Sudan University of Science and Technology

College of Graduate Studies

Effect of Feeding Graded Levels of *Moringa oleifera* Leaf Meal (MOLM) with and without Enzyme on the performance and Carcass Characteristics of Broiler Chicks

أثر التغذية بمستويات متزايدة من مسحوق أوراق المورنقا (MOLM) بإضافة أو بدون إضافة الإنزيم على الأداء الإنتاجي وخصائص الذبيحة للدجاج اللاحم

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الآية

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وَلَحْمِ طَيْرٍ مِمَّا يَشْتَهُونَ)

صدق الله العظيم

سورة الواقعة الآية(21)

Dedication

To the **DR. Prof. Mukhtar Ahmed Mukhtar**, Director of the animal production department

To

My family with the best regards and wishes

I would like to make innumerable dedication by this means.

Firstly, to my mother and father soul who have allowed me to become in this life, and they were my eyes when I couldn't see.

To my dearest helpmate, my wife.

To my beloved brothers and sisters.

To all who helped me with best regard and wishes.

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Abbreviations

SAS	= Statistical analysis system
CRD	= complete randomized design
ANOVA	= analysis of variance
Lsd 0.05	= least significant difference
+- SD	Standard deviation
SE	Experimental standard error
n.s	Not significance
*	Significant (P 0.05)
**	Highly Significant (P 0.05)
MOLM	Moringa olleifera leaf meal

Abstract

This study was carried out to investigate the nutritive value of *Moringa oleifera* leaf meal (MOLM) as a plant protein source with and without enzyme (xylem 500) on the growth performance, carcass characteristic, blood serum chemistry and economical attributes for broiler chicks.

A total of hundred and sixty eight, seven days old, unsexed, aber acre strain were distributed in a complete randomize design, into eight groups of 21 chicks per each. Each group was further subdivided into 3 replicates with 7 chicks per each. Chicks were assigned on the experimental diets (A_1,A_2,B_1,B_2,C_1,C_2,D_1,D_2), group A_1 fed in control diet (without (MOLM and enzyme) as negative control, groups B_1,C_1 and D_1 were fed on diets containing 2.5%, 5% and 7.5% (MLOM) respectively, (without enzyme), diets A_2 fed on control diet supplemented with 50g/kg xylam, enzyme (positive control), diets B_2,C_2 and D_2 were the same as B_1,C_1 and D_1 diets respectively but they were supplemented with 50g/kg xylem enzyme. Diets were formulated to meet the requirements of broiler chicks according to (NRC, 1994). Experimental diets were fed for 6 weeks.

Experimental parameters covered growth performance (live body weight, body weight gain, feed intake and FCR) and carcass values, serum metabolite and economical appraisal. Results obtained showed that supplementation of diets containing different levels of (MOLM) with commercial enzyme improved the performance of broiler chicks. Chicks fed on different levels of (MOLM)without enzyme recorded significantly ($p>0.05$) low performance compared to those fed on diets containing (MOLM) supplemented with enzyme.

Feeding on different levels of (MOLM) with or without enzyme, did not affect on non-carcass components (Head, Gizzard, neck, heart, abdominal fat, and liver) .

The objectives of this study were to investigate the effect of different levels of dietary (MOLM) with or without commercial enzyme supplementation on the performance, carcass characteristics, serum chemistry, and economical attributes on broiler chicks.

المستخلص

أجريت هذه الدراسة بغرض معرفة القيمة الغذائية لمسحوق أوراق نبات المورينقا كمصدر للبروتين النباتي بإضافة إنزيم الزايلام 500 وبدون إضافته علي الأداء الإنتاجي وخصائص الذبيحة وكيميائية مصل الدم وكذلك العائد الاقتصادي لكتاكيت الدجاج اللاحم سلالة أبريكر .

تم توزيع ثمانية وستون ومائة كتكوت دجاج لاحم عمر سبعة أيام غير مجنسة وزعتعشوائياً بطريقة العشوائي الكامل إلى ثمانية مجموعات، في كل مجموعة واحد وعشرون كتكوت.قسمت كل مجموعه إلى ثلاثة مكررات ، كل مكرر يحتوي علي سبعة كتاكيت.

وزعت الكتاكيت علي العلائق **التجريبية (**أ$_1$، أ$_2$، **ب**$_1$،**ب** $_2$، **ج**$_1$،**ج** $_2$، **د**$_1$،**د** (المجموعة أ $_1$ (غُذيت علي العليقة القياسية (خالية من مسحوق أوراق المورنجا وبدون إضافة إنزيم الزلايم كعليقة قياسية سالبة .

المجموعات((**ب** $_1$، **ج** $_1$، **د**$_1$)غُذيت علي علائق محتوية علي 2.5 ، 5، 7.5% من مسحوق أوراق شجرة المورينغا بدون انزيم على التوالى. العليقة أ$_2$ مع إضافة الإنزيم غذيت كعليقة قياسية ايجابية (50 جرام من الإنزيم.) العلائق ب$_2$، ج$_2$، د $_2$ مشابهة للعلائق **ب** $_1$، **ج** $_1$، **د**$_1$مع اضافة 50 جرام / كيلوجرام من إنزيم الزلايم على التوالى.

كونت العلائق جميعها لتقابل وتلبي الاحتياجات الغذائية لكتاكيت الدجاج اللاحم بناء علي توصيات مجلس البحوث العالمي (1994) .

استمرت التجربة لمدة ستة أسابيع، و شملت القياسات التجريبية الاداء العام ، وزن الجسم الحي، الوزن المكتسب،استهلاك العليقة ونسبة التحويل الغذائي، وصفات الذبيحة وكيميائية مصل الدم وكذلك المردود الاقتصادي المتحصل .

أشارت النتائج إلى أن تدعيم وتعزيز العلائق التي تحتوي علي مستويات مختلفة من المورينقا بالإنزيم التجاري زيلام 500 يحسن الأداء الإنتاجي العام للدجاج اللاحم، كما أن العلائق المحتوية علي مستويات مختلفة من مسحوق أوراق المورنقا سجلتفروقاً معنوية ($P>0.05$) سالبه مقارنة مع التي غذيت علي علائق تحتوى علي مستويات مختلفة مدعمة بالإنزيم.

المستويات المختلفة من المورنقا بإضافة الإنزيم وبدون إضافته لم تؤثر معنويا علي أجزاء الجسم غير الأساسية(الرأس، القانصة، الرقبة و القلب ، الدهن والكبد) .

