بسم الله الرحمن الرحيم

Sudan University of Science and Technology
Graduate Studies College

Performance of Broiler Chicks Fed graded levels of Moringa Oleifera Leaves in Finisher Diet

الأداء الأنتاجى للدجاج اللأحم عند إضافة مستويات متدرجه من أوراق المورينقا الى علائق النأهى

by : Amal Mahmoud Malik Mahmoud
Sudan University College of Animal Production Science and Technology(2009).
A Thesis Submitted in Partial Fulfillment for the Degree of M.Sc in Tropic Animal Production

Supervisor . Prof .Intisar Yousif Turki

April 2015

PREFACE

بسم الله الرحمن الرحيم

قال تعالى:

(أولم يروا أنا خلقنا لهم مما عملت أيدينا أنعما فهم لها مالكون * وذللناها لهم فمنها ركوبهم ومنها ياكلون * ولهم يها منافع ومشارب أفلا يشكرون)

صدق الله العظيم
سورة يس
الايات(71 – 73)

DEDICATION

To: My Parents

For your Loving and Support

My Brothers and Sisters

My Friends and colleagues

With love

AKNOWLEDGEMENT

I commend to express my fully thanks to Allah firstly, who gave me the health and patience to conduct this study.

I am in debt of gratitude to many who have helped me to make this work possible . I would like to express my appreciation to my supervior, Professor Intisar Yousif Turki , for her supervision suggestions, un-numerable helps, encouragement, advice and patience. I would like to offer my sincere thanks to university professors staff in graduate studies college for offering their experiences, suggestions and the tannery for the study work.

Abstrat:

This study was conducted to investigate the effect of added graded levels of Moringa Oleifera Leaf (MOL), as a protein source in poultry diets .90 one-day old commercial broiler chicks (Ariorikdt) were used . They are reared in open shade house for 28days fed the starter diet.

At the finisher period chicks were distributed randomly in to 3 group according to similar live body weight. Three experimental finisher diets contain graded level of MOL (0% 8% and 10%) were formulated and randomly signed to group A, B and C, respectively. Birds were managed under the dip litter system of three groups Each experimental groups contained 30 chicks divided in to three replicates of 10 chicks per each. The daily weight gain , daily feed intake, feed conversion ratio(FCR) and mortality rate were taken recorded throughout the experimental period. Results showed that there was a significant differences ($p \leq 0.05$) among the experimental groups. Group A recorded a higher value of daily consumption feed of (145)g followed dy group B (119.88)g and group C (89.21)g. while FCR followed the same treand the vaule were (1.96)g , (2.08)g and (1.48)g for group A ,B and C respectively. No significant difference ($p> 0.05$) was observed for daily weight gain and mortility rate. Therefore the inclusion of Moringa Oleifera Leaf as protein supplement in broiler diets appared the 10% inclusion level is the best and was improved the FCR and reduced the daily feed intake with similer daily weight gain compared to groups.

مـلخص الدراســـــه

أجريت هذه التجربه لدراسه أثر أضافة أوراق المورينقا كمصدر للبروتين على الأداء الانتاجى للدجاج الأحم . أستخدمت 90 كتكوت من سلالات اريوريكدت خضعت لنظام رعايه دقيق وزعت الكتاكيت عشوائياً الى ثلاث معاملات تحتوى على (0%، 8% ، 10%) مورينقا في تصميم كامل العشوائية . تمت تغذيه جميع الكتاكيت على علائق البادى لمدة 28 يوم. بعدها قسمت الكتاكيت الى ثلاث مجموعات متماثلة وفقا لوزن الجسم الحى كل مجموعة تحتوى على 30 طائر مقسمه على ثلاث تكرارت كل تكرار يحتوى على 10 طيور خلال فترة التجربه حيث كانت تتغذاء على علائق الناهى التى تحتوى على مستويات مختلفه من المورينقا اوليفيرا. تم تسجيل كمية العلف المستهلك اليومى ، معدل الزيادة الوزنية اليوميه ،معدل لتحويل الغذائى ومعدل النفوق.

كانت النتائج كالاتى لاتوجد فروق معنويه ($p>0.05$) فى الوزن المكتسب فى كل المعاملات وتوجد فروق معنويه ($p\cdot 0.05$) فى كل من العلف المستهلك حيث سجلت مجموعة (أ) 0% اعلا معدل استهلاك (145)جرام/يوم تليها المجموعه " ب" 8% (119.88)جرام/يوم والمجموعه "ج" 10% (89.21)جرام/يوم تبعه معدل التحول الغذائى حيث كانت قيمته كالاتى (1.48 ، 2.08 ، 1.96)جرام/يوم للمجموعات أ، ب و ج على التوالى، لم يلاحظ اى فرق معنوى فى لمعدل النفوق. وبالتالى فأن ادراج اوراق المورينقا فى علائق الدواجن بمستوى 10% هو افضل لتحسين معدل التحويل الغذائى وتخفيض معدل استهلاك العلف مع الحصول على نفس الزيادة الوزنيه.

LIST of CONTENTS

CHAPTER

ONE

INTRODUCTION

Poultry production plays a major role in bridging, the protein gap in developing countries where average daily consumption is far below recommended standards However , the productivity of poultry in the tropics has been limited by scarcity and consequent high prices of the conventional protein and energy sources. Protein sources are especially limiting factors in poultry feed production in the tropics (Atawodi et al., 2008). It has caused a problem of high priced feed as well as insufficient nutrition. A significant proportion of poultry diets high-priced, cakes is imported and locally made, is utilized to help decreasing the costs. Researchers are therefore looking for cheap, available, and safe alternative sources of protein and energy. In addition, scientists are also searching for natural antimicrobial ingredients. Some tropical legumes and plants were introduced into poultry diets as protein sources to decrease the cost of the feed. Recent studies report that some herbs, spices, and extracts may have antimicrobial, coccidiostatic, and anthelminthic properties.

Moringa Oleifera is a tree with many uses and of great economic importance, found throughout most of the tropics. It was incorporated into the poultry diet by nutritionists to examine its effects on broilers, weaner rabbits and laying hens productive performance Melesse et.al.,(2009).

The moringa is a fast growing plant widely available in tropics and subtropics with several economic-important industrial uses and is a native food in Southeast Asia. The moringa leaves have been known to be effective for certain medicinal purposes.

