

Dedication

To my late mother Fatima and late Sister Yousra.

To my father, family and friends

To my teachers and colleagues.

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All the praises to "Allah" the Lord of the "Alamin" for the blessings favored to me to achieve a successful completion of this study. I am in debt to many institutions and people who have helped. I am indebted to Research Institute for Humanity and Nature for the generous financial support for this study. I wish to express my sincere gratitude to my advisor Professor Shadia Abdel Attia Omer, for the valuable opportunity offered to me to join the Mesquite Research Project. I am grateful to appreciate her patience, encouragement and her commitment for excellence throughout the study. I would like to thank my Co-supervisor Dr. Shams Eldein Hassaballa Ahmed, for his invaluable support and encouragement. Thanks are due to the technical staff in the lab of physiology and bacteriology for their assistance in the laboratory work. I would like to thank the workers in the Research Farm University of Sudan, Kuku for their help in management, of the experimental animals. Thanks are due to colleagues in Animal Research Centre Kuku, for their help in feed analysis. I would like to appreciate with pleasure the support and inspiration of my family members and my friends.

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List of abbreviations			
Denotation	.Abbrev	Denotation	.Abbrev
milliequivalent per liter	MEq/L	.Micron	μ

Milligrams	mg	Micro liter	(μ l (UL
Milligram per deciliter	mg/dl	Amino acids	AA
Millimeter/hour	mm/hr	Albumin globulin ratio	AG
millimole per liter	mmol/l	Average daily gain	AGD
Nitrogen	N	Blood urea nitrogen	BUN
Ammonium salt	NH ₄	Body weight	BW
Anhydrous Ammonia Gas	NH ₃	Condensed tannins	CT
Ammoniacal nitrogen	NH ₃ -N	Degrees centigrade	°C
Non protein nitrogen	NPN	Deciliter	dl
<i>Net Protein Utilization</i>	NPU	Dry matter intake	DMI
Prosopis pods	PD	Ethylene diamine tetra acetic acid	EDTA
Rumen microorganism	RMO	Effective degradability	Ed
Rumen undegradable Protein	RUP	Erythrocyte sedimentation rate	ESR
Short chain fatty acids	SCFA	Feed conversion ratio	FCR
Volatile fatty acids	VFAs	foetal haemoglobin	FHb
		Gram	g
		Gram per day	g/d
		Hour	h
		Hydrogen	H
		Haemoglobin C	Hb C
		Hydrolysable tannins	HT
		In vitro dry matter digestibility	IVDMD
		Kilogram calorie	Kcal
		Liter	L

ABSTRACT

This study was conducted at the Sudan University of Science and Technology (SUST) Hilat Kuku, Khartoum North, Sudan from

2010 to 2012, four experiments were performed. Experiment (1) to study the effect of feeding diets containing graded level of Mesquite (*Prosopis juliflora*) pods on the haemto-biochemical parameters and the growth performance of Nubian goats kids. In experiment (2) ruminal liquor was collected from three Kenana steers fitted with rumen cannulae, to determine the effect of *Prosopis* pods diets on the rumen ecosystem and rumen pH and rumen metabolites. The nutritive value of *Prosopis* pods and parts (sweet and seed) was determined by *in vitro* gas production technique in experiment (3) the inoculum was drawn from the cannulated steers. The three steers were used for *in sacco* determination of the rumen dry matter and protein degradability of *Prosopis* pods and seeds experiment (4). To evaluate the effect of inclusion of different levels of Mesquite pods (*Prosopis juliflora*) on some haematological parameters, blood metabolites and serum enzymes activity. Twenty four male Nubian goats kids of less than six months (average initial body weight (13.1 ± 0.37 kg)) were randomly allotted to four experimental groups of six animals according to randomized-block design. Kids in groups 1, 2, 3 and 4 were fed a concentrate mixture containing dry powder of mesquite pods at 0, 10, 20 and 30g/100Kg by replacing berseem hay, wheat bran and molasses in the diet. During the seven weeks experimental period, blood samples were taken weekly and were analyzed according to standard analytical laboratory methods. The daily feed intakes and weekly body weight of the goat kids were reported. There was no significant ($P > 0.05$) treatment effect in hematological parameters. However dietary treatment significantly ($P > 0.05$) increased glucose level, which increased with increasing levels of the pods in the diet. Triglyceride, total and direct bilirubin concentrations were significantly ($P > 0.05$) decreased. Three steers local Kenana 3- 3.5 years old were fitted with ruminal canulae and were fed *Prosopis* diets in proportion similar to that fed to the goat kids. The trial was designed

according to Latin square design with four treatments and four experimental periods. Each period experimental period lasted ten days. The adaption period was seven days followed by 10 days of sampling. Rumen liquor was taken at 0, 2, 4, 6 and 8 h interval to determine pH, ammonia, and volatile fatty acids concentration, bacterial and protozoal count.