هدفت هذه الدراسة إلى تقييم اثر التغذية بمستويات مختلفة من مسحوق أوراق المورنقا مع إضافة أو بدون إضافة الإنزيمعلى الأداء الإنتاجي وخصائص الذبيحة وكيمياء مصل الدم والمردود الاقتصادى للدجاج اللاحم .

CHAPTER ONE

INTRODUCTION

Protein supplementation is often important to improve livestock performance, and this needs to be done with respect to the requirements of the animal, in addition to the balance of other nutrients available. Soybean meal and fish meal have been widely and successfully used as conventional protein sources for livestock.

However, the prices of the protein source have been escalating continuously in the recent times, while available is often erratic. The problem has been worsening due to the increasing competition between human and livestock for the protein ingredients as food. According to **Odunsi (2003)** the rapid growth of human and livestock population, which is creating increased needs for food and feed in the less developed countries, demand that alternative food resource must be identified end evaluated.

In low- income Food –Deficit Countries (LIFDCs), surplus of the cereals is generally not available; therefore it is not advisable to develop a wholly grain- based feeding system. The recommended policy is to identify and use locally available feed resource to formulate diets that as balanced as possible **(Guẻye and Brancheart, 2002).** There is the need, to explore the use of non- conventional sources that have the capacity to yield the same output as conventional feeds, and perhaps at cheaper cost.

Hence, any high similar protein ingredient which could partially or completely be used as a substitute for soybean meal or fish meal is desirable.

The strategy could help reduce the cost of production; and ensure cheaper meat production thereby making available the major crops for human consumption. The economization of feed cost using cheaper and unconventional feed resources **(Vasahthakumar *et al*., 1999; Bhatt and**

Sarweatt, 2001; Muriu *et al*., 2002) is an important aspect of commercial rabbit production.

One possible source of cheap protein is the leaf meals of some tropical legume browse plants. Leaf meal does not only provide protein source but also oxycratenoids. The constraints to enhanced utilization of leaf meals reside chiefly on factor such as fiber content, the presence of anti-nutritive compounds and deficiencies of certain amino acids.

Recently, there has been interest in the utilization of (*Moringa oleifera*) commonly called horseradish tree or drumstick tree, as a protein source for livestock **(Makker and Becker, 1997; Sarweatt *et al*., 2002).** Moringa oleifera leaves have quality attributes that make a potential replacement for soybean meal of fish meal in

The objectives of the study are to:

• To investigate the effect of MOLM meal on performance, carcass characteristics and serum chemistry.

• To study the effect of enzyme xylam (500) on broiler chicks feeding.

• To study economical inclusion of **MOLM** in broiler diets.

CHAPTER TWO

LITERATURE REVIEW

2-1 Origin and distribution of moringa

Moringa (*Moringa oleifera* Lam) belongs to the Moringaceae family and is considered to have its origin in the north- west region of India, south of the Himalayan mountains as a legume tree, it's now widely cultivated and has become naturalized in many locations in the tropics, its reported that there are thirteen species of moringa tree in the family Moringaceae and that *Moringa oleifera* is the most widely cultivated species. It was further stated that they are native to India the Red sea area, and or parts of Africa including Madagascar, *Moringa oleifera* is Indigenous to Northern India and Pakistan and was introduced throughout the tropic and sub-tropics and becoming naturalized in many African countries **(Odee, 1998; Anwar, 2003).** This rapidly-growing tree also known as horse radish tree (describing the taste of its roots) or drumstick tree (describing the shape of its foods); and Al-Rwag tree in Sudan, water purification and Nile valley **(Von - Maydell, 1986).**

In the Dravidian language, there are many' local names for this tree but all are derived from the generic root Moringa". In English it is commonly known as Horseradish tree, Drumstick tree. Never Die tree, West Indian Ben tree, and Radish tree **(Ramachandran *et al*.,1980).** In Nicaragua the Marango (local name for *Moringa oleifera*) was introduced in the 1920s as an ornamental plant and for use as a livestock fence. The tree grows best and is most commonly found in the Pacific part of Nicaragua but can be found in forest inventories in every part of the country.

It's also in recent years, interest has grown in the utilization of what have come known as "Multipurpose" plant, it was widely cultivated species of monogeneric family moringaceae (Moringa oleifera) is one of 14 species of

family- Muringaceae, .native to India, Africa , Arabia, south east Asia, south America and the pacific and Caribbean Island **(Igbal *et al*., 2006; Muluri, 1999)**. Because M. Oliefera naturalized in many tropic and subtropic Regions, worldwide, a number of names such as, Ben oiltree, miracle tree, and Mother's Best friends refer to the plant **(Jahn., 1981).** The moringa tree introduced to Africa as non-ruminant diets. Moringa can easily be established in the field, has good coppicing ability, as well as good potential for forage production. Furthermore, there is the possibility of obtaining large amounts of high quality forage from moringa without expensive inputs due to favorable soil and climatic conditions for its growth. **Sarwatt *et al*.,(2004)** reported that Moringa foliage's are a potential inexpensive protein source for livestock feeding. The advantages of using Moringa for a protein resource are numerous, and include the fact that it is a perennial plant that can be harvested several times in one growing season and also has the potential to reduce feed cost .*Moringa oleifera* is in the group of high-yielding nutritious browse plants with every part having food value **(Duke, 1998).**

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. The stem is normally straight but occasionally is poorly formed. The tree grows with a short, straight stem that reaches a height of 1.5-2 m 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 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 pinnate each bearing two pairs of opposite, elliptic or obviate leaflets and one at the apex, all 1-2 cm long; with glands at the bases of the petioles **(Morton, 1991)**

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 live 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).** 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).**

This tree was introduced to Sudan during British rule as ornamental tree in Gezira province and kordofan. Sudanese women in village used moringa oleifera seeds as clarifier tree. (shagaratalrauwag) to treat highly turbid water of the Nile. **(Mohamed Elshami, 2002.; Jahn and Dirar; 1979 Jahn, 1981)**

The investigation of the different parts of plant is multidisciplinary, including but not limited to mutation ethrobotamy medicine, analytical chemistry, photochemistry, and anthropology. **(Meburny *et al*., 2004)**

2-2 Description

Moringa is a small, fast-growing, drought deciduous tree or shrub that reaches in height at maturity it was a wide-open , typically, umbrella shaped crown, straight trunk (10-3 0 cm thick) and a corky, whitish bark. The plant (depending on climate) has leaflets 1-2 cm in diameter and 1.5-2.5 cm in length, its leaves are impair pinnate, rachis 3 to 6 cm long with 2 to 6 pairs of pinnules. Each pinnule has 3 to *5* obovate leaflets that are 1 to 2 cm long (Von Maydell., 1986). The terminal leaflet is often slightly larger. Its leaflets are quite pale when young, but become richer in color with maturity. Cream-colored flowers emerge in sweet- smelling panicles during periods of drought or water stress when the tree loses its leaves. The pods are triangular in cross-

section30 to 50 cm long and legume-like in appearance. The oily seeds are black and winged. . The tree produces a tuberous taproot, which explains its tolerance to drought Conditions (F/FRED., 1992).