Dietary supplementation of Moringa Oleifera leaves might have increased immune ability of broilers. Thus, leaf meal from both *Moringa stenopetala* and *Moringa oleifera* might be potential feed additives in livestock production, (Du et al. 2007).

Moringa Leaf diets don't serve only as protein source but also provide some necessary vitamins, minerals and oxycaretenoids which cause yellow color of broiler skin, shank and egg yolk, (D'Mello et al.,1987; Fasuyi et al., 2005). Apart from these nutritional constituents, Moringa leaves are known to contain phenols, anti-nutritional factors such as tannins, saponins, phytate and oxalate (Gupta et al., 1989).

Among various types of Moringa species, *Moringa Oleifera, Moringa Stenopetala* are the most economically important species. It is used as vegetable food for human consumption and animal feed resources during dry period . The edible parts of the Moringa tree are exceptionally nutritious (Rams, 1994; Teketay, 2001). Leaf parts are promising as a feed source in the tropics because the tree is full of leaves during the dry season when other feeds are typically scarce . The leaf of Moringa could be used as a protein supplement for poultry its Provide an alternative diet of conventional feed its available and cheap instead of concentrates imported.

The present study is thus designed to evaluate the Nutritive value of Moringa Oleifera leaf . Also to evaluate the economical impact of feeding MOL as protein sources added to finisher diet and determine its effect on performance of broiler chicks.

CHAPTER

TWO

CHAPTER TWO

2. LITERATURE REVIEW

2 -1 Background of the moriga tree:

Moringa oleifera is indigenous to Northwest India (Ramachandran et al., 1980). At present it is widely distributed in the tropics throughout the Pacific region Aregheore (2002). West Africa (Freiberger et al., 1998; Lockett et al., 2000), as well as Central America and the Caribbean (Ramachandran et al., 1980; Foidl et al., 1999). The most frequently common names in the pacific are variants of malunggai, kalamunggai or Katdes Sajina and Benaile . English common name include Drumstick tree (describing the shape of its pods), Horseradish tree (describing the taste of its roots) , Bennoil and Alrwag tree in sudan(water purification). And it was utilized by the ancient Romans, Greeks and Egyptians. It is a typical multipurpose tree of significant economic importance because there are several industrial and medicinal applications and various products to be used as food and feed which can be derived from its leaves and fruits (Ramachandran et al., 1980).

Moringa is one of the most useful tropical trees. The relative ease with which it propagates through asexual means and its low demand for soil nutrients and water after being planted make its production and management easy. Introduction of this plant into a farm which has a biodiverse environment can be beneficial for both the owner of the farm and the surrounding eco-system.

2-2 Morphology and physical characteristics:

Moringa is a fast growing, perennial tree which can reach a maximum height of 7-12 m and a diameter of 20-40 cm at chest height(Morton, 1991).

2 -2 -1 Stem and Branch :

The stem is normally straight but occasionally is poorly formed. The tree grows with a short straight stem that reaches a height of 1.5 - 2m before it begins branching but can reach up to 3.0 m. The extended branches grow in a disorganized manner and the canopy is umbrella shaped(Morton, 1991).

2 -2 -2 Leaves:

The alternate twice or thrice pinnate leaves grow mostly at the branch tips. They are 20-70 cm long, grayish-downy when young long petiole with 8-10 pairs of pinnae each bearing two pairs of opposite elliptic or obovate leaflets and one at the apex all 1-2 cm long with glands at the bases of the petioles and pinnae (Morton, 1991).

2 – 2 – 3 Flowers:

The flowers which are pleasantly fragrant and 2.5 cm wide are produced profusely in axillary drooping panicles 10 to 25 cm long. They are white or cream colored and yellow-dotted at the base. The five reflexed sepals are linear-lanceolate. The five petals are slender-spatulate. They surround the five stamens and five staminodes and are reflexed except for the lowest (Morton, 1991).

2 -2- 4 Fruits and Seeds:

The fruits are three lobed pods which hang down from the branches and are 20-60 cm in length. When they are dry they open into 3 parts. Each pod contains between 12 and 35 seeds.

The seeds are round with a brownish semi-permeable seed hull. The hull itself has three white wings that run from top to bottom at 120-degree intervals. Each tree can produce between 15.000 and 25.000 seeds/year. The average weight per seed is 0.3 g and the kernel to hull ratio is 75 : 25 (Makkar and Becker, 1997).

2 -3 Uses of Moringa Oleifera tree:

It is considered as one of the world's most useful trees, as almost every part of the Moringa tree can be used for food, medication and industrial purposes (Khalafalla et al., 2010). People use its leaves, flowers and fresh pods as vegetables while others use it as livestock feed (Anjorin et al., 2010). This tree has the potential to improve nutrition, boost food security and foster rural development all of the parts of the tree can be used in a variety of ways. Moringa is full of nutrients and vitamins and is good in your food as well as in the feed of your animals. Moringa helps to clean dirty water and is a useful source of medicines. It provides lots of leafy material that is useful when using alley cropping systems(Hsu, 2006).

One of the most important industrial applications is the use of Moringa seeds for water-cleaning purpose (Kalogo et al., 2001; Broin et al., 2002). Oil obtained from Moringa seeds is used for cooking and was found to contain high levels of unsaturated fatty acids (Lalas and Tsaknis, 2002).

2-4 Nutritine value of moriga plant:

Leaves and seeds of Moringa represent an important source of nutrients for rural populations in certain areas of India and West Africa (Lockett et al., 2000). Most reports indicate that Moringa leaves (ML) are rich in protein and present an amino acid composition, which is suitable for human and animal nutrition (Makkar and Becker, 1996; Freiberger et al., 1998). High biomas production of Moringa of over 100 tans of dry matter (DM)/hectare can be achieved under intensive farming conditions (Foidl et al., 1999). Therefore, there is a need to make proper use of the protein-rich residual materials from plantations and from the extraction of carotenes or growth promoting components. Previous studies indicated that both unextracted ML and ethanol-extracted ML (800 ml of aqueous ethanol per litre) had high content of crude protein (CP. Although, Moringa may contain certain amounts of antinutritional factors like tannins and saponins (Makkar and Becker, 1997; Oliveira et al., 1999).

Recently, a high degree of renewed interest was placed on the nutritional properties of Moringa in most countries where it was not native (Reyes et al., 2006; Oduro et al., 2008). This could be due to the claims that it increases animal productivity as it has nutritional, therapeutic and prophylactic properties (Fahey, 2005). Studies from other countries indicate that the leaves have immunse nutritional value such as vitamins, minerals and amino acids (Anwar et al., 2007). It is good source of good cholesterol which is known to protect against cardiovascular diseases. as such, the leaves have been used to combat malnutrition, especially among infants and nursing mothers.

