

**UTILIZATION OF BITTER LEAF (*Vernonia amygdalina*) MEAL AS FEED FOR WEST
AFRICAN DWARF (WAD) GOATS**

Abiodun Oluwasesan OLOSUNDE

B.Agric., M.Phil. (Ife)

**THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
DOCTOR OF PHILOSOPHY IN ANIMAL SCIENCE**

**FACULTY OF AGRICULTURE
OBAFEMI AWOLOWO UNIVERSITY
ILE-IFE, NIGERIA
2016**

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

HEZEKIAH OLUWASANMI LIBRARY

POSTGRADUATE THESIS

AUTHORIZATION TO COPY

AUTHOR: Olosunde Abiodun Oluwasesan

TITLE: Utilization of bitter leaf (*Vernonia amygdalina*) meal as feed for West African Dwarf (WAD) Goats

DEGREE: Ph.D. (Animal Science)

YEAR: 2016

I, Olosunde Abiodun Oluwasesan, hereby authorize the Hezekiah Oluwasanmi Library to copy my thesis, in whole or in part in response to request from individual researchers and organizations for the purpose of private study or research.

Date: _____

Signature: _____

CERTIFICATION

This is to certify that this research project titled “Utilization of bitter leaf (*Vernonia amygdalina*) meal as feed for West African Dwarf (WAD) Goats” was carried out by Mr. Olosunde Abiodun Oluwasesan under my supervision in accordance with the partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy (Ph.D.) in Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.

Prof. (Mrs.) S. M. Odeyinka
(Supervisor)
Department of Animal Sciences
Faculty of Agriculture
Obafemi Awolowo University
Ile-Ife
Nigeria

Date

Dr. S. I. Ola
(Head of Department)
Department of Animal Sciences
Faculty of Agriculture
Obafemi Awolowo University
Ile-Ife
Nigeria

Date

DEDICATION

I dedicate this project to the God Almighty who has always been my helper and provider and to my family.

OBAFEMI AWOLowo UNIVERSITY

ACKNOWLEDGEMENTS

I give glory to God, creator of all things who never cease from guiding and protecting me in all my endeavours in life. He deserves all praise and honour for his love, mercy, blessing and every good thing he provided throughout my program in this wonderful school, Obafemi Awolowo University, Ile-Ife.

My profound and sincere gratitude goes to my Supervisor – Prof. (Mrs) S. M. Odeyinka without whose meticulous guidance and constructive instruction, this project would have been unsuccessful.

The assistance of Dr. S. I. Ola, the HOD of Animal Science, Prof. E. B. Sonaiya, Prof. A. O. Aderibigbe, Prof. (Mrs.) O. G. Omitogun, Prof. (Mrs.) O. Matanmi, Dr. J. A. Odedire, Dr. (Mrs.) B. O. Oyebanji, Dr. O. A. Makinde, Dr. T. O. Abegunde, Dr. E. O. Akinfala, Dr. S. O. Oseni, Dr. (Mrs.) I. O. Dudusola, Dr. T. O. Akande, Dr. A. A. Fatufe, Mr. Sola, Mr. Kayode Ogunyemi, Mr. Soji Adeyosoye, Mr. M. A. Lasisi and other members of staff of the Department of Animal Science is greatly acknowledged.

Thanks also goes to the Farm Director, staff of the Goat Units of Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, most especially to Prof. S. A. Ajayi, Prof. A. O. Ajayi, Mr Kelani, and Mr. Deji.

My appreciations also go to Dr. O. J. Oyedele, Director National Biotechnology Development Centre, Ogbomoso and Prof. D. J. Oyedele, Principal Investigator Nican-Veg IDRC Project and other project members for the great support and opportunity given to complete this program.

I acknowledge the invaluable assistance rendered to me in various way by my friends, especially Femi Oloidi, Femi Akinwunmi, Ayandiran Kola, Mayowa Adelekun, Moshud Abiola, Victoria Tanimonure, Vincent Emore, Funminiyi Olatoye, Busayo Oladejo, Lasun Ogundele and the whole household of United English Baptist Church, Falaju, Ile-Ife. I wish you God's favour in all your ways.