2-3 Varieties of Moringa species

Moringa oliefera., M. arborea.B; M. borziana; M. concanensis; *M.* drouhard*ii*; M. hildebrandt ii; M. longituba; ovalifoija; M. pygmaea; M. stenopetala; M. ruspoijama; M. riv;. M. peregrine; **(Fugue *et al*., 2001; (Beiteke., 2012)**.

2-4 Chemical composition

Grubben and Dentin (2014) reported that the leaf tips of M**.** oleifera contain per 100g edible protein: water 87.7g, Energy 268 kj (64 Kcal), protein 9.4 g, fat 1.4 g, carbohydrates 8.3g. Total dietary fiber 2.0g, ca 185 mg, l47mg, P 112 mg, Fe 4.0 mg, Zn 0.6 mg vitamin A 7564 Iu, thiamine 0.3 mg, Riboflavin 0.7 mg, niacin 2.2 mg, folate 40 ug, and ascorbic acid 51.7 mg, the raw fruits of the plant, according to **Beitake, (2012) and Bosch, (2004)** study, contain per 100 g edible protein : water 88.2 g, energy *155* kj, (37 kcal), Protein 2.1 g, fat 0.2 g, carbohydrates 8.5g, total dietary fiber 3.2g, Ca 30 mg. Mg 45 mg, p 50mg, Fe 0.4 mg, Zn 0.4mg, vitamin A 7.4 u, Thiamin 0.05 mg, riboflavin 0.07 mg, niacin 0.6mg, folate 44 ug, and ascorbic acid 141.0 mg. Analysis of Nutritional value of moringa according to **Booth and Wickens., (1988) and Beitake., (2012)** is presented Table (1).

Moringa oleifera was contents moisture 74.42% protein 16.7%, fiber *3.5%*, ash 8% and oil 1.7% in addition the minerals content were determined and they found that the calcium content was 0.20 mg/l00mg, Magnesium 0.13 mg/l00mg, potassium *0.075* mg/100 mg and phosphors 0.03/mg/l00mg. **(Jed *et al*., 2005 and Anwar *et al*., 2005).**

Table (2.1): analysis of nutritional value of Moringa pods, fresh (raw) leaves and dried powder per 100 g of edible protein

Components	Pods	Leaves	Leaf powder
Moisture (%)	86.9	75.0	7.5
Calories cal/kg	26	92	205
Protein (g)	2.5	6.7	27.1
Fat (g)	0.1	1.7	2.3
Carbohydrates (g)	3.7	13.4	38.2
Fibers (g)	4.8	0.9	19.2
Minerals (g)	2.0	2.3	-
Ca .. (mg)	30	440	2003
Cu . (mg)	3.1	1.1	0.57
Fe . (mg)	5.3	7.0	28.2
K .. (mg)	259	259	1324
Mg .. (mg)	24	24	368
P . (mg)	110	70	204
S . (mg)	137	137	870
Se . (mg)	-	-	0.09
Zn . (mg)	-	-	3.29
Oxalic acid (mg)	10	101	1600
Vitamin A (mg)	0.11	6.8	18.9
Vitamin B (mg)	423	423	-
Vitamin B1(mg)	0.05	0.21	2.46
Vitamin B2 (mg)	0.07	0.05	20.5
Vitamin B3 (mg)	0.2	0.8	8.2
Vitamin C (mg) Vit E	120	220	17.3
AMINO ACID:			
Arginine (mg)	90	402	1325
Histidine (mg)	27.5	141	613
Methionine (mg)	37.5	288	1325
Phenylanaline (mg)	108	429	1388
Threonine (mg)	98	328	118
Tryptophan (mg)	20	127	425
Valine (mg)	135	476	1063

Source: Booth and wickens (1988)and Beitake (2012).

2-5 Anti-nutritional factors

Polyphenols, commonly known as tannins, occur widely in many different plants, especially those from tropical regions. Their consumption by animals has adverse effects on productivity and health. The un- extracted leaves had negligible, amounts of tannins (1.4 %) and condensed tannins were not detectable. The content of total phenols was 3.4 % . A total phenol content of 2.7 % has been reported by **Gupta *et al.*, (1989)** for the un extracted leaves. At this concentration, these simple phenols do not produce any adverse effects when eaten by animals. In the extracted leaves, no tannins were detected and the content of phenols was very low (1.6 %*)*. The tannins are soluble in aqueous organic solvents such as ethanol, methanol, acetone etc. **(Makkar and Sinh, 1992).** Another group of anti-nutritional factors reported to occur in the un extracted Moringa leaves are the saccharine raffinose and stachyose which produce flatulence in monogastrics. According to **Gupta *et al.*, (1 989)** these compounds comprise *5.6 %* of the dry matter in the un extracted leaves but occur in higher concentrations in legumes. They can however be removed to a large extent by soaking and cooking in water **(Bianchi *et al.*, 1983).** These flatulence factors are determined after extraction in 80 % aqueous ethanol **(Williams., 1 984; Gupta *et al.*, 1 989).**Therefore be absent in extracted Moringa leaves. Other antinutritional factors present in un extracted Moringa leaves are nitrate (0.5 mmol/1 00 g), oxalate (4.1 %), saponin (1 .2 %) and phytate (3.1 %).

