-3035.

Ivan, M., & Veira, D. M. (1982). Duodenal flow and soluble proportions of zinc, manganese, copper and iron in the rumen fluid and duodenal digesta of faunated and defaunated sheep. *Canadian Journal of Animal Science*, *62*(3), 979-982.

Ivan, M., Rusihan, M., Alimon, A. R., Hair-Bejo, M., Jelan, Z. A., & Jalaludin, S. (1999). The efficacy of dietary supplements of bentonite and sulphur plus molybdenum to alleviate chronic copper toxicity in sheep fed palm kernel cake. *Czech Journal of Animal Science (Czech Republic*), 44, 125–130.

Ivan, M., Veira, D. M., & Kelleher, C. A. (1986). The alleviation of chronic copper toxicity in sheep by ciliate protozoa. *British Journal of Nutrition, 55*(02), 361-367.

Jain, N.C. (1993) *Essentials of Veterinary Hematology*. Blackwell Publishing, Philadelphia, PA.

Jaishankar, M., Tseten, T., Anbalagan, N., Mathew, B. B., & Beeregowda, K. N. (2014). Toxicity, mechanism and health effects of some heavy metals. *Interdisciplinary Toxicology, 7*(2), 60-72.

Jaiswal, A. K., Das, S., Kumar, V., Gupta, M., & Singh, N. (2015). Simultaneous Determination of Zinc (Zn), Cadmium (Cd), Lead (Pb) and Copper (Cu) in Blood Using Differential-Pulse Anodic-Stripping Voltammetry. *International Journal of Engineering Research, 4*(5), 235-239.

Jallow, D. B., & Hsia, L. C. (2014). Effect of sodium bicarbonate supplementation on carcass characteristics of lambs fed concentrate diets at different ambient temperature levels. *Asian Australasian Journal of Animal Sciences, 27*(8), 1098-1103.

Jayanegara, A. (2014). Pattern of polyunsaturated fatty acid biohydrogenation as influenced by dietary tannin. *Indonesian Journal of Animal and Veterinary Sciences, 19*(1).

Jenkins, T. C., Wallace, R. J., Moate, P. J., & Mosley, E. E. (2008). Board-invited review: Recent advances in biohydrogenation of unsaturated fatty acids within the rumen microbial ecosystem. *Journal of Animal Science, 86*(2), 397-412.

Jeon, S. M., Bok, S. H., Jang, M. K., Kim, Y. H., Nam, K. T., Jeong, T. S., Park, T. S., & Choi, M. S. (2002). Comparison of antioxidant effects of naringin and probucol in cholesterol-fed rabbits. *Clinica Chimica Acta, 317*(1), 181-190.

Jiménez-Colmenero, F., Carballo, J., & Cofrades, S. (2001). Healthier meat and meat products: their role as functional foods. *Meat Science, 59*(1), 5-13.

Johan, A. M., & Jamaludin, A. B. (1996). The development of small ruminant industry in Malaysia: experiences in the transfer of technology. In *Workshop on Small Ruminant Production: Recommendations for Southeast Asia, Parapat (Indonesia), May 12-15, 1996*. Small Ruminant Collaborative Research Support Program.

Johnson, D. E., Johnson, K. A., & Baldwin, R. L. (1990). Changes in liver and gastrointestinal tract energy demands in response to physiological workload in ruminants. *The Journal of Nutrition, 120*(6), 649-655.

Johnson, K. A., & Johnson, D. E. (1995). Methane emissions from cattle. *Journal of Animal Science, 73*(8), 2483-2492.

Jones, M., & Van Der Merwe, D. (2008). Copper toxicity in sheep is on the rise in kansas and nebraska. *Kansas State University/Veterinary Medical Teaching Hospital: Manhattan, KS, USA*, 5.

Jouany, J. P., & Ushida, K. (1999). The role of protozoa in feed digestion-Review. *Asian Australasian Journal of Animal Sciences*, *12*(1), 113-128.

Juárez, M., Horcada, A., Alcalde, M. J., Valera, M., Polvillo, O., & Molina, A. (2009). Meat and fat quality of unweaned lambs as affected by slaughter weight and breed. *Meat Science*, *83*(2), 308-313.

Juniper, D. T., Phipps, R. H., Ramos-Morales, E., & Bertin, G. (2009). Effect of high dose selenium enriched yeast diets on the distribution of total selenium and selenium species within lamb tissues. *Livestock Science*, *122*(1), 63-67.

Juráček, M., Bíro, D., Šimko, M., Gálik, B., Rolinec, M., Hanušovský, O., Pastierik, O., Píšová, A., & Andruška, N. (2018). Fatty acid composition of maize silages from different hybrids. *Acta Fytotechnica et Zootechnica*, *20*(4), 95-98.

Juszczuk-Kubiak, E., Bujko, K., Cymer, M., Wicińska, K., Gabryszuk, M., & Pierzchała, M. (2016). Effect of inorganic dietary selenium supplementation on selenoprotein and lipid metabolism gene expression patterns in liver and loin muscle of growing lambs. *Biological Trace Element Research*, *172*(2), 336-345.

Kaneko, J. J. (1989). Carbohydrate metabolism and its diseases. *Clinical Biochemistry of Domestic Animals*, *4*, 44-81.

Karami, M., Alimon, A. R., Sazili, A. Q., & Goh, Y. M. (2010). Meat quality and lipid oxidation of infraspinatus muscle and blood plasma of goats under dietary supplementation of herbal antioxidants. *Journal of Animal and Veterinary Advances*, *9*(24), 3039-3047.

Karami, M., Ponnampalam, E., & Hopkins, D. (2013). The effect of palm oil or canola oil on feedlot performance, plasma and tissue fatty acid profile and meat quality in goats. *Meat Science*, *94*, 165-169.

Kargin, F., Seyrek, K., Bildik, A., & Aypak, S. (2004). Determination of the levels of zinc, copper, calcium, phosphorus and magnesium of Chios ewes in the Aydın region. *Turkish Journal of Veterinary and Animal Sciences*, *28*(3), 609-612.

Karim, S. A., & Verma, D. L. (2000). Blood metabolites and circulating mineral profile of lambs maintained under intensive feeding and grazing with supplementation. *The Indian Journal of Small Ruminants*, *6*(2), 77-81.

Katsande, S., Baloyi, J. J., Nherera-Chokuda, F. V., Ngongoni, N. T., Matope, G., Zvinorova, P. I., & Gusha, J. (2016). Apparent digestibility and microbial protein yield of *Desmodium uncinatum*, *Mucuna pruriens* and *Vigna unguiculata* forage legumes in goats. *African Journal of Range & Forage Science*, *33*(1), 53-58.

Kawashima, T., Sumamal, W., Pholsen,P., Chaithiang, R., & Hayashi, Y. (2003). Ruminal degradation of sugarcane stalk. *Asian Australasian Journal of Animal Sciences. 16,*1280-1284.

Kellogg, D. W., Rakes, J. M., & Gliedt, D. W. (1989). Effect of zinc methionine supplementation on performance and selected blood parameters of lactating dairy cows. *Nutrition Reports International, 40*(6), 1049-1057.

Kelly, K. (2003). The interaction of cigarette smoking and antioxidants. Part III: ascorbic acid. *Alternative Medicine Review, 8*(1), 43-54.

Kemp, J. D., Johnson, A. E., Stewart, D. F., Ely, D. G., & Fox, J. D. (1976). Effect of dietary protein, slaughter weight and sex on carcass composition, organoleptic properties and cooking losses of lamb. *Journal of Animal Science, 42*(3), 575-583.

Kempster, A. J., Cuthbertson, A., & Smith, R. J. (1976). Variation in lean distribution among steer carcasses of different breeds and crosses. *The Journal of Agricultural Science, 87*(03), 533-542.

Kessel, J. A. S. & Russell, J. B. (1996). The effect of pH on ruminal methanogenesis. *FEMS Microbiology Ecology, 20*(4), 205-210.

Khalifa, E. I., Ahmed, M. E., Hafez, Y. H., El-Zolaky, O. A., Bahera, K. M., & Abido, A. A. (2013). Age at puberty and fertility of Rahmani sheep fed on biological inoculated corn silage. *Annals of Agricultural Sciences, 58*(2), 163-172.

Khogali, H. M. (1999). The effect of different dietary energy levels on performance, carcass characteristics and meat quality of Sudan Baggara cattle. Ph.D. Thesis, University of Khartoum.

Kim, B. E., Nevitt, T., & Thiele, D. J. (2008). Mechanisms for copper acquisition, distribution and regulation. *Nature Chemical Biology, 4*(3), 176-185.

Kim, B. E., Turski, M. L., Nose, Y., Casad, M., Rockman, H. A., & Thiele, D. J. (2010). Cardiac copper deficiency activates a systemic signaling mechanism that communicates with the copper acquisition and storage organs. *Cell Metabolism, 11*(5), 353-363.

Kim, E. J., Huws, S. A., Lee, M. R., & Scollan, N. D. (2010). Dietary transformation of lipid in the rumen microbial ecosystem. *Asian Australasian Journal of Animal Sciences, 22*(9), 1341-1350.

Kim, J. Y., Carlson, B. A., Xu, X. M., Zeng, Y., Chen, S., Gladyshev, V. N., Lee, P. J., & Hatfield, D. L. (2011). Inhibition of selenocysteine tRNA [Ser] Sec aminoacylation provides evidence that aminoacylation is required for regulatory methylation of this tRNA. *Biochemical and Biophysical Research Communications, 409*(4), 814-819.

Kim, S. C., Adesogan, A. T., Badinga, L., & Staples, C. R. (2007). Effects of dietary n-6: n-3 fatty acid ratio on feed intake, digestibility, and fatty acid profiles of the ruminal contents, liver, and muscle of growing lambs. *Journal of Animal Science, 85*(3), 706-716.

Kincaid, R. L. (2000). Assessment of trace mineral status of ruminants: A review. *Journal of Animal Science, 77*(E-Suppl), 1-10.

Kincaid, R. L., Miller, W. J., Fowler, P. R., Gentry, R. P., Hampton, D. L., & Neathery, M. W. (1976). Effect of high dietary zinc upon zinc metabolism and intracellular distribution in cows and calves. *Journal of Dairy Science, 59*(9), 1580-1584.

Kirby, K. D., Thomas, J. D., & Ross, T. T. (1996). Growth and carcass characteristics of feedlot lambs supplemented with selenium enriched yeast and Vitamin E. In *88th Annual Meeting Abstracts* (p. 162).

Kirton, A. H., Fourie, P. D., & Jury, K. E. (1972). Growth and development of sheep: III. Growth of the carcass and non-carcass components of the Southdown and Romney and their cross and some relationships with composition. *New Zealand Journal of Agricultural Research, 15*(2), 214-227.

Knowles, S. O., Rounce, J. R., Grace, N. D., & Lee, J. (1998). Variation in copper metabolism between two flocks of Romney sheep in response to increasing dietary copper. In *Proceedings-New Zealand Society of Animal Production* (Vol. 58, pp. 195-198). New Zealand Society of Animal Prod Publ.

Koenig, K. M., Rode, L. M., Cohen, R. D., & Buckley, W. T. (1997). Effects of diet and chemical form of selenium on selenium metabolism in sheep. *Journal of Animal Science, 75*(3), 817-827.

Koike, S., & Kobayashi, Y. (2001). Development and use of competitive PCR assays for the rumen cellulolytic bacteria: *Fibrobacter succinogenes, Ruminococcus albus* and *Ruminococcus flavefaciens*. *FEMS Microbiology Letters, 204*(2), 361-366.

Kolmer, J. A., Spaulding, E. H., & Robinson, H. W. (1951). Approved laboratory techniques. Appleton Century Crafts, New York, 1090, 1091.

Kongmuna, P., Wanapata, M., Nontasob, N., Nishidac, T., & Angthongd, W. (2009). Effect of phytochemical and coconut oil supplementation on rumen ecology and methane production in ruminants. *Sustainable Improvement of Animal Production and Health, 197*. 246-247.