Chemical composition of unextracted and extracted Moringa leaves:

Type of leaf	Extracted leaves	Unextracted leaves
Crude protein%	43.5	25.1
Lipid%	1.4	5.4
Ash %	10.0	11.5
NDF %	47.4	21.9
ADF%	16.3	11.4
ADL%	2.2	1.8
Gross energy (MJ/Kg DM)	17.7	18.7

source: fuglie(1999).

2-5 Human consumption of Moringa:

The young leaves are edible and are commonly cooked and eaten like spinach or used to make soups and salads. They are an exceptionally good source of provitamin A vitamins ,B and C minerals (in particular iron), and the sulphur- containing amino acids methionine and cystine **(**Becker and Makkar, 1995) **.**

. **Mineral contents of Moringa leaves from different agroclimatic origins**

Mineral (g \kg DM)	Nicaragua	India	Niger
Calcium	17.5	26.4	13.9
Phosphorus	1.16	1.36	1.22
Magnesium	0.11	0.11	0.11
Sodium	1.16	2.73	2.61
Potassium	19.1	21.7	18.4
Iron	582	175	347
Magense	47.1	51.8	113.9
Zinc	13.5	13.7	24.2
Copper	11.2	7.1	10.6

(Becker and Makkar, 1995).

The young green pods are very tasty and can be boiled and eaten like green beans. The pods are best for human consumption at the stage when they can be broken easily without leaving any visible strings of fibre. These are rich in free leucine. The seeds must first be boiled for a few minutes to remove the fine transparent hull and the water drained before they are eaten. Seeds should be eaten green before they change color to yellow. The hull is not desirable as food because it tastes bitter **(**Becker and Makkar, 1995).

The dry seeds can be ground to a powder and used for seasoning sauces. The roots from young plants can also be dried and ground for use as a hot seasoning base with a flavor similar to that of horseradish. This is why the Moringa tree has been given the name "Horseradish Tree" (Delaveau and Boiteau, 1980). A tasty hot sauce from the roots can also be prepared by cooking them in vinegar. The flowers can be eaten after being lightly blanched or raw as a tasty addition to salads. The resin from the trunk of the tree is also useful for thickening sauces.

2-6 Uses Moringa for Animal diets:

Agood alternative seems to be the use of fodder trees and shrub forages of moringa. Moringa has proven to be a valuable supplement for animals. Moringa Oleifera has 23% CP in DM, 12.3 MJ ME/kg DM and in fresh leaves (Becker, 1995). Supplementing *B. brizantha* hay (BBH) with Moringa significantly increased milk production from 3.1 to 4.9 and 5.1 kg\day when feeding BBH hay alone or with 2 kg or 3 kg\DM of Moringa, respectively. Supplementation with Cratylia increased milk production from 3.9 to 5.1 and 5.7 kg\day for sorghum silage alone and supplementation with 2 kg and 3 kg\DM of Cratylia, respectively. Milk composition and organoleptic characteristics were not significantly affected by feeding Moringa.The digestibility of DM, crude protien (CP) and neutral detergent fiber (NDF) increased($P<0.05$) in the diets supplemeted with moringa compared to BBH alone (Nadiar, 2006).

Sarwatt et.al.,(2002) studied the effect of substituting Moringa Oleifera Leaf meal (MOLM) for cottonseed cake (CSC) on milk yield and composition of cross bred cows fed napier grass (*Pennisetum purpureum*) as basal diet.

They recorded that when CSC was substituted with MOLM milk yield was significantly($p \leq 0.05$) increased. There were no effects of substituting CSC with MOLM on total solids, fat, milk protein and ash contents of the milk. MOLM had higher DM (820 g/kg) than CSC (697 g/kg DM). DM degradability of MOLM was higher than CSC. It is concluded that up to 1.65 kg DM of MOLM could substitute for 1.23kg CSC in dairy cow diets without affecting the milk yield. For best performance a combination of the two with lower levels of MOLM gave higher milk yield than anther protein source fed alone.

Adeniji et.al.,(2012) studied effects of replacing groundnut cake with Moringa Oleifera Leaf Meal (MOLM) in the Diets of grower rabbits at 0, 20, 40, 60, 80 and 100%. Results showed significant difference ($P<0.05$) between the treatments. Weight gain values increased from the control diet up to the rabbits on 60% Groundnut cake replaced with Moringa Oleifera leaf meal and there after began to decrease. There was also significant effect of treatment ($P<0.05$) on the cost of feed per kg. The cost of feed decreased as more Moringa oleifera replaced groundnut cake in the diets. Profit, gross profitability and feed cost efficiency increased as more Moringa Oleifera replaced Groundnut cake in the diets. There was high nitrogen digestibility among the treatment although was not significantly different.

2 – 7 Uses of moriga in poultry diets:

Some plant leave as well as Moringa leave have been used as feed stuffs for poultry and rabbit as a supplement or partial substitute for the conventional cereal grains and forages.

Oluglcemil et.al.,(2010) He studied the effect of adding the moringa cassava leaves meal on broiler performance and assessment of growth and blood chemistry when feeding levels of (0%, 5%, 10%, 15%). It concluded that the rate of addition 5% can be used in the finisher diet without any adverse impact on the growth, blood chemistry or carcass characteristics .

Melesse et.al.,(2009). investigated The effects of Moringa stenopetala leaf meal (MSLM) on nutrient intake and weight gain of chicks . the experimental diets contained MSML at a rate of 2% (T2), 4% (T3), and 6% (T4) of the diets (as fed basis) to replace 3%, 5.9% and 8.8% of the crude protein (CP) of the control diet. The results showed that the daily feed, dry matter and CP intake of the chicks fed MSLM diets were higher ($p<0.05$) than those fed the control diet. Average weight gain (AWG) of birds fed MSLM diets were higher ($p<0.05$) than those fed the control diet. Chicks fed 6% showed higher ($p<0.05$) AWG than those on 2% and 3%. Feed efficiency ratio and protein efficiency ratio were higher for chicks fed MSLM. MSLM elicited no deleterious effects in the birds. The results indicated that MSLM is a potential plant protein supplement and could be included to 6% in the diet of grower chicks to substitute expensive conventional protein sources.