Trypsin inhibitor activity was not detected **(Gupta *et al.*, 1989).** Phytates are present to the extent of 1 to 5 % in *legumes* and are known to decrease the bioavailability of minerals in monogastiric **(Reddy *et al.*, 1982).** The leaves of Moringa arc quite rich in minerals and the presence of oxalates and phytates at concentrations of 4.1 % and 3.1 % respectively is likely to decrease the minerals' bioavailability. Saponins from some plants have an adverse effect on the growth of animals but those present in Moringa leaves

appear to be innocuous (did .not show hemolytic activity), and humans consume them without apparent harm. Cyanogenilglucoside and glucosinolates were not detected in leaves **(Makkar and Becker, 1997).** Most of the antinutritional factors mentioned above are soluble in aqueous ethanol and would most probably be absent in the extracted leaves.

2.6 Uses of moringa

2-6-1 Uses as forage

The feeding as a fresh forage material for animals, the leaves are rich in protein, carotene, iron and ascorbic acid and the pod is rich in the amino acid lysine **(CS1R., 1992)** in an experiment where extracted and un extracted leaves of Mroinga were used as a component of animal feed, **(Makker and Becker., 1996)** analyzed these samples for nutrients and ant -nutrient, they reported that un extracted leaves of M. oleifera had negligible amount of Tannins (14 g/ 10g / DM) and condensed Tannins were not detectable.

Both the extract and un extract moringa leaves reported by **Fugue *et al.*, (1999)** showed crude protein values of 43.5 and 25.1% respectively suggesting that both the extract and un extract leaves are good sources of protein for livestock. As expected the crude protein and fiber contents of the extracted leaves were higher than those of the un extract leaves due to the loss of some cell soluble and lipids during the treatment with 80% ethanol. The crude protein, crude lipids and as values of 26.4% 6.5% and 12% respectively were reported for the un-extracted leaves by **Gupta *et al.*, (1989).** Also higher leaves of NDF (28.8%) and ADF (13.9%) were reported, in an experiment to determine the nutritional potential of two leafy vegetables (Moringa oleifera and pomoea batatas), **Oduro *et al,* (2008)** reported that M. oleifera leaves contained crude protein. While **(Beitake, 2012)** showed the chemical analysisof leaf meal 27.51% crude fiber 19.25%, crude fat 2.23%, ash 7.13%, moistine*76.53%* carbohydrates 43.88% and caloric value 1296.00 kj/g

(305.62 cal/g), calcium and iron content in mg/100g (Dm) were 20.09 and 28.29, respectively.

2-6-2 Uses as food for human

This tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein calcium , iron, vitamin C, and carotenoids suitable for utilization in many of the so called “developing regions of the world where undernourishment is a major concern” (Fahey *et al.*, 2010).

Moringa leaves have also been shown to increase breast milk production. **(Estrlla *et al.*, 2000)** In many Asian and African countries women consume moringa leaves to enhance breast milk production. **(Fuglie., 2001)**

The nutritional characteristics of the Moringa tree are excellent so it can easily be used as a fresh forage material for cattle, the leaves are rich in protein, carotene, iron and ascorbic acid and the pod is rich in the amino acid lysine **(CSIR., 1992; Chawla *et al.*, 1998; Dogra *et al.*, 1975)**. Another important advantageous characteristic of Moringa is its high productivity of fresh material per unit area compared with other forage crops.

Table (2.2):Showed the chemical composition of extracted and un-extracted Moringa leaves

Type of leaf	C.P	Lipid	Ash	NDF	ADF	ADL	G.E. (Mjkg-1)
Extracted leaves	43.5	1.4	10.0	47.4	16.3	2.2	17.7
Un-extracted leaves	25.1	4.5	11.5	21.9	11.4	1.8	18.7

All values except gross energy are expressed as percentage dry matter. NDF Neutral Detergent Fiber, ADF Acid Detergent Fiber, ADL = Acid Detergent Lignin Source: **Fugue (1999)**.

The pods are often cooked and eaten like green beans. The whole seeds also ate green, roasted or powdered, and steamed in tea and curries **(Fahey, 2005).** The pods and seeds, often referred to as Moringa kernels, have a taste that ranges from sweet to bitter and are most popularly consumed after frying to get a peanut-like taste **(Makkar *et al.*, 1996).** The pods are generally prepared in a similar fashion to green beans and have a slight asparagus taste. The pods are highly nutritious containing all the essential amino acids **(Ramachandran *et al.*, 1980).** Although primarily utilized worldwide by the Asian Asia, Africa, America population as a vegetable, usage by other peoples is increasing. An international mark*et al*ready exists for both fresh and tinned pods **(Jahn, 1986)**.

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. The composition of the amino acids in the leaf protein is well balanced. The young green pods are very tasty and can he 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 fiber. These are rich in free leucine. The seeds must first be boiled for a few minutes to remove the line 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. **(Beitake, 2012).**

The Leaves rich in biologically active carotenoids, tocopherols and vitamin C have health-promoting potential in maintaining a balanced diet and preventing free-radical damage that can initiate many illnesses **(Smolin *et al.*, 2007;Mc Burney *et al.*, 2004; Fahey., 2005; Dan Malain *et al.*, 2001)**.

Leaves are harvested daily for soups, sauces, or salads, ate fresh, cooked, or stored as a dried powder for many months reportedly without any major loss of its nutritional value, fresh leaves are picked, shade dried, ground to a powder, and then stored for later as a food flavoring or additive. Dried or fresh leaves used in foods such as soups and porridges **(Lockett *et al*., 2000).** .Also used as curry gravy in noodles, rice or wheat **(Abilgos and Barba., 1999).**

Pregnant women and lactating mothers use the powdered leaves to enhance their child or children's nourishment. especially, in underdeveloped countries mothers suffering from malnutrition **Mcburney *et al.*, (2004); Lockett *et al.*, 2000; WHO Readers Forum., 1999** and**(Kasolo *et al* (2011)** stated that *Moringa oleifèra* leaves were safe for human consumption because no serious side effects have been observed by the people using them. However, the toxicity of biologically active agents has been found to depend on the dose, they study the acute toxicity profile of *Moringa oIeiftra* leaves, they concluded that, *Moringa oleifera* leaves extracts of ether, ethanol and water contains phytochemical compounds which when given orally as a single dose in 24 hours to mice were relatively non-toxic.