Konlan, S. P. (2010). Shea Nut cake in supplemental concentrate for growing djallonke rams fed a basal diet of rice straw and groundnut haulms in the dry season. *An MSc Thesis Kwame Nkrumah Universty Of Science and Technology, Kumasi*.

Kotarski, S. F., Waniska, R. D., & Thurn, K. K. (1992). Starch hydrolysis by the ruminal microflora. *The Journal of Nutrition*, *122*(1), 178-190.

Koushki, M., Nahidi, M., & Cheraghali, F. (2015). Physico-chemical properties, fatty acid profile and nutrition in palm oil. *Journal of Paramedical Sciences*, *6*(3).

Koutsoumanis, K. P., Stamatiou, A. P., Drosinos, E. H., & Nychas, G. J. (2008). Control of spoilage microorganisms in minced pork by a self-developed modified atmosphere induced by the respiratory activity of meat microflora. *Food Microbiology*, *25*(7), 915-921.

Kozakai, K., Nakamura, T., Kobayashi, Y., Tanigawa, T., Osaka, I., Kawamoto, S., & Hara, S. (2007). Effect of mechanical processing of corn silage on in vitro ruminal fermentation, and in situ bacterial colonization and dry matter degradation. *Canadian Journal of Animal Science*, *87*(2), 259-267.

Krishnaiah, D., Bono, A., Sarbatly, R., & Fadhilah, S. (2012). Supercritical fluid extraction of palm kernel oil from palm kernel cake. *American Journal of Food Technology*, *7*(8), 168-172.

Kumar, D., & Jhariya, A. N. (2013). Nutritional, medicinal and economical importance of corn: A mini review. *Research Journal of Pharmaceutical Sciences*, *2*, 7-*8.*

Kumar, N., Garg, A. K., Dass, R. S., Chaturvedi, V. K., Mudgal, V., & Varshney, V. P. (2009). Selenium supplementation influences growth performance, antioxidant status and immune response in lambs. *Animal Feed Science and Technology*, *153*(1), 77-87.

Kumar, S. BV, Ajeet., K., & Meena. K. (2011). Effect of heat stress in tropical livestock and different strategies for its amelioration. *Journal of Stress Physiology & Biochemistry*, *7*(1), 45.54.

Kwak, W. S., Kim, Y. I., Choi, D. Y., & Lee, Y. H. (2016). Effect of feeding mixed microbial culture fortified with trace minerals on ruminal fermentation, nutrient digestibility, nitrogen and trace mineral balance in Sheep. *Journal of Animal Science and Technology*, *58*(1), 1-8.

Lahučký, R., Bahelka, I., Novotná, K., & Vašíčková, K. (2005). Effects of dietary vitamin E and vitamin C supplementation on the level of α-tocopherol and L-ascorbic acid in muscle and on the antioxidative status and meat quality of pigs. *Czech Journal of Animal Science*, *50*, 175-184.

Langlands, J. P., Bowles, J. E., Donald, G. E., & Smith, A. J. (1984). Deposition of copper, manganese, selenium and zinc in Merino sheep. *Crop and Pasture Science*, *35*(5), 701-707.

Lanza, M., Bella, M., Barbagallo, D., Fasone, V., Finocchiaro, L., & Priolo, A. (2003). Effect of partially or totally replacing soybean meal and maize by chickpeas (*Cicer arietinum L.*) in lamb diets: growth performances, carcass and meat quality. *Animal Research, 52*(3), 263-270.

Lardy, G. P., & Anderson, V. (2014). Feeding coproducts of the ethanol industry to beef cattle. NDSU Extension Service.

Larraín, R. E., Schaefer, D. M., Richards, M. P., & Reed, J. D. (2008). Finishing steers with diets based on corn, high-tannin sorghum or a mix of both: Color and lipid oxidation in beef. *Meat Science*, 79(4), 656-665.

Lawler, T. L., Taylor, J. B., Finley, J. W., & Caton, J. S. (2004). Effect of supranutritional and organically bound selenium on performance, carcass characteristics, and selenium distribution in finishing beef steers. *Journal of Animal Science, 82*(5), 1488-1493.

Lawrie, R. A. (1985). Meat Science. *4th ed. Pergamon Press, Oxford, UK*.

Lawrie, R.A. (1998). Meat Science, 6th edition. Cambridge England: Woodhead Publishing Ltd.

Lee, J., Peña, M. M. O., Nose, Y., & Thiele, D. J. (2002). Biochemical characterization of the human copper transporter Ctr1. *Journal of Biological Chemistry, 277*(6), 4380-4387.

Lee, R. (2008). Ruminant nutrition for graziers. ATTRA national sustainable agricultural information service. www.attra.ncat.org. pp 7 – 15.

Lee, Y. (2013). Effect of pH on conjugated linoleic acid (CLA) formation of linolenic acid biohydrogenation by ruminal microorganisms. *Journal of Microbiology, 51*(4), 471-476.

Lee, Y. J., & Jenkins, T. C. (2011). Biohydrogenation of linolenic acid to stearic acid by the rumen microbial population yields multiple intermediate conjugated diene isomers. *The Journal of Nutrition, 141*(8), 1445-1450.

Légrádi, G., Emerson, C. H., Ahima, R. S., Flier, J. S., & Lechan, R. M. (1997). Leptin Prevents Fasting-Induced Suppression of Prothyrotropin-Releasing Hormone Messenger Ribonucleic Acid in Neurons of the Hypothalamic Paraventricular Nucleus 1. *Endocrinology, 138*(6), 2569-2576.

Lemenager, R., Applegate, T., Donkin, S., Johnson, T., Lake, S., Neary, M., Radcliffe, S., Richert, B., Schinckel, A., Schutz, M., & Sutton, A. (2006). The value of distillers' grains as a livestock feed. *Purdue University Cooperative Extension Service*.

Li, D., Ferrari, M., & Ellis, E. M. (2012). Human aldo–keto reductase AKR7A2 protects against the cytotoxicity and mutagenicity of reactive aldehydes and lowers intracellular reactive oxygen species in hamster V79-4 cells. *Chemico-Biological Interactions, 195*(1), 25-34.

Li, F., Li, Z., Li, S., d Ferguson, J., Cao, Y., Yao, J., Sun, F., Wang, X., & Yang, T. (2014). Effect of dietary physically effective fiber on ruminal fermentation and the fatty acid profile of milk in dairy goats. *Journal of Dairy Science, 97*(4), 2281-2290.

Li, Q., Mair, C., Schedle, K., Hammerl, S., Schodl, K., & Windisch, W. (2012). Effect of iodine source and dose on growth and iodine content in tissue and plasma thyroid hormones in fattening pigs. *European Journal of Nutrition, 51*(6), 685-691.

Linder, M. C., & Hazegh-Azam, M. (1996). Copper biochemistry and molecular biology. *The American Journal of Clinical Nutrition, 63*(5), 797S-811S.

Lindsay, D. R., Martin, G. B., & Williams, I. H. (1993). Nutrition and reproduction. *Reproduction in Domesticated Animals*, 459-485.

Liska, D. J. (1998). The detoxification enzyme systems. *Alternative Medicine Review, 3*(3), 187-98.

Littledike, E. T., & Young, L. D. (1993). Effect of sire and dam breed on copper status of fat lambs. *Journal of Animal Science, 71*(3), 774-778.

Liu, Y., Zhao, H., Zhang, Q., Tang, J., Li, K., Xia, X. J., Wang, K. N., Li, K., & Lei, X. G. (2012). Prolonged dietary selenium deficiency or excess does not globally affect selenoprotein gene expression and/or protein production in various tissues of pigs. *The Journal of Nutrition, 142*(8), 1410-1416.

Lock, A. L., Corl, B. A., Barbano, D. M., Bauman, D. E., & Ip, C. (2004). The anticarcinogenic effect of trans-11 18: 1 is dependent on its conversion to cis-9, trans-11 CLA by Δ9-desaturase in rats. *The Journal of Nutrition, 134*(10), 2698-2704.

Lockhart, P. J., & Mercer, J. F. (2001). Functional analysis of the sheep Wilson disease protein (sATP7B) in CHO cells. *European Journal of Cell Biology, 80*(5), 349-357.

Loh, T. C. (2002). Livestock production and the feed industry in Malaysia. Food and Agriculture Organization of The United Nations Rome. *Protein Sources For The Animal Feed Industry- Expert Consultation and Workshop Bangkok*, 29 April – 3 May 2002.

Lomiwes, D., Reis, M. M., Wiklund, E., Young, O. A., & North, M. (2010). Near infrared spectroscopy as an on-line method to quantitatively determine glycogen and predict ultimate pH in pre-rigor bovine *M. longissimus dorsi*. *Meat Science, 86*(4), 999-1004.

Loor, J. J., Herbein, J. H., & Jenkins, T. C. (2002). Nutrient digestion, biohydrogenation, and fatty acid profiles in blood plasma and milk fat from lactating Holstein cows fed canola oil or canolamide. *Animal Feed Science and Technology, 97*(1), 65-82.

Lough, D. S., Solomon, M. B., Rumsey, T. S., Elsasser, T. H., Slyter, L. L., Kahl, S., & Lynch, G. P. (1991). Effects of dietary canola seed and soy lecithin in high-forage diets on performance, serum lipids, and carcass characteristics of growing ram lambs. *Journal of Animal Science, 69*(8), 3292-3298.

Lourenço, M., Ramos-Morales, E., & Wallace, R. J. (2010). The role of microbes in rumen lipolysis and biohydrogenation and their manipulation. *Animal, 4*(07), 1008-1023.

Lucy, M. C., Staples, C. R., Michel, F. M., & Thatcher, W. W. (1991). Energy balance and size and number of ovarian follicles detected by Ultrasonography in early postpartum dairy cows1. *Journal of Dairy Science, 74*(2), 473-482.

Ludden, P. A., Wechter, T. L., & Hess, B. W. (2002). Effects of oscillating dietary protein on ruminal fermentation and site and extent of nutrient digestion in sheep. *Journal of Animal Science, 80*(12), 3336-3346.

Lupton, C. J., Huston, J. E., Hruska, J. W., Craddock, B. F., Pfeiffer, F. A., & Polk, W. L. (2008). Comparison of three systems for concurrent production of high quality mohair and meat from Angora male kids. *Small Ruminant Research, 74*(1), 64-71.

Lutsenko, S., & Petris, M. J. (2003). Function and regulation of the mammalian copper-transporting ATPases: insights from biochemical and cell biological approaches. *Journal of Membrane Biology, 191*(1), 1-12.

Lykkesfeldt, J., & Svendsen, O. (2007). Oxidants and antioxidants in disease: oxidative stress in farm animals. *The Veterinary Journal, 173*(3), 502-511.

Maas, J., Galey, F. D., Peauroi, J. R., Case, J. T., Littlefield, E. S., Gay, C. C., Koller, L. D., Crisman, R. O., Weber,D. W., Warner, D. W., & Tracy, M. L. (1992). The correlation between serum selenium and blood selenium in cattle. *Journal of Veterinary Diagnostic Investigation, 4*(1), 48-52.

Machmüller, A., & Kreuzer, M. C. J. A. S. (1999). Methane suppression by coconut oil and associated effects on nutrient and energy balance in sheep. *Canadian Journal of Animal Science, 79*(1), 65-72.

Machmüller, A., Soliva, C. R., & Kreuzer, M. (2003). Methane-suppressing effect of myristic acid in sheep as affected by dietary calcium and forage proportion. *The British Journal of Nutrition, 90*(3), 529-540.

MacLachlan, G. K., & Johnston, W. S. (1982). Copper poisoning in sheep from North Ronaldsay maintained on a diet of terrestrial herbage. *The Veterinary Record, 111*(13), 299-301.

MacRae, J., O'Reilly, L., & Morgan, P. (2005). Desirable characteristics of animal products from a human health perspective. *Livestock Production Science, 94*(1), 95-103.