Gadzirayi.et.al.,(2012). tested to the effects of supplementing soyabeans with Moringa oleifera leaf meal, as a protein source in poultry production. The experimental diets contained (0%, 25%, 50%, 75%, 100% Moringa Oleifera Leaf). Results were recored . no significant differences ($p<0.05$) amount of experimental group white significant differences in feed conversion ratios were noted. It was therefore concluded that inclusion of Moringa oleifera meal as protein supplement in broiler diets at 25% inclusion level produces broilers of similar weight and growth rate compared to those fed under conventional commercial feeds.

Banjo.(2012) determined the impact of adding the moringa leaves meal in broiler diets added various levels of moringa at (0%, 1%, 2%, 3%) . the results showed that there is a difference significant ($P > 0.05$) in weight gain for diet 2% and there were no significant differences in both feed in take and food conversion rate.

A study by (Soad. 2010) to assess the impact of feed Moringa Oleifera on the broiler growth performance and carcass characteristics and digestibility of food ingredients has been done. added at Moringa Oleifera Meal %(0, 2, 4, 6). The trial results indicated that there were significant differences ($P>0.05$) between the tested groups in the final body weight, weight gain, feed conversion rate of Moringa Oleifera as well as carcass weight, chest and abdominal fat. No moral significant ($P < 0.05$) differences between the groups tested in cutting carcass and no differences in moral factor of digestion of feed ingredients and feed intake and protein conversion rate. and proven results in this experiment it can add Moringa Oleifera leaf meal on Bush even 6% positive impact on the performance of broiler growth and carcass quality.

CHAPTER

THREE

Chapter (three)

MATERIALS AND METHODS

3-1 Experimental site and date

The experiment was carried out at poultry farm in Sudan University, Faculty of Animal Production Science and Technology, at winter from 24/12/2013 - 5/2/2014. The ambient temperature ranges between 18 °C and 30 °C throughout the experimental period.

3-2 Collection and processing of sample

Moringa Oleifera Leaves(MOL) harvested from farm at early flowering stage at Khartoum State. Stem and branches will be cut from Moringa trees and spread out under the shade to dry naturaly at 35 °C for 3-5 days. The leaves have been removed by hand (manually) and grounded into powder by milling using a locally made miller machine.

3 -3 experimental Birds

90 one day old commercial broiler ckicks (ariorikdt) purchased by domestic poultry co. Ltd were used. They were selected on basis of uniform live body weight of an average live body weight 40g. They were reared to 42 days of age in large open sided house as expermental period. . Birds were managed under the dip litter system of three groups Eash expermental groups contained 30 chicks divided in to three replicates of 10 chicks per each using the complete randomized design (CRD).

3 -4 experimental Houses

The house was constructed of brick wall 50cm height. The rest of the wall to the ceiliy was made of wire netting on all sides .The roof was made of corrugated iron sheets supported with iron posts. The open sided house was portioned in 24 small (1*1) meter separated from each other by wire netting.

3 -5 Experimental feeds:

They are reared in open shade house for 28days fed the starter diet. At the finisher period chicks were distributed randomly in to 3 group according to similar live body weight. Three experimental finisher diets contain graded level of MOL (0%, 8% and 10%) were formulated and randomly signed to group A, B and C, respectively. Birds in subjected to the same management procedures including all vaccination and medication programs recommended for broilers and provision for *ad labium* feeds and water. The chemical composition of dietary treatments were obtained in (Table 3 - 2).

Table(3-1) chemical analysis of MOL(%) used in this study :

DM	CP	CF	EE	ASH	NFE	NDF	PDF	ADL	Ca	P
90.5	29.88	16.27	6.58	7.35	30.42	11.44	8.68	1.84	2.507	O.3639

Table(3 -2) The chemical composition of the diet Finisher:

Level of MOL % / Ingredient%	0%	8%	10%
Sorghum	69	68	68
Groundnut cake	22.5	14	13
Moringa Oleifera Leaf	0	8	10
Concentrate	5	5	5
Oil	1.59	1.59	1.59
Limestone	1.0	1.41	1.41
Dicalcium phosphate	1.0	1.4	1.4
Lysine	0.10	0.4	0.4
Methaionine	0.04	0.2	0.2
Solt	0.2	0.3	0.3
Mycotoxine	0	0.3	0.3
Total	**100**	**100**	**100**
Diets content%			
Energy kcal\kg	3212.1	3178.2	3208.3
Crude protein %	21.39	19.66	19.80
Crude fiber %	3.59	4.31	4.57
Calcium %	1.21	1.41	1.46
Phosphor %	0.72	0.65	0.65
Lysine %	1.43	1.30	1.29
Methaionine %	0.58	0.53	0.53

3 -6 experimental proudure

Before use the house watering and feeding equipments were cleaned and disinfected with appropriate disinfectants prior to the commencement of the experiment. Chicks were vaccinated against Newcastle and Infectious Bronchitis Diseases on the 18^{th} and 28^{th} days, respectively. at 28 day old, the Birds were vaccinated against Gambaro disease . then leg-tagged and 10 chicks were randomly assigned to each of the 3 replicates of the 3 treatment diets. They were kept in a deep litter housing system with concrete floors. Wood shavings were used as litter at a depth of 5 cm. Each day a measured amount of feed was offered to birds. daily offer of each group was 10% more than intake of the previous day and fresh clean water wa s available at all times. daily feed refusals in each pen was collected weighed and recorded at mornig before feed was offered. Mortality and any abnormality were recorded throughout the entire experimental period. Body weight was taken at the beginning of the experiment and subsequently on a weekly basis. weighting of the chicks was carried out in the morning between 7:00 and 9:00am before the feed was offered. Weight gain, feed intake, feed conversion Ratio and feed efficiency ratios were calculated.

3 -7 Chemical composition of experimented diets:

Dry matter, crude fiber (CF) and ash were determined according to AOAC (1990). Dry matter content of feed offered and refused was determined by drying the samples at 105oC overnight. Ash was determined by combusting the sample at 550oC for 5 hrs. Total nitrogen was determined using the micro-Kjeldahl method. Crude protein (CP) was calculated as N x 6.25. The ME values were calculated indirectly from the ether extract, crude fiber and ash adopting the equation

proposed by Wiseman (1987). The concentration of calcium was analyzed using an atomic absorption spectrophotometer. Phosphorus was determined by continuous flow auto-analyzer (Chemlab, 1978). All samples were analyzed in duplicates at the Khartoum university animal production college Laboratory.