My sincere gratitude to my parents: Mr. and Mrs. Olosunde, my Love: Dupe Olosunde and Tantoluwa Olosunde (God's gift) and great family: my lovely brothers and sisters and blessed in laws for their love, care, prayer, patience and their outstanding support during the period of this program. God bless you all.

TABLE OF CONTENTS

CONTENT	PAGE
TITLE PAGE	i
AUTHORIZATION TO COPY	ii
CERTIFICATION	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
PLATES	xiv
ABSTRACT	xv
CHAPTER ONE: INTRODUCTION	1
Statement of Research Problem	4
Objectives of the Study	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1 Goat	5
2.1.1 Origin and domestication of goat	5
2.1.2 Goat distribution in Nigeria	5
2.2 Goat Nutrition	7



2.2.1	Protein requirements	7
2.2.2	Energy requirements	7
2.2.3	Vitamin requirements	9
2.2.4	Mineral requirements	10
2.2.5	Water requirements	11
2.3	Feeding Habits of Goat	12
2.4	Feed Intake of Goat	12
2.5	Forage	13
2.5.1	<i>Panicum maximum</i>	14
2.6	Supplementation	16
2.7	Various Forages and Supplements Fed to Goat	17
2.8	Antinutritional Factors in Forages	22
2.8.1	Mimosine	23
2.8.2	Cyanogens	24
2.8.3	Saponins	24
2.8.4	Phytohemagglutins	28
2.8.5	Tannins	28
2.8.6	Alkaloids	30
2.8.7	Oxalate	32
2.8.8	Phenol	33
2.8.9	Other antinutritional factors (ANFs)	34
2.8.10	The pathological effects of anti-nutritional substance in forage	34
2.9	Techniques to Enhance Feedstuff Utilization	35

2.10	Body Temperature of Goat	37
2.11	Blood of Goat	38
2.12	Bitter Leaf	39
CHAPTER THREE: MATERIALS AND METHODS		47
3.1	Experiment 1: Determination of nutritional composition of processed bitter leaf	47
3.1.1	Laboratory analyses	49
3.1.2	Chemical analysis	49
3.1.3	Determination of antinutritional factors (ANFs)	54
3.1.4	Statistical analysis	57
3.2	Experiment 2: Determination of the optimum level of bitter leaf meal in the diet of West African Dwarf goats for maximal performance	58
3.2.1	Experimental station and the period	58
3.2.2	Animals and housing	58
3.2.3	Veterinary care	58
3.2.4	Processing of bitter leaf meal for WAD goats	58
3.2.5	Diets	59
3.2.6	Management routine	59
3.2.7	Measurements	59
3.2.8	Faeces	61
3.2.9	Chemical analysis	61
3.2.10	Statistical analysis	62
3.3	Experiment 3: Determination of the hematological characteristics and	

blood chemistry of WAD goats fed graded levels of bitter leaf meal	63
3.3.1 Blood components	63
3.3.2 Statistical analysis	65
3.4 Experiment 4: Determination of the carcass characteristics of WAD goats fed graded levels of bitter leaf meal	66
3.4.1 Carcass evaluation	66
3.4.2 Statistical analysis	66
CHAPTER FOUR: RESULTS	67
4.1 Experiment 1: Determination of nutritional composition of processed bitter leaf	67
4.1.1 Chemical composition of processed bitter leaf	67
4.1.2 Antinutritional composition of processed bitter leaf	67
4.1.3 Mineral composition of processed bitter leaf	70
4.2 Experiment 2: Determination of the optimum level of the bitter meal in the diet of West African Dwarf goats for maximal performance	72
4.2.1 Chemical composition of bitter leaf meal and <i>Panicum maximum</i>	72
4.2.2 Chemical composition of experimental diets	72
4.2.3 Feed consumption	72
4.2.4 Digestibility trials	77
4.2.5 Weight gain of experimental weaner goats	79
4.2.6 Feed conversion ratio	79
4.2.7 Percentage mortality	81
4.3 Experiment 3: Determination of the hematological characteristics and	