Madalena, F. E. (2005). Considerations on the management of animal genetic resources in Latin America. In *Proceedings of EAAP/SLU/FAO/ICAR Workshop on "Sustainable Management of Animal Genetic Resources: Linking perspectives globally", Uppsala, Sweden* (p. 10).

Mahgoub, O., Lu, C. D., & Early, R. J. (2000). Effects of dietary energy density on feed intake, body weight gain and carcass chemical composition of Omani growing lambs. *Small Ruminant Research, 37*(1), 35-42.

Mancini, R. A., & Hunt, M. (2005). Current research in meat colour. *Meat science, 71*(1), 100-121.

Mandal, A. (2014). Chelation therapy side effects. www.news-medical.net/health/Chelation-Therapy-Side-Effects.aspx

Manual, M. (2012). Haematologic reference ranges. Mareck Veterinary Manual.

Mapiye, C., Vahmani, P., Mlambo, V., Muchenje, V., Dzama, K., Hoffman, L. C., & Dugan, M. E. R. (2015). The trans-octadecenoic fatty acid profile of beef: Implications for global food and nutrition security. *Food Research International, 76*, 992-1000.

Maraschiello, C., Sárraga, C., & Garcia Regueiro, J. A. (1999). Glutathione peroxidase activity, TBARS, and α-tocopherol in meat from chickens fed different diets. *Journal of Agricultural and Food Chemistry, 47*(3), 867-872.

Marchello, J. A., Dryden, F. D., & Hale, W. H. (1972). Bovine serum lipids IV. The influence of added saturated and unsaturated fat to the ration. *Journal of Animal Science, 35*(3), 611-618.

Martin, G. B., & Walkden-Brown, S. W. (1995). Nutritional influences on reproduction in mature male sheep and goats. *Journal of Reproduction and Fertility-Supplements only*, *49*, 437-450.

Mateo, C., Palomo, J. M., Fernandez-Lorente, G., Guisan, J. M., & Fernandez-Lafuente, R. (2007). Improvement of enzyme activity, stability and selectivity via immobilization techniques. *Enzyme and Microbial Technology, 40*(6), 1451-1463.

Mathis, C. P., & Ross, T. (2000). Sheep production and management. *NM Cooperative Extension Service, 100*.

Matthäus, B. (2007). Use of palm oil for frying in comparison with other high-stability oils. *European Journal of Lipid Science and Technology*, *109*(4), 400-409.

Matthewman, R. W., Dijkman, J. T., & Zerbini, E. (1993). The management and husbandry of male and female draught animals: Research achievements and needs. *Research for Development of Animal Traction in West Africa*, 125-136.

Mayne, S. T. (2003). Antioxidant nutrients and chronic disease: use of biomarkers of exposure and oxidative stress status in epidemiologic research. *The Journal of Nutrition*, *133*(3), 933S-940S.

McCord, J. M., & Fridovich, I. (1969). Superoxide dismutase an enzymic function for erythrocuprein (hemocuprein). *Journal of Biological Chemistry*, *244*(22), 6049-6055.

McDowell, L. R. (1992). Minerals in animal and human nutrition. Academic Press Inc.

McDowell, L. R. (2003). Minerals in animal and human nutrition (No. Ed. 2). Elsevier Science BV.

McEachern, M. G., & Willock, J. (2004). Producers and consumers of organic meat: A focus on attitudes and motivations. *British Food Journal*, *106*(7), 534-552.

Meale, S. J., Chaves, A. V., Baah, J., & McAllister, T. A. (2011). Methane production of different forages in *in vitro* ruminal fermentation. *Asian-Australasian Journal of Animal Sciences*, *25*(1), 86-91.

Melissa, A. Y., Norsida, M., & Nolila, M. N. (2016). Socio-economic factors in relation to small ruminant farming' potential in Malaysia: ranchers' perspective. *International Journal of Agriculture, Forestry and Plantation*, 2; 72-76.

Mendel, M., & Wiechetek, M. (2006). Iron poisoning in animals. *Medycyna Weterynaryjna*, 62(12), 1357-1361.

Menke, K. H., & Steingass, H. (1988). Estimation of the energetic feed value obtained from chemical analysis and in vitro gas production using rumen fluid. *Animal Research and Develop*, *28*(1), 7-55.

Menzies, P. I., Boermans, H., Hoff, B., Durzi, T., & Langs, L. (2003). Survey of the status of copper, interacting minerals, and vitamin E levels in the livers of sheep in Ontario. *The Canadian Veterinary Journal*, *44*(11), 898.

Merchen, N. R., & Bourquin, L. D. (1994). Processes of digestion and factors influencing digestion of forage-based diets by ruminants. In: G. C. Fahey, Jr. (ed) Forage Quality, Evaluation, and Utilization. pp 5564–5612. Am. Soc. Agronomy, Inc., Crop Sci. Soc. Am., Inc., Soil Sci. Soc. Am., Inc., Madison, WI.

Mézes, M., Erdélyi, M., Shaaban, G., Virág, G., Balogh, K., & Wéber, M. (2003). Genetics of glutathione peroxidase. *Acta Biologica Szegediensis*, *47*(1-4), 135-138.

Michal, J. J., Chew, B. P., Shultz, T. D., Wong, T. S., & Magnuson, N. S. (1992). Interaction of conjugated dienoic derivatives of linoleic-acid with beta-carotene on cellular host defense. In Faseb Journal (Vol. 6, No. 4, Pp. A1102-A1102). 9650 Rockville Pike, Bethesda, Md 20814-3998: Federation Amer Soc Exp Biol.

Miller, W. J. (1970). Zinc nutrition of cattle: A Review1. *Journal of Dairy Science, 53*(8), 1123-1135.

Ministry of agriculture & agro-based industry (2015). Driving modernisation in agro-food, strategy paper 20. Eleventh Malaysia Plan. 6-8.

Ministry of Agriculture Malaysia. (1999). Third national agriculture policy (1998-2010) - Executive Summary. Ministry of Agriculture. Kuala Lumpur.

Mohamed, F. (2015). The Effect of dietary pigeon pea (cajanus cajan) seed on growth and some blood parameters of desert goats (Doctoral dissertation, UOFK).

Mohamed, H. K. (1999). The effect of different dietary energy levels on performance, carcass characteristics and meat quality of the Sudan Baggara cattle (Doctoral dissertation, Ph. D thesis, University of Khartoum, Sudan).

Mohamed, W. Z., & Farid, M. M. (2011). Oil palm by products as feeds for livestock in Malaysia. Universiti Malaysia Kelantan (UMK).

Mohammed, A. A. (2013). Growth performance rumen fermentation and microbial population, carcass characteristic and meat fatty acid composition of goats fed diets based on oil palm kernel cake and decanter cake (Doctoral dissertation, Universiti Putra Malaysia).

Mohebbi-Fani, M., Mirzaei, A., Nazifi, S., & Tabandeh, M. R. (2012). Oxidative status and antioxidant enzyme activities in erythrocytes from breeding and pregnant ewes grazing natural pastures in dry season. *Revista De Medicina Veterinaria, 163*, 454-460.

Moore, J. H., & Christie, W. W. (1984). Digestion, absorption and transport of fats in ruminant animals. *Proceedings-Easter School in Agricultural Science*, University of Nottingham.

Morand- Fehr, P., Araba, A., Bas, P., & El Aich, A. (2012). Effects of feeding system and diet on body lipid composition of young goats. *Goat Meat Production and Quality*, 337-354.

Morvay, Y., Bannink, A., France, J., Kebreab, E., & Dijkstra, J. (2011). Evaluation of models to predict the stoichiometry of volatile fatty acid profiles in rumen fluid of lactating Holstein cows. *Journal of Dairy Science, 94*(6), 3063-3080.

Mosaad, G. M., & Derar, D. R. (2009). Effect of dietary energy and phosphorus on nutrients digestibility, blood constituents, and ovarian structures in ewes. *Veterinary World, 2*(12), 456-461.

Mosley, S. A., Mosley, E. E., Hatch, B., Szasz, J. I., Corato, A., Zacharias, N., Hoes, D., & McGuire, M. A. (2007). Effect of varying levels of fatty acids from palm oil on feed intake and milk production in Holstein cows. *Journal of Dairy Science*, *90*(2), 987-993.

Mosoni, P., Chaucheyras-Durand, F., Béra-Maillet, C., & Forano, E. (2007). Quantification by real-time PCR of cellulolytic bacteria in the rumen of sheep after supplementation of a forage diet with readily fermentable carbohydrates: effect of a yeast additive. *Journal of Applied Microbiology*, *103*(6), 2676-2685.

Mosoni, P., Martin, C., Forano, E., & Morgavi, D. P. (2011). Long-term defaunation increases the abundance of cellulolytic ruminococci and methanogens but does not affect the bacterial and methanogen diversity in the rumen of sheep. *Journal of Animal Science*, *89*(3), 783-791.

Mould, F. L., & Ørskov, E. R. (1983). Manipulation of rumen fluid pH and its influence on cellulolysis *in sacco*, dry matter degradation and the rumen microflora of sheep offered either hay or concentrate. *Animal Feed Science and Technology*, *10*(1), 1-14.

MPOB. (2016). Malaysian palm oil board: Overview of the Malaysian oil palm industry 2016. *Selangor: Economics & Industry Development Division*.

MPOB. (2017). Malaysian palm oil board: Overview of the Malaysian oil palm industry 2016. *Selangor: Economics & Industry Development Division*.

MPOIP (2008). Malaysian Palm Oil Industry Performance: Global Oils & Fats Business Magazin. 6(1).

Nam, Y. J., Choi, Y. M., Lee, S. H., Choe, J. H., Jeong, D. W., Kim, Y. Y., & Kim, B. C. (2009). Sensory evaluations of porcine longissimus dorsi muscle: Relationships with postmortem meat quality traits and muscle fiber characteristics. *Meat Science*, *83*(4), 731-736.

Nantapo, C. W., Muchenje, V., Nkukwana, T. T., Hugo, A., Descalzo, A., Grigioni, G., & Hoffman, L. C. (2015). Socio-economic dynamics and innovative technologies affecting health-related lipid content in diets: Implications on global food and nutrition security. *Food Research International*, *76*, 896-905.

Nell, H. (1998). Crossbreeding experiment with the Dorper sheep at UW. Wyoming Livestock Roundup—Wool Growers Edition.

Nestel, P., Noakes, M., Belling, B., McArthur, R., Clifton, P., Janus, E., & Abbey, M. (1992). Plasma lipoprotein lipid and Lp [a] changes with substitution of elaidic acid for oleic acid in the diet. *Journal of Lipid Research*, *33*(7), 1029-1036.

Nève, J. (1989). Biological functions of selenium. In: Nève J &. Favier A (eds.). Selenium in Medicine and Biology. *Proceedings of the Second International Congress on Trace Elements in Medicine and Biology*. March 1988, Avoriaz, France, Walter de Gruyter, Berlin and New York. pp. 97-111.

Newbold, C. J., & Chamberlain, D. G. (1988). Lipids as rumen defaunating agents. *Proceedings of Nutrition Society*, 47, 154A.

Newbold, C. J., Lassalas, B., & Jouany, J. P. (1995). The importance of methanogens associated with ciliate protozoa in ruminal methane production in vitro. *Letters in Applied Microbiology, 21*(4), 230-234.

Ng, W. K. (2004). Researching the use of palm kernel cake in aquaculture feeds. *Palm Oil Developments*, *41*, 19-21.

Nicolosi, R. J., Stucchi, A. F., Kowala, M. C., Hennessy, L. K., Hegsted, D. M., & Schaefer, E. J. (1990). Effect of dietary fat saturation and cholesterol on LDL composition and metabolism. In vivo studies of receptor and nonreceptor-mediated catabolism of LDL in cebus monkeys. *Arteriosclerosis, Thrombosis, and Vascular Biology, 10*(1), 119-128.