The moringa flowers also produce a good honey and honey clarifier in India and Sudan **(Jahn., 1984)** the roots tats similar to horse radish and is a popular food in east Africa **(Sattaur., 1983).**

2-6-3 Industrial uses of moringa oil

The oil content of de- hulled seed (kernel) is approximately 42 %. The oil is brilliant yellow. It is used as a lubricant for fine machinery such as timepieces because it has little tendency to deteriorate and become rancid and sticky **(Ferrao and Mandez Ferrao., 1970; Ramachandran *et al*., 1980).** It is also useful as a vegetable cooking oil. The oil is known for its capacity to absorb and retain volatile substances and is therefore valuable in the perfume

industry for stabilizing scents. The free fatty acid content varies from 0.5 to 3 %. The seed oil of Moringa contains approximately 1 3 % saturated fatty acids and 82 unsaturated fatty acids. It has a particularly high level of oleic acid (70 %) Other vegetable oils normally contain only about 40 % oleic acid. **(Ferrao., 1970; Ramachandran., 1980).**

2-6-4 Uses as Water Purifier:

In parts of the world where clean drinking water is scarce, Moringa offers another crucial benefit such as the ability to purify water. Many countries use river water as their primary water source, but this water can contain harmful particles, bacteria and microorganisms. Water treatment plants are not available in many countries, but if there, is a Moringa tree nearby, river water users can still enjoy clean water **(Jahn and Dirar., 1979; and Jahn., 1981; Berger *et al*., 1980; Gassen Schmidt *et al*., 1995; Olsen., 1987;).** The Moringa tree harvested from the seedpod, crushed, and then put into waste of the water. Harmful particles bind to the seed and sink after an hour of treatment, and then clean water can remove from the top of the vat **(Jahn., 1986).** Moringa seeds contain between 30-42 % oil and the press cake obtained as a byproduct of the oil, extraction process contains a very high level of protein. Some of these proteins (approximately 1 %) are active cationic polyelectrolytes having molecular weights between 7-17 K Dalton. The cationic polyelectrolytes neutralize the colloids in muddy or dirty water since the majority of these colloids have a negative electrical charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimenting mineral particles and organics in the purification of drinking water, for cleaning vegetable oil, or for sedimenting fibers in the juice and beer industries **(Dar Essalaam 2001).**

For the final treatment of waste, water in a town of 10,000 inhabitants, approximately 960kg of Moringa flour is required per day'. **1998)**.

2-6-5 Uses as Plant growth enhancer

Lab experimentation had shown that Moringa spray had a wide range of beneficial effects on plant crop. Effects of spray indicated accelerated growth of young plants. Plants were firmer, more resistant to pests and disease, longer life-span, heavier roots, stems and leaves, produced more fruit, larger fruit, increase in yield 20-35% even a fraction of these results could be reproduced in the field, it could be a great help in increasing food supplies for millions of hungry people **(Fahey., 2005).**

The extract obtained from the leaves of Moringa in 80 % ethanol contains growth enhancing principles *(i.e.* hormones of the cytokinine type). The extract can be used in the form of a foliar spray to accelerate the growth of young plants. Use of the growth hormone spray will also cause the plants to be firmer and more resistant to pests and disease. Plants that are treated with this growth hormone spray will also produce more and larger fruit and will consequently have a higher yield at harvest time. The extract can be obtained either through press extraction or by using an ultra-turrax and filtering 20g of tender leaves in a total volume of 675 ml of 80 % aq. ethanol **(Makkar and Becker., 1996).**

2-6-6 Uses as a source of biogas

Moringa plants (approximately 30 day old) were milled together with water. The fiber was separated by filtration through a mesh with 5 mm pores and the liquid fraction produced and then added to a biogas reactor. With an average feed of *5.7* g of volatile solids, the gas production was 580 liters of gas per 1 kg of volatile solids. The average methane content of the gas was 81% (Dar Essalaam) (2011).

2-6-7 Medicinal Benefits

A number of natural compounds have been isolated from M. oleifera leaves including fully acetylated glycosides bearing thiocarbamates, carbamates or nitriles **(Faizi *et al*., 1995; Murakami *et al*., 1998).** Glycosides containing isothiocyanates, malonates and flavonoids also identified and isolated in the leaves of the Moringa plant.**(Faizi *et al*., 1.995; Bennett *et al*., 2003; Mieari *et al*., 2001)**.Plant glycosides can be used as treatments for cancer or chronic conditions such as high cholesterol and atherosclerosis **(Chumark *et al*., 2008; Ghasi *et al*., 2000)**. Plant flavonoids are important to the diet because of their effects on human nutrition. These phyto chemicals can modulate lipid peroxidation involved in atherogenesis, carcinogenesis and thrombosis and other known properties of free radical scavenging or inhibition of hydrolytic and oxidative enzymes (phospholipidase A2, cyclooxygenase, lipooxygenase), shows strong antioxidant and anti-inflammatory activity **(Siddhuraju *et al*., 2003).** Numerous studies have indicated that flavonoids also have anti-carcinogenic, anti-viral and anti-estrogenic activities **(Havsteen., 2002; Miean *et al*., 2000 and Middleton *et al*., 2000)**. These identified bioactivc compounds in the leaves of M. oleifera make this an excellent candidate for nutritional and pharmaceutical supplementation. The World Health Organization (WFIO) has been studying the use of M, oleifera for many decades as a low cost supplement enhancer in the poorest countries around the world **(WHO Readers Forum., 1999)**. This organization has been promoting the use of this plant to help those countries suffering from malnutrition, which is one of the major causes of death worldwide. United Nations Food and Agriculture reported that one in twelve people worldwide is malnourished, including 160 million children under the age of five **(United Nations Food and Agriculture Statistics, 2008).**

2-6-8 Uses of moringa as poultry feed

2-6-8-1 Uses as broiler feed

Inclusion of *Moringa oleifera* leaf meal (MOLM) as feed ingredient in cassava based broiler diets was studied by **(Oluglemi *et al.*, (2010)**, reduction in performance was observed with increasing inclusion levels of (MOLM) beyond *5%* the study conducted that broilers could be safety fed cassava based diets containing (MOLM) at a maximum level of 5% without deleterious effects. **Melesse, *et al* ., (2011)** studied the effect of feeding different levels of *moringa stenopetala* leaf meal (0%, 2%, 4%, and 6%) on nutrient intake and growth performance of chick. Average body weight, body weight gain and feed efficiency ratio, of chicks fed the different levels of Moringa stenopetala leaf meal (MSLM) diet was significantly ($P<0.05$) higher than those fed on control diet. The results indicated that (MSLM) in a potential plant protein supplement that could be included up to 6% in the diet of grower chicks.