blood chemistry of WAD goats fed graded levels of bitter leaf meal	82
4.3.1 Blood component	82
4.3.2 Serum biochemistry	86
4.4 Experiment 4: Determination of the carcass characteristics of WAD goats fed graded levels of bitter leaf meal	88
4.4.1 Carcass characteristics	88
CHAPTER FIVE: DISCUSSION	91
5.1 Experiment 1: Determination of nutritional composition of processed bitter leaf	91
5.1.1 Chemical composition of processed bitter leaf	91
5.1.2 Antinutritional composition of processed bitter leaf	92
5.1.3 Mineral composition of processed bitter leaf	92
5.2 Experiment 2: Determination of the optimum level of the bitter meal in the diet of West African Dwarf goats for maximal performance	94
5.2.1 Chemical composition of bitter leaf meal and <i>Panicum maximum</i>	94
5.2.2 Chemical composition of experimental diets	94
5.2.3 Feed consumption	94
5.2.4 Digestibility trials	95
5.2.5 Weight gain of experimental weaner goats	96
5.2.6 Feed conversion ratio	98
5.2.7 Percentage mortality	98
5.3 Experiment 3: Determination of the hematological characteristics and blood chemistry of WAD goats fed graded levels of bitter leaf meal	100



5.3.1	Blood component	100
5.3.2	Serum biochemistry	101
5.4	Experiment 4: Determination of the carcass characteristics of WAD goats fed graded levels of bitter leaf meal	105
5.4.1	Carcass characteristics	105
CONCLUSION		106
LIST OF REFERENCES		107-141

OBAFEMI AWOLowo UNIVERSITY

LIST OF TABLES

Table	Title	Page
1.	Livestock population in Nigeria	6
2.	Nutrient requirements of goats	8
3.	Conventional and Alternative sources of Ingredients for Livestock in Nigeria	18
4.	Normal haematological profile of ruminants	40
5.	Composition of experimental diets	60
6.	Chemical composition of processed bitter leaf	68
7.	Antinutritional factors of processed bitter leaf	69
8.	Mineral composition of processed bitter leaf	71
9.	Chemical composition of bitter leaf and <i>Panicum maximum</i>	73
10.	Chemical composition of diets fed to experimental goats	74
11.	Mean dry matter and nutrient intakes (g/day) of goats fed experimental diets	75
12.	Apparent digestibility coefficient of the dry matter and nutrients Intake (g/day) of goats fed experimental diets	78
13.	Performance characteristics of the experimental goats	80
14.	Haematological parameters of WAD goats fed different levels of bitter leaf meal	83
15.	Blood glucose levels of WAD goats fed different levels of bitter leaf meal	84



16.	Serum biochemistry of WAD goats	87
17.	Carcass characteristics of experimental weaner goats	89
18.	Carcass characteristics of experimental weaner goats in percentages	90

OBAFEMI AWOLOWO UNIVERSITY

LIST OF FIGURES

Figure	Title	Page
1.	Blood glucose levels of WAD goats fed different levels of bitter leaf meal	85

OBAFEMI AWOLowo UNIVERSITY

PLATES

Plate	Title	Page
1.	Bitter leaf site at Teaching and Research farm, Obafemi Awolowo University, Ile-Ife	48

OBAFEMI AWOLOWO UNIVERSITY

ABSTRACT

This study investigated the nutritive value of bitter leaf meal, optimum level of offer of bitter leaf (*Vernonia amygdalina*) meal (BLM) to West African Dwarf (WAD) goats, the haematological characteristics, blood chemistry and carcass characteristics of WAD goats fed graded levels of bitter leaf meal. This was with a view to assess the nutritive value of bitter leaf meal as a feedstuff for West African Dwarf goats.