Nielsen, A. E., Bohr, A., & Penkowa, M. (2006). The balance between life and death of cells: roles of metallothioneins. *Biomarker Insights, 1*, 99-111.

Nieminen, M., & Timisjärvi, J. (1983). Blood composition of the reindeer. II. Blood chemistry. *Rangifer, 3*(1), 16-32.

Njidda, A. A., & Nasiru, A. (2010). In vitro gas production and dry matter digestibility of tannin-containing forages of semi-arid region of north-eastern Nigeria. *Pakistan Journal of Nutrition, 9*(1), 60-66.

Noakes, M., Nestel, P. J., & Clifton, P. M. (1996). Modifying the fatty acid profile of dairy products through feedlot technology lowers plasma cholesterol of humans consuming the products. *The American Journal of Clinical Nutrition, 63*(1), 42-46.

Nocek, J. E., & Tamminga, S. (1991). Site of digestion of starch in the gastrointestinal tract of dairy cows and its effect on milk yield and composition. *Journal of Dairy Science, 74*(10), 3598-3629.

Notter, D. R., Greiner, S. P., & Wahlberg, M. L. (2004). Growth and carcass characteristics of lambs sired by Dorper and Dorset rams. *Journal of Animal Science, 82*(5), 1323-1328.

Nozière, P., Steinberg, W., Silberberg, M., & Morgavi, D. P. (2014). Amylase addition increases starch ruminal digestion in first-lactation cows fed high and low starch diets. *Journal of Dairy Science, 97*(4), 2319-2328.

NRC. (2005). National research council: Mineral tolerance of animals. 2nd ed. Washing, DC: The National Academy Press.

Nuernberg, K., Kuechenmeister, U., Kuhn, G., Nuernberg, G., Winnefeld, K., Ender, K., Cogan U., & Mokady, S. (2002). Influence of dietary vitamin E and selenium on muscle fatty acid composition in pigs. *Food Research International*, *35*(6), 505-510.

Nwokolo, E. N., Bragg, D. B., & Kitts, W. D. (1976). The availability of amino acids from palm kernel, soybean, cottonseed and rapeseed meal for the growing chick. *Poultry Science*, *55*(6), 2300-2304.

O'Rourke, B., Russell, R., & Buege, D. (2005). Lamb carcass evaluation. Indian 4-H Sheep Project.

Obeidat, B. S., & Gharaybeh, F. F. (2011). Effect of feeding sesame hull on growth performance, nutrient digestibility, and carcass characteristics of Black goat kids. *Asian Australasian Journal of Animal Sciences, 24*(2), 206-213.

Obeidat, B. S., Abdullah, A. Y., Awawdeh, M. S., Kridli, R. T., Titi, H. H., & Qudsieh, R. I. (2008). Effect of methionine supplementation on performance and carcass characteristics of Awassi ram lambs fed finishing diets. *Asian Australasian Journal of Animal Sciences, 21*(6), 831-837.

Ocak, S., Ogun, S., & Yilmaz, O. (2016). Dorper sheep utilizing feed resources efficiently: a Mediterranean case study. *Revista Brasileira de Zootecnia, 45*(8), 489-498.

Offer, G., & Knight, P. (1988). Structural basis of water-holding in meat. 2. Drip losses. *Developments in meat science*. In Lawrie (Ed.), Developments in meat science. Barking, UK: Elsevier Applied Science.

Offer, G., & Trinick, J. (1983). On the mechanism of water holding in meat: the swelling and shrinking of myofibrils. *Meat Science*, *8*(4), 245-281.

Ofori-Boateng, C., & Lee, K. T. (2013). Sustainable utilization of oil palm wastes for bioactive phytochemicals for the benefit of the oil palm and nutraceutical industries. *Phytochemistry Reviews*, *12*(1), 173-190.

Ogbuewu, I. P., Okoli, I. C., & Iloeje, M. U. (2010). Evaluation of toxicological effects of leaf meal of an ethnomedicinal plant-neem on blood chemistry of puberal Chinchilla Rabbit does. *Report and Opinion*, *2*(2), 29-34.

Okeudo, N. J., Onyike, I. L., Okoli, C. V., & Chielo, I. L. (2006). Production performance, meat quality and feed cost implications of utilizing high levels of palm kernel cake in broiler finisher diets. *International Journal of Poultry Science, 5*(12), 1160-1163.

Oladokun, A. A., Wahab, A., Rahman, N., & Suparjo, M. (2016). Prospect of maximising palm kernel cake utilization for livestock and poultry in Malaysia: A Review. *Journal of Biology, Agriculture and Healthcare, 6*(13), 107 – 113. ISSN 2224-3208 (Paper) ISSN 2225-093X (Online).

Olafadehan, O. A., & Adewumi, M. K. (2009). Productive and reproductive performance of strategically supplemented free grazing prepartum Bunaji cows in the agropastoral farming system. *Tropical Animal Health and Production*, *41*(7), 1275-1281.

Olafedehan, C. O., Obun, A. M., Yusuf, M. K., Adewumi, O. O., Oladefedehan, A. O., Awofolaji, A. O., & Adeniji, A. A. (2010). Effects of residual cyanide in processed cassava peal meals on haematological and biochemical indices of growing rabbits. In *Proceedings of 35th Annual Conference of Nigerian Society for Animal Production* (Vol. 2, p. 212).

Olfaz, M., Ocak, N., Erener, G., Cam, M. A., & Garipoglu, A. V. (2005). Growth, carcass and meat characteristics of Karayaka growing rams fed sugar beet pulp, partially substituting for grass hay as forage. *Meat Science*, *70*(1), 7-14.

Omar, B. A., & McCord, J. M. (1990). The cardioprotective effect of Mn-superoxide dismutase is lost at high doses in the postischemic isolated rabbit heart. *Free Radical Biology and Medicine*, *9*(6), 473-478.

Omu, A. E., Al-Azemi, M. K., Kehinde, E. O., Anim, J. T., Oriowo, M. A., & Mathew, T. C. (2008). Indications of the mechanisms involved in improved sperm parameters by zinc therapy. *Medical Principles and Practice*, *17*(2), 108-116.

Onwudike, O. C. (1986). Palm kernel meal as a feed for poultry. 1. Composition of palm kernel meal and availability of its amino acids to chicks. *Animal Feed Science and Technology*, *16*(3), 179-186.

Onyango, C. A., Izumimoto, M., & Kutima, P. M. (1998). Comparison of some physical and chemical properties of selected game meats. *Meat Science*, *49*(1), 117-125.

Ørskov, E. & McDonald, I. (1979). The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. *The Journal of Agricultural Science 92*, 499–503.

Ørskov, E. R. (1999). Supplement strategies for ruminants and management of feeding to maximize utilization of roughages. *Preventive Veterinary Medicine*, *38*(2), 179-185.

Oruc, H. H., Cengiz, M., & Beskaya, A. (2009). Chronic copper toxicosis in sheep following the use of copper sulfate as a fungicide on fruit trees. *Journal of Veterinary Diagnostic Investigation*, *21*(4), 540-543.

Oskoueian, E., Abdullah, N., Idrus, Z., Ebrahimi, M., Goh, Y. M., Shakeri, M., & Oskoueian, A. (2014). Palm kernel cake extract exerts hepatoprotective activity in heat-induced oxidative stress in chicken hepatocytes. *BMC Complementary and Alternative Medicine*, *14*(1), 368. doi: 10.1186/1472-6882-14-368

Ott, E. A., Smith, W. H., Harrington, R. B., & Beeson, W. M. (1966). Zinc toxicity in ruminants. I. Effect of high levels of dietary zinc on gains, feed consumption and feed efficiency of lambs. *Journal of Animal Science*, *25*(2), 414-418.

Ott, E. A., Smith, W. H., Stob, M., Parker, H. E., & Beeson, W. M. (1965). Zinc deficiency syndrome in the young calf. *Journal of Animal Science, 24*(3), 735-741.

Oyawoya, B. M., & Ogunkunle, H. N. (2004). Biochemical and haematological reference values in normal experimental animal. (p. 212-218). New York: Masson.

Pal, A., & Prasad, R. (2015). Expression profile of hepatic metallothionein-I and ATP7B, and brain metallothionein-III and acetyl cholinesterase genes in wistar rat model for non-wilsonian brain copper toxicosis. *Journal of Neurology and Neurological Disorders*, *2*(1), 1. DOI: 10.15744/2454-4981.2.102

Palmquist, D. L., Lock, A. L., Shingfield, K. J., & Bauman, D. E. (2005). Biosynthesis of conjugated linoleic acid in ruminants and humans. *Advances in Food and Nutrition Research, 50*, 179-217.

Pambu-Gollah, R., Cronje, P. B., & Casey, N. H. (2000). An evaluation of the use of blood metabolite concentrations as indicators of nutritional status in free-ranging indigenous goats. *South African Journal of Animal Science*, *30*(2), 115-120.

Pampori, Z. A. (2003). Field cum laboratory procedures in animal health care. Daya Publishing House. New Delhi, India, pp 172-182.

Pamukçu, T., Sel, T., & Yarim, G. (2001). Blood serum concentrations of selenium and glutathione peroxidase activity in Akkaraman sheep. *Turkish Journal of Veterinary and Animal Sciences*, *25*(5), 731-734.

Pan, J., Koike, S., Suzuki, T., Ueda, K., Kobayashi, Y., Tanaka, K., & Okubo, M. (2003). Effect of mastication on degradation of orchardgrass hay stem by rumen microbes: fibrolytic enzyme activities and microbial attachment. *Animal Feed Science and Technology*, *106*(1), 69-79.

Pareek, A., Godavarthi, A., Issarani, R., & Nagori, B. P. (2013). Antioxidant and hepatoprotective activity of *Fagonia schweinfurthii* (Hadidi) Hadidi extract in carbon tetrachloride induced hepatotoxicity in HepG2 cell line and rats. *Journal of Ethnopharmacology*, *150*(3), 973-981.

Pariza, M. W., Park, Y., & Cook, M. E. (2001). The biologically active isomers of conjugated linoleic acid. *Progress in Lipid Research, 40*(4), 283-298.

Parsons, R.T., Yoshiaki, M. & Lalli, G.M. (1984). A manual of chemical and biological methods for seawater analysis. 1st Edition.Pergamon Press, Oxford, UK., ISBN: 9780080302874, Pages: 173.

Paswan, J. K., Kumar, K., & Kumar, S. (2016). Effect of feeding *Acacia nilotica* pod meal on hematobiochemical profile and fecal egg count in goats. *Veterinary World*, *9*(12), 1400.

Pavlata, L., Misurova, L., Pechova, A., Husakova, T., & Dvorak, R. (2012). Direct and indirect assessment of selenium status in sheep–a comparison. *Veterinarni Medicina, 57* (5), 219–223

Payne, J. M., Dew, S. M., Manston, R., & Faulks, M. (1970). The use of a metabolic profile test in dairy herds. *Veterinary Record*, *87*, 150-158.

Paynter, J. A., Camakaris, J., & Mercer, J. F. (1990). Analysis of hepatic copper, zinc, metallothionein and metallothionein-Ia mRNA in developing sheep. *European Journal of Biochemistry, 190*(1), 149-154.

Pearson, A. M. (1966). Desirability of beef—its characteristics and their measurement. *Journal of Animal Science*, *25*(3), 843-854.

Penny, G. (1999). A Study into the prevention of copper toxicity in North Nonaldsay sheep. *Ark-Rare Breeds Survival Trust*, *27*, 134-135.

Petri, R. M., Forster, R. J., Yang, W., McKinnon, J. J., & McAllister, T. A. (2012). Characterization of rumen bacterial diversity and fermentation parameters in concentrate fed cattle with and without forage. *Journal of Applied Microbiology, 112*(6), 1152-1162.