Inclusion of (MOLM) in broiler diets were studied by **(Cariaso., 1988)**, he reported that when the leaf meal is fed to 1- week - old broilers up to a level of 5%, growth rate, body weight gain, feed consumption, and feed efficiency are not adversely affected. Higher levels of leaf meal (7.5 and 10%) resulted in depressed growth rate, body weight gain, and feed efficiency, and increased feed consumption.

Du *et al.*, (2007) observed no significance difference in growth performance of 3 weeks old broiler (Arbor Acres) that were fed on diets supplemented with 0.5, 1.0, 2.0 and 3.0% levels of (MOLM).**Oun..*et al.*,(2011)** reported that (MOLM) could be included up to 7.5% dietary level without any deterious effect on performance and blood characteristics of broiler starters fed different level of (M OLM) 0, 2.5, 5 and 7.5%. **Kakengi *et al.*, (2007)** also investigated the effect of substituting *Moringa oleifera* leaf meal (MOLM) for sunflower

seed meal (SFSM) as a protein source for egg strain commercial chickens. They showed that (MOLM) could completely replace SFSM up to 20% without any determinate effects in laying chickens, however for better efficiency 10%, inclusion level was optimal and on addition of (MOLM) above10% high-energy base feeds were required far better utilization.

The potential of Moringa oleifera leaf meal (MOLM) as hypocholesterolemic agent was investigated by **Olugbemi *et al*., (2010)** using layers fed.

Cassava based diets and (MOLM) at 0, 5, and 10% over 990 day period. Results of the study indicate that Moringa olifera possesses hypercholesterolemia properties and its inclusion in layers diets could facilitate reduction in egg cholesterol content.

Odeyinka *et al*., (2008) evaluated the reproduction performance of rabbits fed Moringa oleifera as a replacement for centrosema pubescens. The study concluded that *moringa oleifera* can be used to replace centrosema pubescens without adverse effect on the reproductive performance of the rabbits. Some plant leaves as well as moringa leaves have been used as feed stuffs for poultry and rabbits as supplement or partial substitute for the conventional cereal grains and forages.

2-6-8-2 Uses Laying Hens

The responses of laying hens to enzyme – supplemented feeds are also well documented. Typically, enzymes added to layer feed appear to have little effect on egg mass but improve feed efficiency **(Benabdeljlil ,and A rbaoui., 1994; Vuki Vranjes and Wenk .,1995)** energy utilization **(Wyatt and Good man., 1993; Vuki Vranjes and Wenk., (1995)**, and laying rate(NRC, 1996). **Wyatt and Goodman., 1993)** reported that corn – fed layers exhibited better feed efficiency than those fed enzyme supplemented barley – based diets.

Increased energy utilization in laying hens appears to be due to microbial fermentation of solubilization NSPs **(Vukic vranjes and Wenk., 1995)** and the subsequently higher Absorption of volatile fatty acids **(Choct *et al.*, 1995).**

2-7 Nutri – Xylanase Enzyme application

Nutri – xylanase is abacterial xylanase processed from Bacillus subtilis, and produced by a microfiltration advanced fermentation technique. Nutri – xylanase is a highly efficacious xylanase indegrading both soluble and

insoluble arabino – xylans, the most important antinutritional factor in cereals and cereal by products used in animal feed so as to improve the utilization of nutrients, animal uniformity and animal performance, increase proportional usage of cereal byproducts in formulating animal feed to reduce feed costs.

As results of endo – zylanase and glucarnase supplemention, the only backbones of the arabinoxylans and glucanse are cleaved into shorter fragments, thereby, reducing their viscosity **(Gruppen *et al.*, 1993).**

Supplementary broiler diets with combinations of zylanase and glucanase minimizes the adverse effects of NSPs and improve the nutritive value of diets **(Campbell *et al.*, 1989; Francesch *et al.*, 1989;Helander and Inborr ,1989; Wiedmer and Vlker 1998; Jansson *et al.*, 1990; Beford *et al.*, 1991; Ben abdelielil 1992; Brufau *et al.*, 1993; Jeroch and Dicke 1993; Schuqz *et al.*, 1993; Vukic Vranjes and Wenk 1993; Benabdel jlil and Arbaoui 1994; Broz an - Perrin –Volt 2 1994; Broz *et al.*, 1994; Marquardt *et al.*, 1994; Veldman and Vahl 1994; Allen *et al.*, 1995; Almirall *et al.* 1995; Choct *et al.*, 1995; Classen *et al.*, 1995; Fuente *et al.*,1995; Juin *et al.*, 1995; lclenter, devaud *et al.*,1995 ; Klenter, weber *et al.*. 1995; Langhout and Schutte 1995; Mohammed 1995; Partridge and whyatt 1995; Schutte *et al.*, 1995;Vander Klis *et al.*, 1995; Vukic Vranjes and Wenk 1995; Dunk1996).**

One of the main reasons for supplementary wheat and barely – based poultry diets with enzyme is to increase the available energy content of intake diets. Increased availability of carbohydrates for energy utilization is associated with increased energy digestibility **(Partridge and Wyatt 1995; Vander Klis *et al.*, 1995).** Enzyme supplementation enhance carbohydrates digestibility reducing gut viscosity, and improving fat utilization **(Almirall *et al.*, 1995).**

CHAPTER THREE

MATERIALS AND METHODS

3-1 Experiment site

The experiment was carried out at the Animal Production Department at College Agriculture Studies, Sudan University of Science and Technology, Khartoum north, during the period from 27/9/2014 up to 1/11/2014.

3-2 Preparation of experiment diets

Moringa oleifera leaves meal (MOlM) was collected from privet farm in Khartoum north, they building till they were dried. Then were cleaned, crushed and milled in an electric mill to pass through after mesh sieve, a sample was taken for approximate analysis according to **AOAO (1990)** and milled leaves kept in a plastic bags.

According to the result of approximate analysis of Moringa leaves (Table) (1) experimental diets were formulated to be ISO- nitrogenous (%) ISO - energetic to meet the nutrient requirements of broiler chicks according to **NRC (1994).** Microbial xylam 500 used, produce by Nutrex Company for feed enzyme production obtained from khargiate. El- Nile Company (Khartoum North). Zylam 500 It was compounds of Bacillus Sabtilis composition/.a.amylase 8000 u/gm ;1-4 B Xylanase 1260 .u/gm.