In a 20-week trial, twenty four West African Dwarf (WAD) goats of both sexes, 5-7 months old, were randomly allotted to four treatments of graded levels of BLM (0% BLM (Control diet/CD), 15% BLM, 30% BLM and 45% BLM diets) in a completely randomized design to determine the utilization of bitter leaf meal as feed for West African Dwarf goats. The diets served as supplements to a basal ration of guinea grass (*Panicum maximum*). Growth and digestibility trials lasted for 20 weeks. Two digestibility trials were carried out. Feed and faeces collected were subjected to chemical analysis to determine proximate components. Data obtained were statistically analyzed with the General Linear Model and significant means were separated using the Duncan's Multiple Range Test.

Processing methods had significant ($P < 0.05$) effect on the proximate, antinutritional and mineral composition of the bitter leaf meal. Comparison of the chemical composition of bitter leaf meal (BLM) and *Panicum maximum* (PM) revealed higher dry matter, crude protein, ether extract and ash content in bitter leaf meal. However, PM had higher crude fibre, nitrogen free extract and organic matter content. The mean daily dry matter intake (DMI g/day) was not significant but higher ($P > 0.05$, $F_{\text{cal}} (0.55) < F_{\text{tab}} (3.10)$) in goats fed 30% BLM than goats on 45% BLM, CD and 15% BLM. The apparent digestibility coefficient of the crude protein, crude fibre, ether extract, nitrogen free extract and ash were significantly ($P < 0.05$) affected by the

inclusion levels of bitter leaf meal. The digestible ether extract intake and digestible organic matter of goats fed CD were significantly ($P < 0.05$, $F_{\text{cal}} (20.14) > F_{\text{tab}} (3.10)$), ($P < 0.05$, $F_{\text{cal}} (7.88) > F_{\text{tab}} (3.10)$) higher than the values obtained for goats fed 45% BLM, 15% BLM and 30% BLM diets. The average daily weight gain (g/day) for goats on CD was significantly ($P < 0.05$, $F_{\text{cal}} (8.61) > F_{\text{tab}} (3.41)$) higher than that of others. The analysis of blood components, red blood cell (RBC), white blood cell (WBC) and packed cell volume (PCV) counts showed that there were no significant differences ($P > 0.05$) in each of these parameters among the goats fed experimental diets. The result of the serum glucose of goats fed 30% BLM and 45% BLM was significantly ($P < 0.05$, $F_{\text{cal}} (3.84) > F_{\text{tab}} (2.92)$) lower than that of CD. There were no significant differences ($P > 0.05$) in the parameters used in determining the carcass characteristics except in the lung %. The lung weight (%) of animals fed CD diet was significantly ($P < 0.05$, $F_{\text{cal}} (8.69) > F_{\text{tab}} (6.59)$) higher than that of 15% BLM and 30% BLM.

It was concluded that bitter leaf meal could be included in the diets of WAD goats up to 15% without any deleterious effect.

CHAPTER ONE INTRODUCTION

One of the major problems confronting the small ruminant production is the non availability of feed all year round to meet the maintenance and productive requirements of the animals. Solomon *et al.*, (2007) reported that the major problems confronting the development and expansion of livestock industries in developing countries are the reduced supply, high demand, and prohibitive cost of feeds and feed stuffs especially protein source. Although, grasses abound in the tropics, seasonal changes which affect their palatability and nutritive value had been a major problem in ruminant animal production (Alokan, 1998). This seems to be a great concern to researchers (Huston *et al.*, 1993) in the tropics because the availability of good quality grasses during the dry season is difficult (Onwuka, 1986). Babayemi (2007) stated that in the tropics, ruminants are raised mainly on grasses, which are poor in nutrients and digestibility coupled with scarcity during the dry season (Odeyinka, 2014).