3 – 8 Statistical analysis:

Data were subjected to analysis of variance (ANOVA) for completely randomized designs consisting of three treatments by three replications using the least significant different (LSD) Procedure of Statistical Analysis System (SAS, 2001).

CHAPTER

FOUR

CHAPTER FOUR

4-1 RESULTS:

Table(4-1)Daily feed intake (g\day) of broilers fed graded level of MOL in finisher diets.

Treatments / Week	0%	8%	10%	sig
Five	153.81 $\pm^{a}$ 0.11	119.05 $\pm^{b}$ 20.38	88.33 $\pm^{c}$ 4.65	**
Six	130.24 $\pm^{a}$ 15.16	120.71 $\pm^{b}$ 7.42	98.10 $\pm^{c}$ 11.87	*

Figer are mean ± standard deviation of 30 chicks of each treatment.

* = significant different (P< 0.05)

** = high significant different (P< 0.01).

a, b,c = Means between treatments having different letters are significantly (p<0.05).

Table(4-2) Daily live body weight (g\day) of broilers fed graded level of MOL in finisher diets.

Treatments / Week	0%	8%	10%	sig
First	61.79 ± 5.56	61.05 ± 27.32	67.10 ± 17.69	N.S
Second	81.86 ± 15. 98	79.86 ± 19.10	77.57 ± 29.04	NS

Figer are mean ± standard deviation of 30 chicks of each treatment.

NS = No significant different

Table(4-3) Daily weight gain (g\day) of broilers fed graded level of MOL in **finisher diets**.

Treatments / Week	0%	8%	10%	sig
First	63. 59 ± 50	61.33 ± 19.09	60.10 ± 17.38	N.S
Second	87.91 ± 9.91	81.90 ± 18.97	84.95 ± 10.54	N.S

Figer are mean ± standard deviation of 30 chicks of each treatment.

NS = No significant different

Table(4-4) Daily FCR (g\day) of broilers fed graded level of MOL in finisher diets.

Treatments / Week	0%	8%	10%	sig
First	$2.44 \pm^{b} 0.42$	$2.62 \pm^{c} 1.61$	$1.41 \pm^{a} 0.66$	*
Second	$1.48 \pm^{b} 0.10$	$1.56 \pm^{c} 0.31$	$1.17 \pm^{a} 0.23$	*

Figer are mean ± standard deviation of 30 chicks of each treatment.

* = significant different ($P< 0.05$).

a, b,c = Means between treatments having different letters are significantly ($p<0.05$).

Table(4-5):The number of duration, average final body weight (kg), daily feed intake(g), daily weight gane(g/bird/day), feed conversion rate(feedintake/ weight gane/g), mortality(%) , cost of feeding (kg/pound)

Treatments / Parmeter	0%	8%	10%	Sig
Number of birds	30	30	30	_
Experiment period\day	14	14	14	_
Average final body weight{kg}	17276.6 ± 34	1664.67 ± 32	1699.89 ± 32	N.S
Daily feed intake{g}	145.0 ± [a] 19.30	119.88 ± [b] 13.39	89,21 ± [c] 12.5	**
Daily weight gain{g}	75.74± 15.2	71.26 ±15.11	71.52 ± 16.61	NS
Fcr {feed intake (g)\weight gain(g)}	1.96 ± [b] 0.59	2.08 ± [c] 1.19	1.41 ± [a] 0.55	*
Mortality%	0.00 ± 0.00	0.00 ± 0.00	0.17 ± 0.41	N.S
Cost of feeding {kg\pound}	5.00	3.20	3.00	_

Figer are mean ± standard deviation of 30 chicks of each treatment.

* = significant different (P< 0.05).

** = high significant different (P< 0.05).

a, b,c = Means between treatments having different letters are significantly (p<0.05).

NS = No significant different

4-2 DISCUSSION

4-2-1 Chemical composition of MOL:

The chemical composition of MOL was showed in Table (4-1). The Proximate analysis of *Moringa Oleifera Leaves* showed that the leaves contained 30.09% CP, Other studies have reported variable protein contents ranging between 16, 22, 42, 23, 27, 27.4 and 40% (Gidamis et al., 2003; Sarwatt et al., 2004; Nouala et al., 2006; Reyes-Sanchez et al., 2006; Oduro et al., 2008; Sanchez-Machado et al., 2010) ,respectively. The level of crude protein content is of particular nutritional significance as it may meet animals protein and energy requirements and boost the immune system against diseases (Kyriazakis and Houdijk, 2006; Brisibe et al., 2009). This makes the Moringa leaves to be a good potential source of supplementary protein in animal diets.

Results showed that the leaves contained Dry Matter 90.5, Crude Fibre 16.27, Ether Extract 6.58, Ash 7.35 and Nitrogen Free Extract 30.42%. Adeniji et.al.,(2012) reported value of Dry Matter 93.4, Crude Protein 24.8, Crude Fibre 11.1, Ether Extract 2.1, Ash 8.7 and Nitrogen Free Extract 53.5%. The variation of chemical composition level in MOL

4-2-2 Neutral detergent fibres, acid detergent fibres and acid detergent lignin of MOL :

The values of NDF and ADF were 11.44 and 8.68% respectively. They are differed from that is findings by Foidl et al.(2001) who recorded highly NDF and ADF values of 21.9 and 11.4%, respectively. These variations of NDF and ADF which obtained in our study may be due

to differences in agroclimatic conditions, age of the trees and possibly due to different stages of maturity of leaves (fahey, (2005).

The fragmentation of carbohydrates showed that the concentrations of acid detergent lignin (ADL) was (1.84).This result was consistent with values reported by Foidl et al. (2001).

4-2-3 feed in take :

Table (4-1-2) showed the effect of feeding graded level of MOL on daily feed intake/g. Results showed a significant effect (P< 0.05) in feed intake between experimental group in week one as 153.81g, 119.05g and 88.33g for 0% ,8% and 10% , respectively. chicks in week 2 it the same parameter recorded 130.42g , 120.71g and 98.10g for 0% , 8 % and 10 %, respectively. Ekenyem and Madubuike (2006) reported improved feed intake for broilers fed diets with 5% and 10% levels of moringa. but intake was depressed at 15%. not consistent with present study. On the other hand, Gadzirayi.et.al.,(2012) showed that no significant differences were noted in the amount of feed intake by broiler chicks feed (25 , 50 , 72 and 100%) MOL. Banjo,(2012) reported similar feed intake in chicks fed levels of Moringa at (0%, 1%, 2%, 3%).consistent with Soad,(2010), who state that no significant differences (P>0.05) in feed intake between the groups feed (0, 2, 4, 6) Moringa Oleifera Leaf which is not agreement with the present finding.