Diet A1 was positive control (With enzyme)), but Diet A2 was negative control with enzyme), control, B1, C1 and D1 were formulated to contain (2.5% , 5.0% and 7.5%) of Moringa oleifera leaves flour as source of plant protein without enzyme.

Table (3.1): Components of Experimental Diets (%)

Component	Control A	Level of Moringa (%)		
		2.5 (B)	5.00 (C)	7.50 (D)
Dura	64.142	66.0	65.0	64.5
G.N cake	14.0	13.74	13.0	12.0
Sesame cake	15.0	11.0	10.0	09.0
Moringa leave	-	2.5	5.0	7.5
Concentrate[8]	5.0	5.0	5.0	5.0
Oster shell	0.487	0.86	0.86	0.86
Lysine	0.618	-	-	-
Methionine	0.25	0.25	0.25	0.25
Vitamin	0.344	0.23	0.15	0.16
Oil	-	-	-	0.29
Dicalphos.	-	0.25	0.2	0.2

[8]Cp = 40%, ME = 2000kj / kg, C.F = 3% , Na = 1.5% , Ca= 8%Phos = 4.6%Lys = 12%Meth = 3.5%

Table (3.2): Chemical Analysis of Experimental Diet (%)s

Level of Moringa (%)	DM	ME K/cal	Ash	C.P	EE	CF
Control	93.20	3105.212	7.09	27.07	5.00	11.40
s2.5	93.50	3111.16	7.27	25.82	5.40	14.80
5.0	93.7	3100.54	7.69	26.63	5.40	11.60
7.5	93.40	3101.28	7.50	22.77	5.40	13.60

Animal production research center Lab Kuku. .

Table (3.3): Calculate nutrient composition of experimental diet required diets

Analysis	Control	2.5%	5%	7.5%
ME kj/kg	3105.212	3111.76	3100.54	3101.28
C. P	22.42	21.95	21.811	21.53
c. F	4.12	25.82	11.60	13.60
EE	5.00	5.40	5.40	5.40
ASH	7.09	7.27	7.96	7.50
NFE		1.03	1.0	1.0
Ca	1.1	1.03	1.0	1.0
Lysine	1.3	1.29	1.21	1.21
Meth.	0.63	0.83	0.62	0.59
DM	93.20	93.50	93.70	93.40
Phos.	0.7	0.61	0.598	0.58

MoringaOlifera leave meal (M) * Ellis 1981

Bluttin III Animal Production Research Center Kuku ,Lodhi., (1976)

Diets B2, C2 and D2 were similar to diets B1, C1 and D1, but they were supplemented with 50 g/kg xylem enzyme, the metabolized level was adjusted by vegetable oil where is required, ingredients presents, calculated and determined were illustrated in the table (3) .

3-2 Feeding Trial

One hundred and sixty eight 7 days, old un sexed broiler chicks were purchased from a commercial poultry production company (Meiko) on basis of uniform live weight, average live body weight 218.5 (Grs) they were reached 42 days of age in a large open sided house. The house was conducted of brick wall 50 cm height the rest of the wall, the ceiling was made of wire netting on all sides, the roof was made of corrugated iron sheets supported iron posts, the open sided house was portioned into 28 small units 1*1 m^2 separated from each other by wire netting, before use, the house feeding requirements were thoroughly cleaned and disinfected. Chicks were randomly distributed into 24 units on deep litter bedding in such a manner that each experimental unit accommodate 7 birds per each replicate of the treatment diets (21 chicks /treatment) water was available at all the time during the study. Feed was distributed in Metallic Tubular feeders, and water was also provided in plastic drinkers at the rate of one drinker per 7 birds. Chicks were vaccinated against Newcastle and meter bronchitis diseases at 5 days old, at 14 days researched, also vaccinated against Gumboro disease at 21 days old, another dose against Newcastle disease, was received and boosting dose at 30 days of age, light was provided 24 hours, in a form of natural light during the day and artificial during night was provided by a 60- watt bulb hayed down to one foot high from the ground during the first week and late to three foot high from the ground during whole period of experiment.

3-3 Parameters

Chicks of each replicate were group weighed at weekly interval and feed consumption was recorded at the time of weighing .feed conversion Ratio (FCR) and body weight gain were calculated weekly, mortality was recorded daily throughout the experimental period.

3-4 Slaughter procedure and carcass cuts

At the end of feeding trial birds were fasted overnight except from water, individually weighed before slaughtering; the birds from each treatment were randomly selected for carcass analysis (8 birds from experiment were slaughtered.

3.5 Blood serum procedure and Method of Analysis

Slaughtered chicks were left to bleed for 1-2 minutes and then immersed in hot water for defeathering and evisceration, head and feet were removed and the hot carcass weight was determined, Giblets (heart, gizzard, and liver) and abdominal fats weights were recorded. the eviscerated carcasses were left overnight in the refrigerator (4c) to determine cold carcass weight then they saved into ton halves , the left side, then divided, into commercial cuts, wing and back were separated from carcass and weighted separately, cuts, were deboned to determine the weight of meat frozen for chemical analysis and panel taste. The frozen reflect from each group was thawed, the samples were then cut into equal pieces and warped individually in Aluminum foil and even- cooked at 190^{o} for 70 min and served worm panelists were instructed to record their response for attribute on scale in the ring from 1-8.

Samples of the blood were took from each group (8 samples) randomly before slaughter with injection from wing of the birds and put in test tubes and put it in deep freezer for 24hours. Serum was separated into test tubes and analyzed with spectrophotometer with enzymatic method.

3-6 Calculation

Hot and cold carcass weights were expressed as a percentage of live weight, the commercial cuts of hot carcass, non carcass components (heart, head, gizzard and liver) were expressed as percentage of live weight, meat and bone of each cut were percentage of the weight of the cut.

3-7 Statistical analysis

The experimental design was in completely randomized design, the data collection of experiment were subjected to analysis variance (ANOVA) using computer program stat soft (2001) and mean separation was done according the Duncan's test **(Duncan .,1955)**.

CHAPTER FOUR

THE RESULTS

4-1 The results:

The supplementation the diets containing graded levels of Moringa oleifera leaf meal and control diets with enzyme recorded improvement in feed intake throughout the experiment period, also the level of the Moringa oleifera leaf meal did not affect significantly ($P > 0.05$) on feed consumption throughout the experiment period.