Pinto, A. P. P., Furusho-Garcia, I. F., Leopoldino Júnior, I., Olalquiaga Pérez, J. R., Alves, N. G., & Pereira, I. G. (2011). Performance and carcass characteristics of lambs fed diets with fat and vitamin E. *Revista Brasileira de Zootecnia, 40*(12), 2911-2921.

Plascencia, A., Estrada, M., & Zinn, R. A. (1999). Influence of free fatty acid content on the feeding value of yellow grease in finishing diets for feedlot cattle. *Journal of Animal Science*, *77*(10), 2603-2609.

Ponnampalam, E. N., Mann, N. J., & Sinclair, A. J. (2006). Effect of feeding systems on omega-3 fatty acids, conjugated linoleic acid and trans fatty acids in Australian beef cuts: potential impact on human health. *Asia Pacific Journal of Clinical Nutrition, 15*(1), 21-29.

Prescott, S. L., Smith, P., Tang, M., Palmer, D. J., Sinn, J., Huntley, S. J., Cormack, B., Heine, R. G., Gibson, R. A., & Makrides, M. (2008). The importance of early complementary feeding in the development of oral tolerance: concerns and controversies. *Pediatric Allergy and Immunology, 19*(5), 375-380.

Priolo, A., Micol, D., & Agabriel, J. (2001). Effects of grass feeding systems on ruminant meat colour and flavour. A review. *Animal Research*, *50*(3), 185-200.

Pritchet, K. R., & Corning, B. F. (2004) Biology and Medicine of rats. In: Renter KM, SuckowAM, Ramachandran SV (2006) Biomarkers of cardiovascular disease molecular basis and practical considerations. *Circulation*. 113: 2335–2362.

Puchala, R., Min, B. R., Goetsch, A. L., & Sahlu, T. (2005). The effect of a condensed tannin-containing forage on methane emission by goats. *Journal of Animal Science*, *83*(1), 182-186.

Purchas, R.W. (1990). Advances in measurement of carcass quality. Limousin yearbook 1990. 34-36.

Radzik-Rant, A., Rant, W., Rozbicka-Wieczorek, A., & Kuźnicka, E. (2012). The fatty acid composition of *longissimus lumborum* muscle of suckling and early weaned dual-purpose wool/meat lambs. *Archiv Fur Tierzucht*, *55*(3), 285-293.

Raeth-Knight, M. L., Linn, J. G., & Jung, H. G. (2007). Effect of direct-fed microbials on performance, diet digestibility, and rumen characteristics of Holstein dairy cows. *Journal of Dairy Science*, *90*(4), 1802-1809.

Raghavan, V. (2000). Managing risks by the feed industry for safe food. In *22nd MSAP Annual Conference*. pp. 27-48.

Rahman, A. M. Y., Wong, H. K., Zaini, H., & Sharif, H. (1989). Preliminary observation on the alleviation of copper in sheep fed with palm kernel meal based diet. In *Proceedings of 12th Malaysian Society of Animal Production Conference, Malaysia* (pp. 75-78).

Rahman, M. M., Abdullah, R. B., Embong, W. K. W., Nakagawa, T., & Akashi, R. (2013). Effect of palm kernel cake as protein source in a concentrate diet on intake, digestibility and live weight gain of goats fed Napier grass. *Tropical Animal Health and Production*, *45*(3), 873-878.

Rajion, M. A., McLean, J. G. & Cahill, R. N. (1985). Essential fatty acids in the fetal and new bornlamb. *Australian Journal of Biological Sciences*, *38*, 33-40.

Ranjhan, S. K. (2001). Animal nutrition in the tropics (No. Ed. 5). Vikas Publishing House Pvt. Ltd..

Ravia, J. J., Stephen, R. M., Ghishan, F. K., & Collins, J. F. (2005). Menkes Copper ATPase (ATP7A) is a novel metal-responsive gene in rat duodenum, and immunoreactive protein is present on brush-border and basolateral membrane domains. *Journal of Biological Chemistry*, *280*(43), 36221-36227.

Research Animal Resource [RAR]. (2009). Reference values for laboratory animals: Normal haematological values. RAR Websites, RAR, University of Minnesota. Retrieved from http://www.ahc.umn.edu/rar/refvalues.html. Retrieved from http://www.merckmanuals.com/.

Rhee, K.S. (2000). Fatty acids in meat and meat products. Pages 83-108. in C.K. Chow ed. Fatty acids in food and their health implications. 2nd ed. Marcel Dekker, Inc. New York, New York.

Ribeiro, R. D. X., Oliveira, R. L., Macome, F. M., Bagaldo, A. R., Silva, M. C. A., Ribeiro, C. V. D. M., Carvalho, G.G.P., & Lanna, D. P. D. (2011). Meat quality of lambs fed on palm kernel meal, a by-product of biodiesel production. *Asian Australasian Journal of Animal Sciences,* 24, 1399 – 1406.

Robert. K., Murray, D., Daryl, K., Grammer, K., & Rodwell, W. (2003) Harper Biochemistry, 29th edn.

Romero-Isart, N., & Vašák, M. (2002). Advances in the structure and chemistry of metallothioneins. *Journal of Inorganic Biochemistry*, *88*(3), 388-396.

Rudel, L. L., Parks, J. S., Hedrick, C. C., Thomas, M., & Williford, K. (1998). Lipoprotein and cholesterol metabolism in diet-induced coronary artery atherosclerosis in primates.: Role of Cholesterol and Fatty Acids. *Progress in Lipid Research*, *37*(6), 353-370.

Russell, J. B., Sharp, W. M., & Baldwin, R. L. (1979). The effect of pH on maximum bacterial growth rate and its possible role as a determinant of bacterial competition in the rumen. *Journal of Animal Science*, *48*(2), 251-255.

Russell, J. R., Loy, D. D., Anderson, J., & Cecava, M. (2011). Potential of chemically treated corn stover and modified distiller grains as a partial replacement for corn grain in feedlot diets. *Animal Industry Report*, *657*(1), 10-16.

Russell, R. (2008). RNA misfolding and the action of chaperones. *Frontiers in bioscience: A Journal and Virtual Library*, *13*, 1.

Russo, G. L. (2009). Dietary n− 6 and n− 3 polyunsaturated fatty acids: from biochemistry to clinical implications in cardiovascular prevention. *Biochemical Pharmacology*, *77*(6), 937-946.

Rymer, C., Huntington, J. A., Williams, B. A., & Givens, D. I. (2005). In vitro cumulative gas production techniques: History, methodological considerations and challenges. *Animal Feed Science and Technology*, *123*, 9-30.

Sainz, R. D. (1996). Qualidade das carcaças e da carne ovina e caprina. *Reunião Anual da Sociedade Brasileira de Zootecnia*, *33*, 3-14.

Säkkinen, H. (2005). Variation in the blood chemical constituents of reindeer: significance of season, nutrition and other extrinsic and intrinsic factors. Oulu University Press.

Sales, J. (1999). Slaughter and products, Chapter 10. The ostrich biology, production and health. *DC Deeming (Ed.)*, 232-233.

Santos-Silva, J., Bessa, R. J. B., & Mendes, I. A. (2003). The effect of supplementation with expanded sunflower seed on carcass and meat quality of lambs raised on pasture. *Meat Science, 65*(4), 1301-1308.

Sañudo, C., Alfonso, M., Sanchez, A., Berge, P., Dransfield, E., Zygoyiannis, D., Gonzalez, J., & Mills, C. (2003). Meat texture of lambs from different European production systems. *Crop and Pasture Science, 54*(6), 551-560.

Sanudo, C., Enser, M. E., Campo, M. M., Nute, G. R., Maria, G., Sierra, I., & Wood, J. D. (2000). Fatty acid composition and sensory characteristics of lamb carcasses from Britain and Spain. *Meat Science, 54*(4), 339-346.

Sañudo, C., Santolaria, M. P., Maria, G., Osorio, M., & Sierra, I. (1996). Influence of carcass weight on instrumental and sensory lamb meat quality in intensive production systems. *Meat Science, 42*(2), 195-202.

Sarnklong, C., Cone, J. W., Pellikaan, W., & Hendriks, W. H. (2010). Utilization of rice straw and different treatments to improve its feed value for ruminants: a review. *Asian-Australasian Journal of Animal Sciences, 23*(5), 680.

Sarwar, M. U. H. A. M. M. A. D., Khan, M. A., & Iqbal, Z. A. F. A. R. (2002). Status paper feed resources for livestock in Pakistan. *International Journal of Agriculture & Biology, 4*(1), 186-192.

Sarwar, M., & Ajmal Khan, M., & Mahr-un-Nisa. (2003). Nitrogen retention and chemical composition of urea treated wheat straw ensiled with organic acids or fermentable carbohydrates. *Asian-Australasian Journal of Animal Sciences, 16*(11), 1583-1592.

Sarwar, M., Shahzad, M. A., Farooq, M. K., & Nisa, M. (2011). Performance of growing lambs receiving altered plant protein sources with or without probiotics. In *International Conference on Asia Agriculture and Animal IPCBEE* (Vol. 13, pp. 139-144).

SAS. (2003). SAS User's Guide: Statistics. 9.0 ed, SAS Institute Inc. Cary, NC.

Sato. H. (1974). Effects of dietary fat on lipid composition of serum and erythrocytes of the swine and *in vitro* incorporation of fatty acids into erythrocyte membranes. *Journal of Nutritional Science and Vitaminology, 20*(6), 451-469.

Satter, L. D., & Slyter, L. L. (1974). Effect of ammonia concentration on rumen microbial protein production in vitro. *British Journal of Nutrition, 32*(02), 199-208.

Savell, J. W., Mueller, S. L., & Baird, B. E. (2005). The chilling of carcasses. *Meat Science, 70*(3), 449-459.

Sayed, A. B. N. (2009). Effect of different dietary energy levels on the performance and nutrient digestibility of lambs. *Veterinary World, 2*(11), 418-420.

Saylor, W. W., Morrow, F. D., & Leach Jr, R. M. (1980). Copper-and zinc-binding proteins in sheep liver and intestine: effects of dietary levels of the metals. *The Journal of Nutrition*, *110*(3), 460-468.

Sazili, A. Q., Parr, T., Sensky, P. L., Jones, S. W., Bardsley, R. G., & Buttery, P. J. (2005). The relationship between slow and fast myosin heavy chain content, calpastatin and meat tenderness in different ovine skeletal muscles. *Meat Science*, *69*(1), 17-25.

Scandalios, J. G. (1997). Oxidative stress and the molecular biology of antioxidant defenses. Cold Spring Harbor Laboratory Press. pp 1-17 and 842-843. Schardl,

Scholz, R. W., & Hutchinson, L. J. (1979). Distribution of glutathione peroxidase activity and selenium in the blood of dairy cows. *American Journal of Veterinary Research*, *40*(2), 245-249.

Schroeder, J. W., Cramer, D. A., Bowling, R. A., & Cook, C. W. (1980). Palatability, shelflife and chemical differences between forage-and grain-finished beef. *Journal of Animal Science*, *50*(5), 852-859.

Schroeder, J. W., Marx, G. D., & Park, C. S. (1998). Waxy corn as a replacement for dent corn for lactating dairy cows. *Animal Feed Science and Technology*, *72*(1-2), 111-120.

Sebsibe, A. (2008). Sheep and goat meat characteristics and quality. *Sheep and Goat Production Handbook for Ethiopia. Ethiopian Sheep and Goats Productivity Improvement Program (ESGPIP)*, Addis Ababa, Ethiopia. pp323-328.

Seephueak, W., Ngampongsai, W., & Chanjula, P. (2011). Effects of palm oil sludge in concentrate on nutrient utilization and rumen ecology of thai native cattle fed with hay. *Sonklanakarin Journal of Science and Technology*, *33*(3), 271-280.

Sen, A. R., Santra, A., & Karim, S. A. (2006). Effect of dietary sodium bicarbonate supplementation on carcass and meat quality of high concentrate fed lambs. *Small Ruminant Research*, *65*(1), 122-127.