4-2-4 The body weight gain:

Table (4-1-4) showed the effect of feeding graded level of MOL on body weight gain .Results obtain in this study showed that there is no significance difference (p>0.05) in body weight gain. Similar result was obtained Du et.al., (2007) who observed no significance difference in

growth performance of three weeks old broilers that were fed on diets supplemented with 0.5, 1.0, 2.0 and 3.0% levels of MOL. Consistent with Banjo,(2012) study Showed that there is no significant differences in feed in take in chicks feed levels of moringa (0%, 1%, 2%, 3%) . Nworgu and Fasogbon. (2007) stated increased body weight in growing chick fed diets containing 2%, 4% and 6 % MOL which isn't agreement with the present findings.

These discrepancies observed in the weight gain of chicks maintained on diets containing MOL and other leaf supplements might be explained by the presence of high pepsin soluble nitrogen (82-91%), low acid detergent insoluble protein (1-2%) and low anti-nutritional factors in Moringa leaf compared to the other leaf meals (Makkar and Becker, 1997). This suggests that the protein in Moringa leaf is readily available to most animals and more suitable to monogastric animals (Kakengi et al., 2003). It might also be due to the influence of other substances such as the vitamins in MOL diet, which improved the efficiency of feed utilization of chicks in the present study. Thus, these substances need further investigation. the response of chickens to amino acid levels in the diet may affect (Coon, 2002).

4-2-5 The feed conversion rate:

Table (4-1-5) showed the effect of feeding graded level of MOL on body FCR . Results obtain in this study showed that there is a significance difference ($p<0.05$) in feed conversion rate in two weeks . Soad,(2010) reported similar observations in broiler chicks fed graded level of MOL at (0, 2, 4, 6)% in the food conversion rate.

Gadzirayi,et.al.,(2012) noted increased the FCR by broiler birds feed (25 , 50 , 72 and 100%)MOL which isn't agreement with the present findings. Moreover, low FER was observed in broilers fed diets containing 5%, 10% and 15% (Iheukwumere et al., 2008) consistent with present study . FCR among the Moringa leaf fed groups was comparable on 10% MOL were more efficient compared to those on other diets.

There was also different effect of treatments on the cost of feed per Kg. the cost of feed decreased as more moriga oleifera replaced groundnut cake in the diets.

No mortality was observed among chicks fed MOL diets throughout experiment. Consistent with the present findings, Nworgu and Fasogbon (2007) who observed no mortality in chicks . the absence of mortality in chicks fed on the MOL diet might be due to the presence of antioxidants in Moringa leaves, which enhances the immune system of animals (Yang et al., 2006). Moreover, Moringa leaf extracts exhibited antimicrobial activity including inhibition of the growth of Staphylococcus aureus strains isolated from food and animal intestines.

This results showed that no effect of ani-nutritional factors on health of chichs. Makkar and Becker (1997) observed some traces of anti-nutritional factors in Moringa oleifera . On the other hand, yellow coloration of body parts observed was mainly attributed to the presence of xanthophylls and carotenoid pigments in MOL as in other tree and shrub leaf meals (Austic and Neisheim 1990). However, the decreasing trend of yellow colour intensity on body parts with time

probably partly was associated with the gradual losses of xanthophylls and carotenoids in MOL during storage and or partly by the transfer of pigmenting agents for production of egg yolk pigments (North 1990).

Du et al. (2007) reported that dietary supplementation of M. oleifera might have increased immune ability of broilers. Thus, leaf meal from both M. stenopetala and M. oleifera might be potential feed additives in livestock production.

CHAPTER

FIVE

Conclusion and Recommendations

5-1 Conclusion:

Feed intake, feed conversional rate and cost rate of chicks fed on MOL diets increased with increasing levels of MOL. Thus, the supplementation of chicks' diet with MOL could be an alternative feeding strategy in rural and peri-urban chicken production practices in Moringa growing tropical regions. However, further investigation is needed to establish the optimum level of MOL inclusion in grower dual purpose chicks.

5-2 Recommendations:

On the basis of the present study the following recommendations can be drowned

- moringa oleaifera tree can be used as a source of vegetable protein and vitamin since it was accepted even in high standards for inclusion in the diet.

- In areas where access to moringa free we recommend their use in poultry feed.

- Further researches investigation state level of MOL should added to poulty diet well conducted on the broiler chicks with levels higher than 10% of moringa oleaifera leaves.

- The result showed that added graded level of MOL can improve the FCR.

- the cost of feed decreased as more moriga oleifera replaced groundnut cake in the diets.

References:

Adeniji Lawal, (2012). Effects of Replacing Groundnut Cake with Moringa oleifera Leaf Meal in the Diets of Grower Rabbits, International Journal of Molecular Veterinary Research, Vol.2, No.3 8-13 (doi: 10.5376/ ijmvr.2012. 02.0003).

Aderemi, (2003). Chemomodulatory effect of Moringa oleifera,lam ,on hepatic carcinogen metabolising parameters and skin papillomagenesis in mice . Asian Pac J Cancer Prev .4(2): 9-13.
rbharali@rediffmail.com.

Anjorin,T.S., Ikokoh.P, and Okolo.S (2010). Mineral composition of *Moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria. Int. J. Agric Biol., 12: 431-434.

Anwar .H.G, Sajid. L, Muhammad .A and Anwar. F (2007).
Moringa oleifera: A Food plant with Multiple Medicinal Uses. Phytother. Res., 21: 17- 25.

Atawodi, S. E., Mari, D., Atawodi, J. C. and Yahaya, Y. (2008). Assessment of Leucaena leucocephala leaves as feed supplement in laying hens. African Journal of Biotechnology. 7 (3): 317-321.

(A.O.A.C), (1990). Official Methods of Analysis. 13th ed. Arlington, Virginia, USA. pp 12-18.Y. 2008. Assessment of Leucaena leucocephalaleaves as feed supplement in laying hens. African Journal of Biotechnology. 7 (3): 317-321.