The steers were used for collection of rumen liquor for *in vitro* gas production technique and for incubation of mesquite pods and seeds for *in sacco* evaluation. Ammonia level 2 hours post feeding was significantly ($p < 0.05$) increased as the level of Mesquite pods was increased in the diet. Other rumen environment parameters did not vary with feeding. Mesquite whole pod, pulp (sweet) and seed were incubated in buffer rumen fluid for 96 hours to determine their gas production, and fermentation parameters by *in vitro* gas production technique. The cumulative gas production of Mesquite whole pod, pulp (Sweet) and seeds varied significantly ($p < 0.05$). At 3 and 96h the gas production on the pulp (sweet) was the highest (11.17 ± 0.76 - 56.83 ± 1.75 mg/OM) and the lowest was (4.5 ± 0.50 - 51.67 ± 0.57 mg/OM) on the seed. Organic matter digestibility (OMD) and metabolizable energy (ME) were significantly ($p < 0.05$) higher ($49.86 \pm 0.02\%$ and 7.29 ± 0.03 MJ/Kg) on the pulp and were lower ($48.56 \pm 0.085\%$ and 7.20 ± 0.14 MJ/Kg) on the whole pod. The chemical composition, *in vitro* organic matter digestibility (IVOMD) and *in vitro* metabolizable energy (IVME), degradation kinetics of mesquite pods has desirable nutritive value. The degradability of Mesquite pods and seeds was evaluated by *in Sacco* technique following the standard procedure. There was an increase disappearance of DM and CP from the incubated samples over time. The disappearance of DM by 48 hours post incubation was significantly ($p < 0.05$) higher on the pods than that of the seed (67.43 ± 0.43 Vs $59.29 \pm 2.94\%$) and CP was significantly ($p < 0.05$) higher on the seeds than that of the pods (84.00 ± 2.72 Vs $76.07 \pm 2.72\%$). The soluble fraction (a) of DM of the pods was significantly ($p < 0.01$) higher than that of the seeds. The insoluble fraction (b) DM of the pods was

significantly lower than that of the seeds. At all the known flow rates (0.02, 0.05 and 0.08) the pods registered the highest value for effective degradability in DM and CP. Throughout the period of incubation the disappearance of CP of seed was significantly ($p < 0.01$) highest than the pods. At 24 hrs to the end of the incubation period CP disappearance was $> 70\%$ and $> 80\%$ on the pods and seed respectively. The pods were significantly ($p < 0.01$) the highest in the CP soluble fraction (a) and the seed was the highest in the CP insoluble fraction (b) and potential degradable fraction. The results showed that *Prosopis* pods and seeds had a desirable nutritive value and could be considered as feed for ruminants. The animals did not show any signs of illness due to inclusion of Mesquite pods in their feed. Final weight and weight gain did not vary significantly ($p < 0.05$) among the four groups. The daily intake of dry matter (DM) (ME) and (CP) of control group were significantly lower ($p < 0.05$) than of the group fed the Mesquite pods and there were no differences among the groups fed the pods. The control group had the best feed conversion ratio (FCR). Group fed 10% pods had the highest dry matter and protein intake and best feed conversion ration. The inclusion of *Prosopis* pod up to 30% of the diet of goat kids, did not affect the performance of the animals, their blood constituents and rumen environment.

(مستخلص الأطروحة)

أجريت أربعة تجارب منفصلة بمزرعة جامعة السودان للعلوم والتكنولوجيا بحلة كوكو بالسودان في عام 2010 إلى 2012 م. في التجربة الأولى تمت دراسة اثر استهلاك حبات المسكيت علي مكونات الدم وخصائصه الكيميائية والنمو في صغار الماعز النوبي السوداني. العلائق المستخدمة متماثلة في الطاقة والنروجين و احتوت علي مقدار 0, 10, 20 و 30 بالمائة من حبات المسكيت. في كل التجارب الأربعة لم تظهر أي علامات مرضية علي الحيوانات نتيجة ادخال المسكيت في العليقة. في التجربة رقم (1) استخدم عدد 24 راس من ذكور صغار الماعز النوبي بعمر اقل من 6 أشهر ووزن 13,37 كجم وزعت عشوائيا علي اربعة مجموعات وغذيت كل مجموعة عشوائيا باحدي العلائق الأربعة. امتدت التجربة لفترة سبعة اسابيع تم فيها سحب عينات من الدم وتم تحليلها وفقا للطرق المعملية القياسية. كما تم تسجيل الاستهلاك اليومي للراس من العلف ووزن الحيوان أسبوعيا. ولم تسجل اثار ذات دلالة معنوية (عند مستوي > 5 بالمائة) على مكونات الدم كعدد الكريات الحمراء أو تركيز الهيموجلوبين أو على مؤشرات كريات الدم الحمراء. سجلت اثار ذات دلالة معنوية (عند مستوي > 5 بالمائة) في تركيز الجلوكوز بمصل الدم حيث ازاد تركيزه بزيادة نسبة المسكيت في العليقة. رصدت زيادة معنوية في تركيز البلروبين (المريه) الاجمالي و المباشر والدهون الثلاثية في مصل دم صغار الماعز. كما لم تظهر فروق ذات دلالة معنوية (عند مستوي > 5 بالمائة) بين المجموعات في معدل النمو اليومي والوزن النهائي للحيوان. كانت المجموعات التي تغذت على المسكيت الاعلا في استهلاك المادة الجافة والبروتين الطاقة الممتلة بالمقارنة بالمجموعة الضابطة. امتازت العليقة الضابطة بأجود معدل للتحويل الغذائي. بينما المجموعة التي تغذت علي العليقة التي احتوت 10 بالمائة من حبات المسكيت كانت الاعلا في استهلاك المادة الجافة والبروتين وكانت الأحسن في معدل التحويل الغذائي. صممت تجربة من عدد 3 من العجول من نوع كنانة ثبتت عليها أنبوب داخل الكرش على منوال 4×4 أربعة معاملات وأربعة فترات زمنية وغذيت العجول على عليقة مماثلة لتلك التي استخدمت في تجربة صغار