Shakila, S., & Reddy, P. S. (2014). Certain observations on nutritive value of palm kernel meal in comparison to deoiled rice bran. *International Journal of Science, Environment and Technology*, *3*, 1071 – 1075.

Shamberger, R. (2012). Biochemistry of selenium (Vol. 2). Springer Science & Business Media.

Shamberger, R. J. (1985). Selenium metabolism and function. *Clinical Physiology and Biochemistry*, *4*(1), 42-49.

Sharif, H. (2014). Advances in r&d to address the livestock industries issues beyond 2020. *Eterinary Research*, 2-6.

Sharma, M. C., Yadav, M. P., & Cimay, J. (2004). Minerals, deficiency, disorders, therapeutic and prophylactic management in animals. IVRI Publication, I Edition (2004), 67.

Sharp, R., Ziemer, C. J., Stern, M. D., & Stahl, D. A. (1998). Taxon-specific associations between protozoal and methanogen populations in the rumen and a model rumen system. *FEMS Microbiology Ecology*, *26*(1), 71-78.

Shek Vugrovečki, A., Vojta, A., & Šimpraga, M. (2017). Establishing reference intervals for haematological and biochemical blood variables in Lika pramenka sheep. *Veterinarski Arhiv*, *87*(4), 487-499.

Shi, C., Zhang, Y., Lu, Z., & Wang, Y. (2017). Solid-state fermentation of corn-soybean meal mixed feed with Bacillus subtilis and Enterococcus faecium for degrading antinutritional factors and enhancing nutritional value. *Journal of Animal Science and Biotechnology*, *8*(1), 50.

Shi, L., Xun, W., Yue, W., Zhang, C., Ren, Y., Shi, L., Wang, Q., Yang, R., & Lei, F. (2011). Effect of sodium selenite, Se-yeast and nano-elemental selenium on growth performance, Se concentration and antioxidant status in growing male goats. *Small Ruminant Research, 96*(1), 49-52.

Shija, D. S., Mtenga, L. A., Kimambo, A. E., Laswai, G. H., Mushi, D. E., Mgheni, D. M., Mwilawa, A. J., Shirima, E. J. M., & Safari, J. G. (2013). Preliminary evaluation of slaughter value and carcass composition of indigenous sheep and goats from traditional production system in Tanzania. *Asian-Australasian Journal of Animal Sciences, 26*(1), 143-150.

Shingfield, K. J., & Offer, N. W. (1998). Evaluation of the spot urine sampling technique to assess urinary purine derivative excretion in lactating dairy cows. *Animal Science, 66*(03), 557-568.

Shingfield, K. J., Bonnet, M., & Scollan, N. D. (2013). Recent developments in altering the fatty acid composition of ruminant-derived foods. *Animal*, 7(Suppl. 1), 132-162.

Silva, H. G. D. O., Pires, A. J. V., Silva, F. F. D., Veloso, C. M., Carvalho, G. G. P. D., Cezário, A. S., & Santos, C. C. (2005). Apparent digestibility of diets containing cocoa meal and palm kernel cake in lactating goats. *Pesquisa Agropecuária Brasileira*, *40*(4), 405-411.

Simpson, D. M., Mobasheri, A., Haywood, S., & Beynon, R. J. (2006). A proteomics study of the response of North Ronaldsay sheep to copper challenge. *BMC Veterinary Research, 2*(1), 36. doi: 10.1186/1746-6148-2-36

Singh, K., Kaur, S., Kumari, K., Singh, G., & Kaur, A. (2009). Alterations in lipid peroxidation and certain antioxidant enzymes in different age groups under physiological conditions. *Journal of Human Ecology*, *27*(2), 143-147.

Singh, M., Sharma, K., Dutta, N., Singh, P., Verma, A. K., & Mehra, U. R. (2007). Estimation of rumen microbial protein supply using urinary purine derivatives excretion in crossbred calves fed at different levels of feed intake. *Asian Australasian Journal of Animal Sciences, 20*(10), 1567- 1574.

Singh, S. K., Gupta, K., Tiwari, S., Shahi, S. K., Kumar, S., Kumar, A., & Gupta, S. K. (2009). Detecting aerobic bacterial diversity in patients with diabetic foot wounds using ERIC-PCR: a preliminary communication. *The International Journal of Lower Extremity Wounds, 8*(4), 203-208.

Siregar, Z., & Dan Mirwandhono, E. (2004). Evaluation of the utilization of palm kernel meal fermented by aspergillus niger hydrolyzate chicken feather meal and mineral supplementation in broiler zn. *USU digital library. University of North Sumatra*.

Siregar, Z., Supriadi, dan E. Mirwandhono (2003). Quality improvement palm kernel cake oil – cake through fermentation by *Rhizopus* and *Nopcozime* Supplementation to broiler. *Faculty of Agriculture, University of North Sumatra. Medan*.

Sithambaram, S., & Hassan, Q. N. (2014). Country report-Malaysia.Asian-Australasian dairy goat network, 57. Retrieved from: http://cdn.aphca.org/.

Soetan, K. O., Akinrinde, A. S., & Ajibade, T. O. (2013). Preliminary studies on the haematological parameters of cockerels fed raw and processed guinea corn (Sorghum bicolour)(p. 49-52). Proceed. Annu. Confer. Niger. Soci. Anim. Product

Sokrab, A. M., Ahmed, I. A. M., & Babiker, E. E. (2014). Effect of fermentation on antinutrients, and total and extractable minerals of high and low phytate corn genotypes. *Journal of Food Science and Technology*, *51*(10), 2608-2615.

Solaiman, S. G., Maloney, M. A., Qureshi, M. A., Davis, G., & D'Andrea, G. (2001). Effects of high copper supplements on performance, health, plasma copper and enzymes in goats. *Small Ruminant Research*, *41*(2), 127-139.

Søli, N. E. (1980). Chronic copper poisoning in sheep. A review of the literature. *Nordisk Veterinaermedicin*, *32*(2), 75-89.

Solomon, M. B., Lynch, G. P., & Berry, B. W. (1986). Influence of animal diet and carcass electrical stimulation on the quality of meat from youthful ram lambs. *Journal of Animal Science, 62*(1), 139-146.

Solomon, M. B., Lynch, G. P., & Lough, D. S. (1992). Influence of dietary palm oil supplementation on serum lipid metabolites, carcass characteristics, and lipid composition of carcass tissues of growing ram and ewe lambs. *Journal of Animal Science, 70*(9), 2746-2751.

Somarny, W. W., Erin, A. R., Suhaimi, A. H. M. S., Nurulhuda, M. O., & Hifzan, R. M. (2013). A study of major prolificacy genes in Malin and Dorper sheep in Malaysia. *Journal of Tropical Agriculture and Food Science*, 41(2), 265-272.

Sousa, I. K. F. D., Hamad Minervino, A. H., Sousa, R. D. S., Chaves, D. F., Soares, H. S., Barros, I. D. O., de Araújo, C. A. S. C., Júnior, R. A. B., & Ortolani, E. L. (2012). Copper deficiency in sheep with high liver iron accumulation. *Veterinary Medicine International, 12*,1-4.

Souza, D. A., Selaive-Villarroel, A. B., Pereira, E. S., Osório, J. C. S., & Teixeira, A. (2013). Growth performance, feed efficiency and carcass characteristics of lambs produced from Dorper sheep crossed with Santa Inês or Brazilian Somali sheep. *Small Ruminant Research, 114*(1), 51-55.

Spady, D. K., & Dietschy, J. M. (1985). Dietary saturated triacylglycerols suppress hepatic low density lipoprotein receptor activity in the hamster. *Proceedings of the National Academy of Sciences*, *82*(13), 4526-4530.

Speck, P. A., Davidson, R. B., Dobbie, P. M., Singh, K. K., & Clarke, N. J. (1995). Nutritional status affects meat tenderness in growing lambs. In *Journal of Animal Science (87th Annual Meeting abstracts)* (Vol. 168).

Steel, R. G., & Torrie, J. H. (1980). Principles and procedures of statistics: a biometrical approach (Vol. 633). New York, USA: McGraw-Hill, New York.

Sturniolo, G. C., Mestriner, C., Irato, P., Albergoni, V., Longo, G., & D'Incà, R. (1999). Zinc therapy increases duodenal concentrations of metallothionein and iron in Wilson's disease patients. *The American Journal of Gastroenterology*, *94*(2), 334-338.

Sukaryana, Y. (2001). Effect of fermentation of palm oil-cake with trichoderma viride on change of chemical composition, bioconversion efficiency, and the food and metabolizable energy in broiler chickens (Doctoral dissertation, Thesis. Padjadjaran University Graduate Program. Bandung).

Sunde, R. A., & Raines, A. M. (2011). Selenium regulation of the selenoprotein and nonselenoprotein transcriptomes in rodents. *Advances in Nutrition: An International Review Journal*, *2*(2), 138-150.

Sundu, B., & Dingle, J. G. (2003). Use of enzymes to improve the nutritional value of palm kernel meal and copra meal. In *Queensland Poultry Science Symposium 2003* (Vol. 11, pp. 1-15). World's Poultry Science Association.

Suttle, N. F. (1974). Effects of organic and inorganic sulphur on the availability of dietary copper to sheep. *British Journal of Nutrition, 32*(3), 559-568.

Suttle, N. F. (1985). Estimation of requirements by factorial analysis: potential and limitations. In Trace elements in man and animals: TEMA 5: proceedings of the fifth International Symposium on Trace Elements in Man and Animals/editors CF Mills, I. Bremner, & JK Chesters. Farnham Royal, Slough: Commonwealth Agricultural Bureaux, c1985.

Suttle, N. F. (2010). Mineral nutrition of livestock. 4th ed. pp 426-458. CABI Publishing, New York.

Suttle, N. F. (2010). Mineral nutrition of livestock. Cabi.

Suttle, N. F., & Peter, D. W. (1985). Rumen sulphide metabolism as a major determinant of copper availability in the diets of sheep. In Trace elements in man and animals: TEMA 5: *proceedings of the fifth International Symposium on Trace Elements in Man and Animals/editors CF Mills,* I. Bremner, & JK Chesters. Farnham Royal, Slough: Commonwealth Agricultural Bureaux, c1985.

Sveinbjörnsson, J. (2006). Substrate levels, carbohydrate degradation rate and their effects on ruminal end-product formation (Vol. 2006, No. 26).

Swatland, H. J. (1995). On-line evaluation of meat. CRC Press. USA, Lancaster: Technomic Publishing Company Inc.

Swenson, M.J. (1977). Dukes Physiology of domestic animals (9th edn.). Cornell University Press Ltd., London.

Sylvester, J. T., Karnati, S. K., Yu, Z., Morrison, M., & Firkins, J. L. (2004). Development of an assay to quantify rumen ciliate protozoal biomass in cows using real-time PCR. *The Journal of Nutrition*, *134*(12), 3378-3384.

Tedeschi, L. O., Fox, D. G., & Tylutki, T. P. (2003). Potential environmental benefits of ionophores in ruminant diets. *Journal of Environmental Quality*, *32*(5), 1591-1602.

Tejeda, J. F., Peña, R. E., & Andrés, A. I. (2008). Effect of live weight and sex on physico-chemical and sensorial characteristics of Merino lamb meat. *Meat Science*, *80*(4), 1061-1067.

Terpstra, A. H. (2004). Effect of conjugated linoleic acid on body composition and plasma lipids in humans: an overview of the literature. *The American Journal of Clinical Nutrition*, *79*(3), 352-361.

Thomas, V. M., Glover, D. V., & Beeson, W. M. (1976). Nitrogen and energy utilization of new endosperm types of corn with growing steers. *Journal of Animal Science*, *42*(2), 529-534.

Thompson, J. M., Perry, D., Daly, B., Gardner, G. E., Johnston, D. J., & Pethick, D. W. (2006). Genetic and environmental effects on the muscle structure response post-mortem. *Meat Science*, *74*(1), 59-65.