Austic .R. E and Neishem. M.C (1990) . Poultry Production. Lea and Febiger Publisher. pp 260-275.

Aregheore, E.M., (2002). Intake and digestibility of *Moringa oleifera*-batiki grass mixtures by growing goats. Small Rumin. Res. 46, 23–28.

Banjo,O.S.(2012). Growth and performance as effected by inclusion of moringa oleifera leaf meal in Broiler chicks diet vol 2, No 9 (2012).journal of Biology , Agriculture and Healthcare.

Brisibe EA, Umoren UE, Brisibe F, Magalhaes PM, Ferreira JFS, Luthria D, Wu X, Prior RL (2009). Nutritional characterization and antioxidant capacity of different tissues of Artemisia annua L. Food Chem. 115:1240-1246.

Broin, M., Santaella, C., Cuine, S., Kokou, K., Peltier, G., Jo¨et, T., (2002). Flocculent activity of a recombinant protein from Moringa oleifera Lam. seeds. Appl. Microbiol. Biotechnol. 60, 114–119.

Chemlab, (1978). Determination of Orthophosphate in water and waste water. Chemlab Instrument, Hornchurch, Essex. Continuous flow analysis method sheet no. CW2-0.75-01.

Coon, N.C.(2002). Digestion and metabolism. In: Bell, D.D. and Weaver, W.D. (eds). Commercial chicken meat and egg production, 5th Ed. Springer Science + Business Media, Inc. USA. Pp. 199-213.

Delaveau P, et al. (1980) .Oils of Moringa oleifera and Moringa drouhardii. Plantes Médicinales et Phytothérapie 14(10): 29-33.

D'Mello, J.P.E., Acamovic. T and Walker. A.G. (1987). Evaluation of leucaena leaf meal for broiler growth and pigmentation. Tropical Agriculture (Trinidad). 64: 33-35.

Du, P.L., Lin, P.H., Yang, R.Y., Fan, Y.K., Hsu, J.C. (2007). Effects of dietary supplementation of Moringa oleifera on growth performance, blood characteristics and immune response in broilers. Journal of the Chinese Society of Animal Science. 36 (3):135-146.

Ekenyem, B.U., Madubuike, F.N. (2006). An assessment of Ipomoea asarifolia leaf meal as feed ingredient in Broiler chick Production. Pakistan Journal of Nutrition. 5 (1): 46-50.

Fahey, J.W., (2005). Moringa oleifera: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties, Part1. Trees for Life Journal. 1, 5.

Fasuyi, A.O., Fajemibhin, K.S.O., Omojola, A.B. (2005). The egg quality characteristics of layers fed varying dietary inclusions of Siam Weed (Chromolaena odorata) leaf meal (SWLM). International Journal of Poultry Science. 4 (10): 752-757.

Foidl, N., Mayorga, L., V´asquez, W. (1999). Utilizaci´on del marango (*Moringa oleifera*) como forraje fresco para ganado. In: S´anchez, M.D., Rosales M´endez, M. (Eds.), Agroforester´ıa para la producci´on animal en Am´erica Latina, Memorias de una conferencia electr´onica realizada de abril a septiembre de 1998. FAO Animal Production and Health Paper 143. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy, pp. 341–346.

Foidl, N., Makkar, H.P.S. and Becker, K.(2001). The potential of Moringa oleifera for agricultural and industrial uses. In: Proceedings of International Work shop What development potential for Moringa products. October 29th to November 2nd 2001. Dar Es Salaam, Tanzania.
http://www.moringanews.org/actes/foild_en.doc.

Freiberger, C.E., Vanderjagt, D.J., Pastuszyn, A., Glew, R.S., Mounkaila, G., Millson, M., Glew, R.H. (1998).
Nutrient content of the edible leaves of seven wild plants from Niger. Plant Foods Hum. Nutr. 53, 57–69.

Fuglie, L.J .(1999) .The Miracle Tree: Moringa oleifera: Natural Nutrition for the Tropics. Church World Service, Dakar. 68 pp.; revised in 2001 and published as The Miracle Tree: The Multiple Attributes of Moringa, 172 pp.http://www.echotech.org/bookstore/advanced_search_result.php?keywords=Miracle+Tree.

Gadzirayi,C.T, Masamha .B, Mupangwa,J.F and Washaya.S, (2012). Performance of Broiler chickens fed on mature Moringa oleifera leaf meal as aprotien Supplement to soyabean Meal .International Journal of Poultry Science, 11: 5 – 10.

Gidamis, A., Panga, J., Sarwatt, S., Chove, B., Shayo, N.,(2003). Nutrients and antinutrients contents in raw and cooked leaves and mature pods of Moringa oleifera Lam. Ecol. Food Nutr. 42, 1–13.

Gupta, K., Barat, G.K., Wagle, D.S., Chawla, H.K.I. (1989). Nutrient contents and anti nutritional factors in conventional and non-conventional leafy vegetables. Food Chemistry. 31: 105-116.

Hsu, N.C. (2006). *Moringa oleifera* medicinal and Economic uses. International course on Economic botany, National Herbarium, Leiden, The Netherlands **.**nutrient utilization and cost implications of feeding broiler finishers conventional or underutilized resources. Applied Tropical Agriculture. 2: 57-62.

Iheukwumere, F.C., Ndubuisi, E.C., Mazi, E.A., Onyekwere, M.U. (2008). Performance, Nutrient Utilization and Organ Characterstics of

Broilers Fed Cassava Leaf Meal (Manihot esculenta Crantz). Pakistan Journal of Nutrition. 7(1): 13-16.

Kakengi, A.M.V., Shem, M.N., Sarwatt S.V., Fujihara, T. 2003. Can Moringa olifera be used as a protein supplement to ruminants? Asian Australian Journal of Animal Sciences. 18 (1): 42-47.

Kakengi, A.M.V., Kaijage, J.T., Sarwatt, S.V., Mutayoba, S.K., Shem, M.N., Fujihara, T. (2007). The effect of Moringa olifera leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. Livestock Research for Rural Development. 19, (8). http://www.lrrd.org/lrrd19/8/kake19120.htm.

Kalogo,Y., M'Bassigui´eS´eka, A.,Verstraete,W., (2001). Enhancing the strat-up of a UAS Breactor treating domestic waste water by adding a water extract of *Moringa oleifera* seeds. Appl. Microbiol. Biotechnol. 55, 644–651.