الماعز. لدراسة النظام الايكولوجي ونشاط الكرش تم سحب سائل الكرش خلال فترة التجربة (رقم 2) في (0, 2, 4, 6 و 8 ساعات) بعد الأكل لتعداد الأحياء المجهرية كوحيد الخلية (متعدد الأهداب) والبكتريا الكرش اللاهوائية. وقياس نشاط الكرش برصد تركيز الأس الهيدروجيني بالكرش في فترات زمنية محددة وقياس ونواتج التخمر كالامونيا والأحماض الدهنية الطيارة. كما اجريت (تجربة رقم 3) لتقييم حبات المسكيت باستخدام الاكياس داخل الكرش وفي (تجربة 4). تم التقويم في المعمل بقياس إنتاج الغاز التراكمي أوضحت النتائج عدم وجود فروق في تركيز الأس الهيدروجيني بين المجموعة الضابطة والتي تغذت على حبات المسكيت. كما لم تحدث تغيرات بوسط الكرش نتيجة للمعاملات الغذائية. ولم تؤثر العلائق علي إعداد الكائنات الدقيقة بالكرش. فيما يخص نواتج التخمر في الكرش وجدت فروق معنوية (عند مستوي $5 >$ بالمائة) في تركيز الامونيا بعد ساعتين من تناول العليقة ولم تحدث تأثيرات تذكر علي تركيز الأحماض الدهنية الطيارة. أجريت تجربة الهضم في المعمل لكامل ثمرة المسكيت , البذرة واللب اثبت وجود فرق معنوية عالية في (عند مستوي $1 >$ بالمائة) قيم الغاز المنتج من هذه المكونات بين 3 ساعات إلى 96 ساعة. وكان أعلا إنتاج الغاز بالمل ($11,17 \pm 0,76 - 56,83 \pm 1,7$) من المادة العضوية في اللب وادني في البذرة بقيم ($4,5 \pm 0,50 - 51,67 \pm 0,5$) من المادة العضوية معدل هضم المادة العضوية والطاقة الممتلئة كان الاعلا في اللب ($0,02 \pm 49,86$ و $0,02 \pm 7,29$) بالمقارنة بكامل الثمرة ($0,08 \pm 48,56$ و $0,14 \pm 7,20$). أوضحت تجربة الهضم بالأكياس داخل الكرش لثمرة المسكيت والبذرة ازدياد تحلل المادة الجافة والبروتين لكل من الثمرة و البذرة كلما ازدادت فترة التحضين بالكرش. وجدت فروق ذات دلالة معنوية (عند مستوي $5 >$ بالمائة) في تحلل المادة عند 48 ساعة وكانت الاعلا في الثمرة مقارنة بالبذرة $\pm 67,43$ ($0,43$ مقارنة مع $0,43 \pm 59,29$). اتضح إن تحلل الجزء الذائب (ا) من الثمرة كان الاعلا مقارنة مع البذرة أما تحلل الجزء الغير ذائب (ب) كان الادني في الثمرة بفروق معنوية (عند مستوي $5 >$ بالمائة). خلال كامل فترات التجربة كان تحلل البروتين الخام بنسبة اعلا (عند مستوي $5 >$ بالمائة) في البذرة مقارنة بالثمرة. سجلت الثمرة اعلا معدل تحلل للبروتين الخام في الجزء الذائب والبذرة كانت الاعلا في تحلل البروتين الغير ذائب والبروتين القابل للتحلل (ا , ب). عند معدلات ($8,5,2$ بالمائة) لتدفق السائل من الكرش كانت ثمرة المسكيت الاعلا في درجة التحلل الفاعل (الهضمية). وجد إن تحلل معدل ثمرة وبذرة المسكيت في الأكياس بالكرش مناسب ومشابه للعلائق

التقليدية وله معدلات هضمية بالمعمل جيدة مما يجعله عليقة ملائمة للمجترات. وان تغذية صغار الماعز النوبي بعليقه تحتوي ما نسبته 30% من حبات المسكيت لم تؤثر علي النمو في الحيوان ولا علي بعض مكونات الدم وخصائصه الكيميائية ووظائف الكرش. مما يتيح امكانية التغلب علي نقص المواد العلفية للحيوان بالاستفادة من المسكيت والتخلص من الاثار البيئية السالبة الناجمة من انتشار شجرة المسكيت