Poor productivity and high mortality of stock, which characterize this industry is largely explained by the inadequacy of feeding the right quantity and quality of feeds to the various livestock species (Odeyinka *et al.*, 2003; Ayandiran *et al.*, 2013). Rearing of small ruminant animals in urban areas further compounded the problems and makes the use of concentrate diets more reasonable where lots of agro industrial by products and agricultural residues are generated. In Nigeria, utilization of crop residues, agro-industrial by-products and non-conventional feed resources are still at infancy process because of great competition between human and livestock for the resources, and these have greatly reduced the animal protein intake (Odeyinka *et al.*, 2003). The unprecedented increase in the cost of conventional ingredients (e.g. maize) used in compounding livestock feeds has necessitated intensive investigations into the use of agricultural and agro-industrial

by-products, leguminous fodder trees and shrubs which are regarded as non-conventional feed sources (Hamzat and Babatunde, 2001; Mousa, 2011). Asaolu and Odeyinka (2006) suggested that the nutritive value of these feedstuffs should be computed for use in local feed ration formulation since their cost is low enough for local farmers to afford.

Ruminants play an important role in the livelihood of farmers in the developing world, it provides sustenance as milk and meat, animal traction, manure for crop production and energy, cash income from sales of their products and readily available asset to face risks and misfortune in harsh environments (Ørskov and Vigilizzo, 1994). Ruminants have been shown to be able to make contributions to waste management both as consumers and producers. The goat's digestive tract allows it to process many products which would otherwise be considered wastes, and turn those materials into high quality food and/or fiber. The utilization of crop residues and processing by-products is an accepted practice and has been well documented in the literature (Sempeho, 1987; Abdelhamid and El-Ayoty, 1988; Gasa *et al.*, 1989; Serrano, 1989; Smith, 1989; Guessous *et al.*, 1991; Snyman, 1991).

The feeding of selected waste materials to goat has the potential of reducing the burden placed on landfills while converting the waste materials into added value products such as meat, milk, fiber and manure. The use of maize dietary fibre source in most parts of animal producing areas of Nigeria has pushed up its price, thereby necessitating a search for a cheaper and locally available alternative such as leaf from trees and shrubs. This challenge has become more imperative since the developed countries are now diverting their abundant grain reserves, hitherto used for feeding livestock to the production of biofuels to propel their huge industrial sector (Chauynarong *et al.*, 2009). The rising trend in tree planting can be mutually beneficial to both small ruminants and

the environment at large. Leaf of the trees can be used to feed goats and sheep as protein supplements all year round while the wastes accruing from the animals can as well be used as organic manure for the trees. Tropical trees are highly nutritive and rich sources of protein and minerals (Teferedegne, 2000; Babayemi *et al.*, 2004). Many leguminous fodder trees and shrubs have high protein levels and are potentially promising supplements to overcome nutrient deficiencies provided anti-nutritional factors as tannins and other secondary compounds can be controlled (Mousa, 2011).

Bitter leaf (*Vernonia amygdalina*) is a drought tolerant shrub with petiole leaf of about 6mm diameter. It has a characteristic odour and bitter taste and grows under a range of ecological zones in Africa with large mass of forage for both human and animal nutrition (Bonsi *et al.*, 1995). The leaves are used for human consumption, suggesting that the excess may be utilized as feed (Daodu and Babayemi, 2009). Ekeocha (2011) reported that on average the chemical composition of bitter leaf appeared to be suitable as a protein concentrate for ruminants, a suitable replacement for *Gliricidia* and *Leuceana* species. El Hassan *et al.* (2000) concluded that some of the multipurpose leguminous trees (MPT) such as bitter leaf, may prove to be useful dietary supplements for ruminants feeding considering their chemical composition. A special attention should be given to efficient integration of multipurpose fodder shrubs and trees as fodder bank in feeding calendars of sheep and goats under harsh climates (Ben Salem *et al.*, 2004). Kabirizi and Ejobi (2005) reported that goats have developed a mechanism of feeding on indigenous fodder trees and shrubs (IFTS) forage like bitter leaf without treatment and the feeding of it in mixtures helps to overcome possible side effects that could result from feeding species, known to be poisonous in large quantities

. For more information, please contact ir-help@oauife.edu.ng

OBAFEMI AWOLOWO UNIVERSITY