Khalafalla, M.M., Abdellatef, E., Dafalla, HM., Nassrallah, A.A., Aboul-Enein, K.M., Lightfoot, D.A., El-Deeb, F.E., El-Shemy, H.A., (2010). Active principle from Moringa oleifera Lam Leaves effective against two leukemias and a hepatocarcinoma. Afr. J. Biotechnol., 9(49): 8467-8471.

Kyriazakis I, Houdijk JG (2006). Nutritional control of parasites. Small Ruminant Res., 62: 79-82.

Lalas, S., Tsaknis, J., (2002). Characterization of *Moringa oleifera* seed oil variety "Pariyakulam 1". J. Food Compos. Anal. 15, 65–77.

Lockett, C.T., Calvert, C.C., Grivetti, L.E.,(2000). Energy and micronutrient Composition of dietary and medicina l wild plants consumed during drought. Study of rural Fulani, Northeastern Nigeria. Int. J. Food Sci. Nutr. 51, 195–208.

Morton, J.F. (1991). The Horseradish Tree, *Moringa pterygosperma* (Moringaceae) - A Boon to Arid Lands? *Economic Botany* 45, 318-333.

Makkar, H.P.S., Becker, K. (1996). Nutritional value and antinutritional components of whole and ethanol extracted Moringa oleifera leaves. Animal Feed Science and Technology. 63 (1-4): 211- 228.

Makkar, H.P.S., Becker, K. (1997). Nutrients and antiquality factors in different morphological parts of the Moringa oleifera tree. Journal of Agricultural Science. 128: 311-322.

Melesse A., Bulang, M., Kluth, H., (2009). Evaluating the nutritive values and in vitro degradability characteristics of leaves, seeds and seedpods from M. stenopetala. Journal of Science of Food and Agriculture. 89: 281-287.

Nadir ,R. S. (2006). Moringa oleifera and Cratylia argentea: Potential Fodder Species for Ruminants in Nicaragua Doctoral thesis Swedish University of Agricultural Sciences.

Nouala, F., Akinbamijo, O., Adewumi, A., Hoffman, E., Muetzel, S., Becker, K.,2006. The influence of Moringa oleifera leaves as substitute to conventional concentrate on the in vitro gas production and digestibility of groundnut hay. Livest. Res. Rural Dev. 18, 9.

North,M. O. (1990). Commercial Poultry Production manual. Westport connection Publishing Company. Inc, USA. pp 299-301.

Nworgu, F.C., Fasogbon, F.O.(2007). Centrosema(Centrosema pubescens) leaf meal as protein supplement for pullet chicks and Growing pullets. International Journal of Poultry Science. 6 (4): 255-260.

Oduro, I., Ellias, W.O., Owusu, D.(2008). Nutritional potential of two leafy vegetables: Moringa olifera and Ipomoea batatas leaves. Scientific Research and Essay. 3 (2): 57- 60.

Ogbe, O. A.(2013). Proximate Study, Mineral and Anti-nutrient Composition of Moringa Oleifera Leaves Harvested from Lafia, Nigeria: Potential Benefits in Poultry Nutrition and Health. Online: http://en.engormix.com/MA-poultry-industry/nutrition.

Oliveira, J.T.A., Silveira, S.B.,Vasconcelos, I.M., Cavada, B.S., Moreira, R.A., 1999. Compositional and nutritional attributes of seeds from the multipurpose tree Moringa oleifera Lamarck. J. Sci. Food Agric. 79, 815–820.

Olugbemi, T.S., S.K. Mutayoba and F.P. Lekule, (2010). Effect of Moringa oleifera inclusion in cassava based diets fed to broiler chickens. Int. J. Poult. Sci.,9: 363-367.

Ramachandran, C., Peter, K.V., Gopalakrishnan, P.K., (1980). Drumstick (*Moringa oleifera*): a multipurpose Indian vegetable. Econ. Bot. 34, 276–283.

Rams, J. (1994). Moringa a highly nutritious vegetable Tree, Tropical Bulletin, No.2.

Reyes, S. N, Sporndly. E, Ledin I (2006). Effects of feeding different levels of foliage from Moringa Oleifera to creole dairy cows on intake, digestibility, milk production and composition. Livest. Sci., 101(1-3): 24-31.

Sarwatt, S.V., Kapange, S.S., Kakengi, A.M.V.,(2002). Substituting sunflower seed-cake with Moringa oleifera leaves as a supplemental goat feed in Tanzania. Agroforest. Syst. 56, 241–247.

Sánchez-Machado, D., Núñez-Gastélum, J., Reyes-Moreno, C., Ramírez-Wong,B., López-Cervantes, J., (2010). Nutritional quality of edible parts of Moringa oleifera. Food analytical methods 3 (3), 175–180.

Statistical Analysis System (SAS), 2001. SAS User's Guide. SAS, Institute Inc., Cary North California, USA.

Soad.G. (2010). Center of search Animal production . effect of moringa oleifera in diet to Broiler chichen.

Teketay, D. (2001). The Effect of Temperature on the Germination of Moringa Setenopetala: AMulti-purpose Tree, Vol. I, part I.Udedibie, A.B.I. and Opara, C.C. 1998. Responses of growing broilers and laying hens to the dietary inclusion of leaf meal from Alchornia cordifolia. Animal Feed Science Technology. 71: 157-164.

Wiseman, J.(1987). Feeding of Non Ruminant Livestock. Butterworth and Co. Ltd. UK. pp. 9-15.

Yang, R.Y., Chang, L.C., Hsu, J.C., Brian, B.C., Manue, W., Palada, C., Chadha, M.L.,Levasseur, V.(2006). Nutritional and Functional Properties of Moringa Leaves from Germplasm to Plant to Food to Health. In: Moringa and other highly nutritious plant resources: Strategies, standards and markets for a better impact on nutrition in Africa, Accra, Ghana, Nov., 16-18.

Luu Huu Manh, Nguyen Nhut Xuan Dung and Tran Phung Ngoi(2005). Department of Animal Husbandry, Faculty of Agriculture, Cantho University,Cantho,***Vietnam*** ***lhmanh@ctu.edu.vn; nnxdung@ctu.edu.vn***

* Song Hau Farm, Cantho city.

Appendix 1. Moringa oleifera leaf tree leaves

Appendix 1. Moringa oleifera leaf powder

Chicks since breeding group (B)

Chicks since breeding group (A)

Chicks since breeding group (C)

Carcass group (A)

Carcass group (B)

Carcass group (C)