Thorley, C. M., Sharpe, M. E., & Bryant, M. P. (1968). Modification of the rumen bacterial flora by feeding cattle ground and pelleted roughage as determined with culture media with and without rumen fluid. *Journal of Dairy Science, 51*(11), 1811-1816.

Thrall, M.A. (2004) Hematology of amphibians, veterinary hematology and clinical chemistry*: Text and Clinical Case Presentations*. Lippincott Williams & Wilkins, Philadelphia, PA. Valenzuela, A.E., Silva, V.M. & Klempau.

Tipu, M. A., Ahmad, F., Khalique, A., Haque, M. N., Mirza, R. H., & Tayyab, U. (2014). Replacement of cotton seed cake with palm kernel cake in growing nili-ravi buffalo male calves. *Journal of Animal and Plant Sciences, 24*, 24-27.

Titi, H. H., & Fataftah, A. (2013). Effect of supplementation with vegetable oil on performance of lactating Awassi ewes, growth of their lambs, and on fatty acid profile of milk and blood of lambs. *Archiv. Tierzucht, 56*, 1-45.

Tokuda, T., Kimura, D., & Fujihara, T. (2001). The relationships between leptin and insulin in blood plasma of growing lambs. *Animal Science, 73*(01), 71-76.

Trach, N. X., Mo, M., & Dan, C. X. (2001). Effects of treatment of rice straw with lime and/or urea on its chemical composition, *in-vitro* gas production and in-sacco degradation characteristics. *Livestock Research for Rural Development, 13*, 5-12.

Trávníček, J., Racek, J., Trefil, L., Rodinová, H., Kroupová, V., Illek, J., Doucha, J., & Písek, L. (2008). Activity of glutathione peroxidase (GSH-Px) in the blood of ewes and their lambs receiving the selenium-enriched unicellular alga Chlorella. *Group (number of ewes= 5), 100*(E1), E2.

Tribble, D. L., Van Den Berg, J. J., Motchnik, P. A., Ames, B. N., Lewis, D. M., Chait, A., & Krauss, R. M. (1994). Oxidative susceptibility of low density lipoprotein subfractions is related to their ubiquinol-10 and alpha-tocopherol content. *Proceedings of the National Academy of Sciences, 91*(3), 1183-1187.

Tschirhart-Hoelscher, T. E., Baird, B. E., King, D. A., McKenna, D. R., & Savell, J. W. (2006). Physical, chemical, and histological characteristics of 18 lamb muscles. *Meat Science, 73*(1), 48-54.

Tshabalala, P. A., Strydom, P. E., Webb, E. C., & De Kock, H. L. (2003). Meat quality of designated South African indigenous goat and sheep breeds. *Meat Science, 65*(1), 563-570.

Turner, K. E., Wildeus, S., & Collins, J. R. (2005). Intake, performance, and blood parameters in young goats offered high forage diets of lespedeza or alfalfa hay. *Small Ruminant Research, 59*(1), 15-23.

Underwood, E. J. (1981). The Mineral nutrition of livestock. 2nd edCommonwealth Agricultural Bureaux. *Buckinghamshire, UK*, 210.

Underwood, J., & Suttle, F. (1999). The detection and correction of mineral imbalances. The mineral nutrition of livestock, 3rd ed. New York: CABI Publishing.

Utomo, R., Reksodiprodjo, S., Widyobroto, B. P., Bachrudin, Z., & Suhartanto, B. (1998). Determination of nutrients digestibility, rumen fermentation parameters, and microbial protein concentration on Ongole Crossbred cattle fed rice straw. *Bull. of Animal Science. Supplement Edition*, 82-88.

Valente, T. N. P., da Silva Lima, E., dos Santos, W. B. R., Cesario, A. E. S., Tavares, C. A. J., & de Freitas, M. A. M. (2016). Ruminal microorganism consideration and protein used in the metabolism of the ruminants: A review. *African Journal of Microbiology Research, 10*(14), 456-464.

Van den Top, A. M., & Veevoederbureau, C. (2005). Reviews on the mineral provision in ruminants (XII): Zinc Metabolism and Requirements in Ruminants. Centraal Veevoederbureau.

Van Houtert, M. F. J. (1993). The production and metabolism of volatile fatty acids by ruminants fed roughages: A review. *Animal Feed Science and echnology*, *43*(3-4), 189-225.

Van Ryssen, J. B. J., & Barrowman, P. R. (1987). Effect of ionophores on the accumulation of copper in the livers of sheep. *Animal Science, 44*(2), 255-261.

Van Ryssen, J. B. J., & Schroeder, G. E. (2003). Effect of heat processing of protein sources on the disappearance of their selenium from mobile bags in the digestive tract of dairy cows. *Animal Feed Science and Technology, 107*(1), 15-27.

Van Soest, J.P. (1994). Nutritional ecology of the ruminant (2nd ed.). Cornell University *Press, Ithaca, New York, USA*P476.

Van Soest, P. J. (1981). Limiting factors in plant residues of low biodegradability. *Agriculture and Environment*, *6*(2-3), 135-143.

Van Soest, P. J. (1982). Nutritional ecology of the ruminant; ruminant metabolism, nutritional strategies, the cellulolytic fermantation and the chemistry of forages and plant fibers. O & B Books. USA. 374p.

Van Zwieten, J. T., Van Vuuren, A. M., & Dijkstra, J. (2008). Effect of nylon bag and protozoa on *in vitro* corn starch disappearance. *Journal of Dairy Science, 91*(3), 1133-1139.

Venditti, P., & Di Meo, S. (2006). Thyroid hormone-induced oxidative stress. *Cellular and Molecular Life Sciences CMLS, 63*(4), 414-434.

Vergara, H., Molina, A., & Gallego, L. (1999). Influence of sex and slaughter weight on carcass and meat quality in light and medium weight lambs produced in intensive systems. *Meat Science, 52*(2), 221-226.

Verstegen, M. W. A., & Close, W. H. (1994). The environment of the growing pig. In: Cole, D.J.A., Wiseman, J., Varley, M.A. (Eds), Principles of Pig Science. *Nottingham University Press, Nottingham*, pp. 333–353.

Vierboom, M. M., Engle, T. E., & Kimberling, C. V. (2003). Effects of gestational status on apparent absorption and retention of copper and zinc in mature Angus cows and Suffolk ewes. *Asian Australasian Journal of Animal Sciences*, 16(4), 515-518.

Villar, D., Carson, T. L., Janke, B. H., Pallarés, F. J., Fernández, G., & Kinker, J. A. (2002). Retrospective study of chronic copper poisoning in sheep. In *Anales de Veterinaria de Murcia* (Vol. 18, pp. 53-60).

Vinh, N. T., Wanapat, M., Khejornsart, P., & Kongmun, P. (2011). Studies of diversity of rumen microorganisms and fermentation in swamp buffalo fed different diets. *Journal of Animal Veterinary Advances*, *10*(4), 406-414.

Voia, O. S., Filimon, M. N., Dumitrescu, G., & Petculescu-ciochină, L. I. L. I. A. N. A. (2014). The effect of feed processing on ruminal parameters in intensively fattened lambs. *Romanian Biotechnological Letters, 19*(6), 9997-10005.

Völker, H., & Rotermund, L. (2000). Possibilities of oral iron supplementation for maintaining health status in calves. *DTW. Deutsche Tierarztliche Wochenschrift*, 107(1), 16-22.

Vu, C. C., Verstegen, M. W. A., Hendriks, W. H. & Pham, K. C. (2011). The nutritive value of mulberry leaves (Morus alba) and partial replacement of cotton seed in rations on the performance of growing vietnamese cattle. *Asian-Australasian Journal of Animal Sciences, 24*(9): 1233–1242. http://doi.org/10.5713/ajas.2011.90328 downloaded 6 /9/2015

Wan Mohamed, W. E., Hutagalung, R. I., & Chen, C. P. (1987). Feed availability, utilisation and constraints in plantation-based livestock production system. In *Advances in animal feeds and feeding in the tropics. Proceedings of the Tenth Annual Conference of the Malaysian Society of Animal Production, Genting Highlands, Pahang, Malaysia, April 2-4, 1987* (pp. 81-100). Malaysian Society of Animal Production.

Wan Zahari, M., Ariff, O. M., Sukri, I. M., Oshibe, A., & Hayakawa, H. (2000). Oil palm by-products and urea molasses mineral blocks as feed resources for buffaloes in Malaysia. In Third Asean Buffalo Congress, Kandy, Sri Lanka.

Wanapat, M., & Cherdthong, A. (2009). Use of real-time PCR technique in studying rumen cellulolytic bacteria population as affected by level of roughage in swamp buffalo. *Current Microbiology, 58*(4), 294-299.

Wanapat, M., Kongmun, P., Poungchompu, O., Cherdthong, A., Khejornsart, P., Pilajun, R., & Kaenpakdee, S. (2012). Effects of plants containing secondary compounds and plant oils on rumen fermentation and ecology. *Tropical Animal Health and Production*, *44*(3), 399-405.

Wanapat, M., Pimpa, O., Petlum, A., Wachirapakorn, C., & Yuanklang, C. (2000). Participation scheme of smallholder dairy farmers in the Northeast Thailand on improving feeding systems. *Asian Australasian Journal of Animal Sciences, 13*(6), 830-836.

Wanapat, M., Polyorach, S., Boonnop, K., Mapato, C., & Cherdthong, A. (2009). Effects of treating rice straw with urea or urea and calcium hydroxide upon intake, digestibility, rumen fermentation and milk yield of dairy cows. *Livestock Science, 125*(2), 238-243.

Wang, W. X., & Fisher, N. S. (1999). Assimilation efficiencies of chemical contaminants in aquatic invertebrates: a synthesis. *Environmental Toxicology and Chemistry, 18*(9), 2034-2045.

Wang, J. H., Choi, S. H., Lim, K. W., Kim, K. H., & Song, M. K. (2006). Effect of the mixed oil and monensin supplementation, and feeding duration of supplements on c9, t11-CLA contents in plasma and fat tissues of Korean native (Hanwoo) steers. *Asian Australasian Journal of Animal Sciences, 19*(10), 1464.

Ward, J. D., & Spears, J. W. (1997). Long-term effects of consumption of low-copper diets with or without supplemental molybdenum on copper status, performance, and carcass characteristics of cattle. *Journal of Animal Science, 75*(11), 3057-3065.

Warren, R. J., Kirkpatrick, R. L., Oelschlaeger, A., Scanlon, P. F., Webb Jr, K. E., & Whelan, J. B. (1982). Energy, protein, and seasonal influences on white-tailed deer fawn nutritional indices. *The Journal of Wildlife Management*, 302-312.

Webb, E. C., Casey, N. H., & Simela, L. (2005). Goat meat quality. *Small Ruminant Research, 60*(1), 153-166.

WGPOG. (2009). World Growth Palm Oil Green Development Campaign: Palm Oil — The Sustainable Oil a Report by World Growth September. Available on line at <http://www.worldgrowth.org/assets/files/Palm_Oil.pdf>, (accessed 25 June 2012).

WHO. (1998). World health organization: Copper environmental health criteria 200, Geneva, International Programme on Chemical Safety.

Widiawati, Y. & Thalib, A (2009). Comparison of fermentation kinetics (*in vitro*) of grass and shrub legume leaves: The pattern of VFA concentration, estimated CH_4 and microbial biomass production. *Indonesian Journal of Agriculture, 2*(1), 21-27.

Wiener, G., Field, A. C., & Smith, C. (1977). Deaths from copper toxicity of sheep at pasture and the use of fresh seaweed. *The Veterinary Record, 101*(21), 424.

Wiener, G., Suttle, N. F., Field, A. C., Herbert, J. G., & Woolliams, J. A. (1978). Breed differences in copper metabolism in sheep. *The Journal of Agricultural Science, 91*(2), 433-441.

Williams, A. G. & Coleman., G. S. (1992). The rumen protozoa. Springer-Verlag., New York.

Williams, A. G. & Coleman., G. S. (1997). The rumen protozoa. In the rumen microbial ecosystem, eds. P. N. Hobson. & C. S. Stewart., Blackie Academic and Professional, London, UK., pp. 73–139

Williams, B. A., Tamminga, S., & Verstegen, M. W. A. (2000). Fermentation kinetics to assess microbial activity of gastro-intestinal microflora. Pages 97–100 in An EAAP Satellite Symposium on Gas Production: Fermentation Kinetics for Feed Evaluation and to Assess Microbial Activity. British Society of Animal Science, Wageningen, The Netherlands.

Williams, P. E. V., & Agri, A. B. (2014). Alternative feed ingredients–Overview from an end-users perspective with specific reference to bioethanol co-products. *Advances in Animal Biosciences, 5*(1).

Wolkers, H., Wensing, T., Schonewille, J. T., & Klooster, A. T. V. T. (1994). Undernutrition in relation to changed tissue composition in red deer (Cervus elaphus). *Canadian Journal of Zoology, 72*(10), 1837-1840.

Wongsrikeao, M., & Wanapat, M. (1985). The effects of urea treatment of rice straw on feed intake and live weight gain of buffaloes. *The Utilization of Fibrous Agricultural Residues as Animal Feeds. Doyle. PT (Ed.) pp*, 81-84.

Wood, J. D., Enser, M., Fisher, A. V., Nute, G. R., Sheard, P. R., Richardson, R. I., Hughes, S. I., & Whittington, F. M. (2008). Fat deposition, fatty acid composition and meat quality: A review. *Meat Science, 78*(4), 343-358.

Wood, J. D., Richardson, R. I., Nute, G. R., Fisher, A. V., Campo, M. M., Kasapidou, E., Sheard, P.R., & Enser, M. (2004). Effects of fatty acids on meat quality: a review. *Meat Science, 66*(1), 21-32.

Woolliams, J. A., Suttle, N. F., Wiener, G., Field, A. C., & Woolliams, C. (1982). The effect of breed of sire on the accumulation of copper in lambs, with particular reference to copper toxicity. *Animal Production*, *35*(03), 299-307.

Woolliams, J. A., Wiener, G., Woolliams, C., & Suttle, N. F. (1985). Retention of copper in the liver of sheep genetically selected for high and low concentrations of copper in plasma. *Animal Production*, *41*(02), 219-226.

Wright, P. L., & Bell, M. C. (1966). Comparative metabolism of selenium and tellurium in sheep and swine. *American Journal of Physiology--Legacy Content*, *211*(1), 6-10.

Wrobel, B., & Zastawny, J. (2004). The nutritive value and aerobic stability of big bale silage treated with bacterial inoculants. In *Land use systems in grassland dominated regions. Proceedings of the 20th General Meeting of the European Grassland Federation, Luzern, Switzerland, 21-24 June 2004* (pp. 978-980). vdf Hochschulverlag AG an der ETH Zurich.

Wu, Z., Ohajuruka, O. A., & Palmquist, D. L. (1991). Ruminal synthesis, biohydrogenation, and digestibility of fatty acids by dairy cows1. *Journal of Dairy Science, 74*(9), 3025-3034.

Yadi, P., & Yana, S. (2010). The influence of palm kernel cake and rice bran fermentation product mixture to the broiler carcass quality. *International Journal of Science and Engineering*, *2*(1), 1-3.

Yang, D. Y., Chang, C. J., Peh, H. C., & Chen, M. T. (2004). Anti-peroxidation effects of vitamin E on low density lipoprotein and milk fat globule membrane of lactating goats: in vivo versus metal ion challenge in vitro. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*, *139*(1), 11-20.

Yarali, E., Yilmaz, O., Cemal, I., Karaca, O., & Taşkin, T. (2014). Meat quality characteristics in Kıvırcık lambs. *Turkish Journal of Veterinary and Animal Sciences, 38*(4), 452-458.

Yazar, E., & Tras, B. (2002). Free oxygen radicals, antioxidant enzymes and antibiotics. Journal of *Turkish Veterinary Medical Association, 275*, 42-44.

Yeong, S. W. (1980). Palm oil by-products as feed for poultry. In Proc. Of the National Symp. on Oil Palm By-Products for Agro-based Industries, 175-186.

Yıldırım, A., Ulutaş, Z., Ocak, N., Şirin, E., & Aksoy, Y. (2014). A study on gastrointestinal tract characteristics of ram lambs at the same weights from six Turkish sheep breeds. *South African Journal of Animal Science, 44*(1), 90-96.

Yolcu, H., Dasci, M., & Tan, M. (2008). Nutrient value of some lucerne cultivars based on chemical composition for livestock. *Asian Journal of Chemistry*, *20*(5), 4110.

Young, O. A., & Braggins, T. J. (1993). Tenderness of ovine semimembranosus: is collagen concentration or solubility the critical factor?. *Meat science, 35*(2), 213-222.

Young, O. A., West, J., Hart, A. L., & Van Otterdijk, F. F. H. (2004). A method for early determination of meat ultimate pH. *Meat Science, 66*(2), 493-498.

Yu, S., West, C. E., & Beynen, A. C. (1994). Increasing intakes of iron reduce status, absorption and biliary excretion of copper in rats. *British Journal of Nutrition, 71*(06), 887-895.

Yu, Z., García-González, R., Schanbacher, F. L., & Morrison, M. (2008). Evaluations of different hypervariable regions of archaeal 16S rRNA genes in profiling of methanogens by Archaea-specific PCR and denaturing gradient gel electrophoresis. *Applied and Environmental Microbiology, 74*(3), 889-893.

Yue, W., Zhang, C., Shi, L., Ren, Y., Jiang, Y. & Kleemann, D. O. (2009). Effect of supplemental selenomethionine on growth performance and serum antioxidant status in Taihang Black goats. *Asian-Australian Journal of Animal Sciences, 22*, 365-370.

Yulistiani, D., Gallagher, J. R., & Van Barneveld, R. (2000). Nitritive value improvement of rice straw varieties for ruminants as ditermined by chemical composition and in vitro organic matter digestibility. *Jurnal Ilmu Ternak dan Veteriner, 5*(1), 23-31.

Yulistiani, D., Gallagher, J. R., & Van Barneveld, R. J. (2003). Intake and digestibility of untreated and urea treated rice straw base diet fed to sheep. *Jurnal Ilmu Ternak dan Veteriner, 8*(1), 8-16.

Yusoff, S. M., Ibrahim, J., & Salleh, A. R. (1995). Effect of incorporating sodium molybdate in the form of salt lick or in mixed ration on growth and performance of sheep fed palm kernel cake. *Malaysian Journal of Nutrition, 1*(2), 171-178.

Yusuf, A. L., Goh, Y. M., Samsudin, A. A., Alimon, A. R., & Sazili, A. Q. (2014). Growth performance, carcass characteristics and meat yield of boer goats fed diets containing leaves or whole parts of Andrographis paniculata. *Asian-Australasian Journal of Animal Sciences*, *27*(4), 503-510.

Zachara, B. A., Trafikowska, U., Labedzka, H., & Mikolajczak, J. (1993). Effect of dietary Se intake on blood Se levels and glutathione peroxidase activities in lambs. *Small Ruminant Research*, *9*(4), 331-340.

Zhang, Y., Kong, X., Zhu, X., Wang, R., Yan, Y., & Jia, Z. (2006). Effect of forage to concentrate ratio and monensin supplementation on cis-9, trans-11 conjugated linoleic acid and trans-11 octadecenoic acid concentrations of ruminal contents and plasma in sheep. *Asian Australasian Journal of Animal Sciences, 19*(5), 699.

Zantopoulos, N., Antoniou, V., Petsaga, V., & Zdragas, A. (1996). Copper concentrations in sheep liver and kidney in Greece. *Veterinary and Human Toxicology, 38*(3), 184-185.

Zeron, Y., Sklan, D., & Arav, A. (2002). Effect of polyunsaturated fatty acid supplementation on biophysical parameters and chilling sensitivity of ewe oocytes. *Molecular Reproduction and Development*, *61*(2), 271-278.

Zvonko, A., Markovic, B., Šperanda, M., & Didara, M. (2015). Blood MetaBolic profile and oxidative status of endangered Mediterranean sheep Breeds during pregnancy. *Bulgarian Journal of Agricultural Science*, *21*(3), 655-661.

BIODATA OF STUDENT

The student was born in AL-Anbar, Iraq, in 1984. He received the Bachelor degree in Animal Science from 2006 to 2009 and he joined the Master degree in Animal Nutrition from the University of AL-Anbar, Iraq, in 2009 and graduated in 2012. He has been joined the Department of Animal Science, Universiti Putra Malaysia (UPM) in 2014, as a PhD Student. His main research area are: natural feed additives in livestock as growth promoters; nutrition and animal physiology in sheep

LIST OF PUBLICATIONS

Saeed OA, Samsudin, AA, Sazili AQ, Akit H. (2016). Effect of Supplementing Energy to Palm Kernel Cake Diets with Rice Straw – Urea Treated on Rumen Fermentation Characteristics in Dorper Sheep. Annual Conference of the Malaysian Society of Animal Production (MSAP)/ June 2016.

Saeed OA, Samsudin AA, Sazili AQ, Akit H. (2016). Effect of Energy Supplementation on Growth Performance of Dropor Sheep. Proceeding 3rd Animal Production International Seminar (3rd APIS) & 3rd ASEAN Regional Conference on Animal Production (3rd ARCAP).

Saeed OA, Sazili AQ, Akit H, Alimon AR, Mazlan M, Samsudin AA. (2018). Effects of Corn Inclusion as Energy into Palm Kernel Cake Based-Diet on the Growth Efficiency and Carcass Characteristics of Dorper Sheep. Tropical Animal Science Journal.41 (1): 29-36.

Saeed OA, Leo TK, Sazili AQ, Akit H, Jahromi MF, Alimon AR, Samsudin AA. (2018). Effect of Dietary Supplementation of Energy into PKC – Urea Treated Rice Straw Based Diet on the Antioxidant Enzyme Activity and Gene Expression in Dorper Sheep. BMC Veterinary Research. (Manuscript ID: BVET-D-17-00706).

Saeed OA, Sazili AQ, Akit H, Alimon AR, Samsudin AA. (2018). Effect of variations of energy supplements on the hematological and biochemical indices of Dorper sheep fed on palm kernel cake as basal. Italian Journal of Animal Science.

Saeed OA, Sazili AQ, Akit H, Mahdi E, Alimon AR, Samsudin AA. (2018). Effects of various levels of corn supplementation into PKC-urea treated rice straw basal diet on meat quality and fatty acid composition of Dorper sheep. Tropical Animal Health and Production Journal. (Manuscript ID: TROP-D-18-00189).

Saeed OA, Sazili AQ, Akit H, Alimon AR, Samsudin AA. (2018). Effect of Corn Supplementation into PKC-Urea Treated Rice Straw Basal Diet on Purine Derivatives, and Rumen Fermentation in Sheep. Tropical Animal Health and Production Journal. (Manuscript ID: TROP-D-18-00034).

Saeed OA, Sazili AQ, Akit H, Mahdi E, Alimon AR, Samsudin AA. (2018). In vitro Evaluation of Different Levels of Corn Substitution into PKC Based Diet on Rumen Ecosystem with Dorper Sheep Rumen Liquor. Small Ruminant Research.

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : _____

TITLE OF THESIS / PROJECT REPORT :

EFFECT OF CORN SUBSTITUTION AS ENERGY SOURCE INTO PALM KERNEL CAKE AND UREA-TREATED RICE STRAW BASED DIET IN DORPER CROSSBRED LAMBS

NAME OF STUDENT: OSAMA ANWER SAEED

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐ **PATENT** Embargo from _____ (date) until _____ (date)

Approved by:

_____
(Signature of Student)
New IC No/ Passport No.:

Date :

_____
(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]