Chicks fed on control diet with and without enzyme recorded significantly ($p < 0.05$) highest body weight compared to chicks fed on different levels of Moringa oleifera. The inclusion of Moringa oleifera leaf meal on broiler chicks diet at different levels recorded significantly ($P> 0.05$) low in body weight compared to those fed on diet containing Moringa oleifera leaf meal supplemented with enzyme. Chicks fed with and without enzyme recorded significantly ($P <0.05$) the best FCR compared to those fed on diets containing Moringa oleifera leaf meal with and without enzyme followed by groups fed on diets containing Moringa oleifera leaf meal supplemented with enzyme, while chicks fed on diets containing different levels of *Moringa oleifera* leaf meal without supplementation of enzyme showed significantly the lowest FCR values ($p> 0.05$). The effect of feeding broiler chicks on different levels of Moringa oliefera leaf meal (MOLM) with and without enzyme on non-carcass components (head, gizzard, neck heart, fat and liver) showed no significantly ($P >0.05$) different among treated groups

The results obtained the commercial cuts and their meat and bone of chicks fed on different levels of Moringa oliefera leaf meal (MOlM) showed no significant ($P >0.05$) differences in (breast, thigh and drumstick) and their meat values and the weight of wings for treated chicks. However, results

revealed a numerical increase in commercial cuts and weight of wings for chicks fed on diets containing different levels of Moringa oliefera leaf meal (MOLM) supplemented with zylam enzyme)

The effect of feeding different levels of Moringa oliefera leaf meal on blood serum showed significant increase ($p < 0.05$) in total protein for chicks fed on negative control compared to positive control, however, there is no significant difference between groups fed on different levels of Moringa leaf meal with or without enzyme, although, all obtained results were in normal level (Table (5-4)).

The inclusion of Moringa oleifera leaf meal in broiler chicks diet decreased the cholesterol level also the supplementation of enzyme decreased the level of cholesterol compared to groups without enzyme however, this reduction of cholesterol is not significant. ($p> 0.05$).

Results obtained revealed no significant effects ($p> 0.05$) in urea and glucose levels due to Moringa oleifera leaf meal or enzyme supplementation in broiler diet. All values obtained were within normal levels.

Table (4.1): Overall performance of broiler chicks

Parameter	Without enzyme				With enzyme				$Lsd_{0.5}$	SE±
		Level of Moringa (%)								
	Control	2.5	5.0	7.5	Control	2.5	5.0	7.5		
Body weight (gm)	2017.02^{d} ±0.19	1714.58^{d} ±0.23	1706.67^{b} ±0.22	1673.67^{***} ±0.18	1491.79^{h} ±0.19	1623.81^{g} ±0.22	1831.90^{b} ±0.25	1746.12^{c} ±0.17	7.7258^{**}	2.5461
Feed intake (gm)	2829.99^{h} ±0.17	2929.99^{hh} ±0.21	3020.42^{c} ±0.18	3106.78^{b} ±0.20	3289.23^{a} ±0.26	2983.19^{f} ±0.21	3084.05^{c} ±0.18	3078.28^{d} ±0..26	6.3419^{**}	2.1793
Weight (gm)	1774.95^{a} ±0.15	1497.99^{d} ±0.18	1532.48^{c} ±0.14	1427.3^{f} ±0.17	1328.24^{g} ±0.13	1435.49^{e} ±0.18	1553.00^{h} ±0.12	1590.66^{b} ±0.19	5.3627^{**}	1.8544
FCR	1.59^{f} ±0.05	1.52^{8} ±0.04	1.97^{d} ±0.03	2.18^{b} ±0.02	2.48^{a} ±0.07	2.08^{c} ±0.06	1.99^{d} ±0.05	1.94^{e} ±0.03	0.0485^{*}	0.0025
Mortality rate	1.19^{a} ±0.01	0.0^{b} ±0.01	0.0^{b} ±0.0	0.0^{b} ±0.0	0.0^{b} ±0.0	0.0^{b} ±0.0	0.0^{b} ±0.0	0.0^{b} ±0.0	0.1376^{*}	0.0397

Values are mean± SD.

Mean value (s) having different superscript (s) in a row are significantly different ($P \leq 0.05$) according to DMRT.

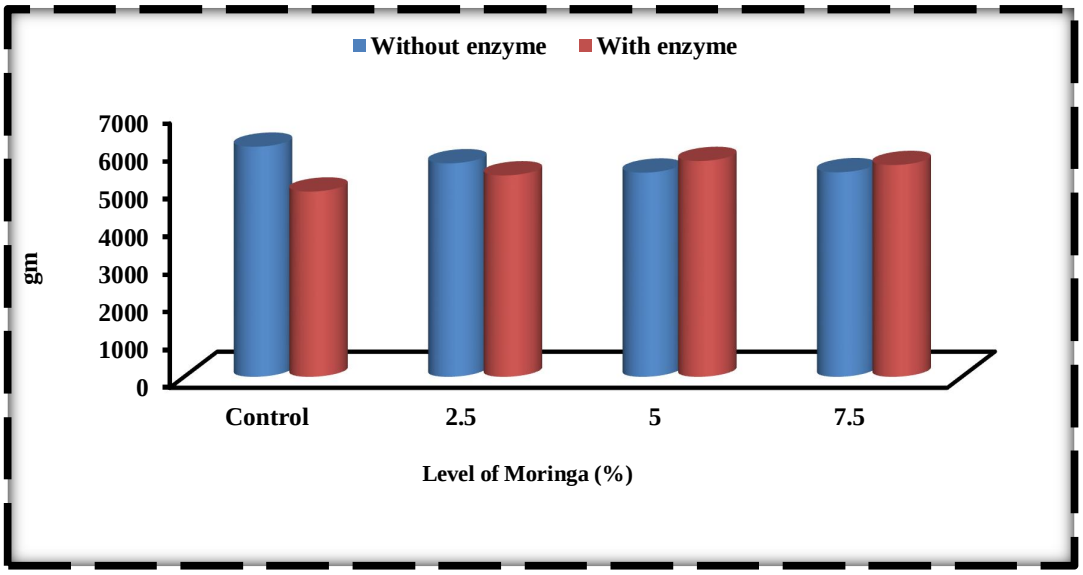

Fig. (1): Overall mean of body weight

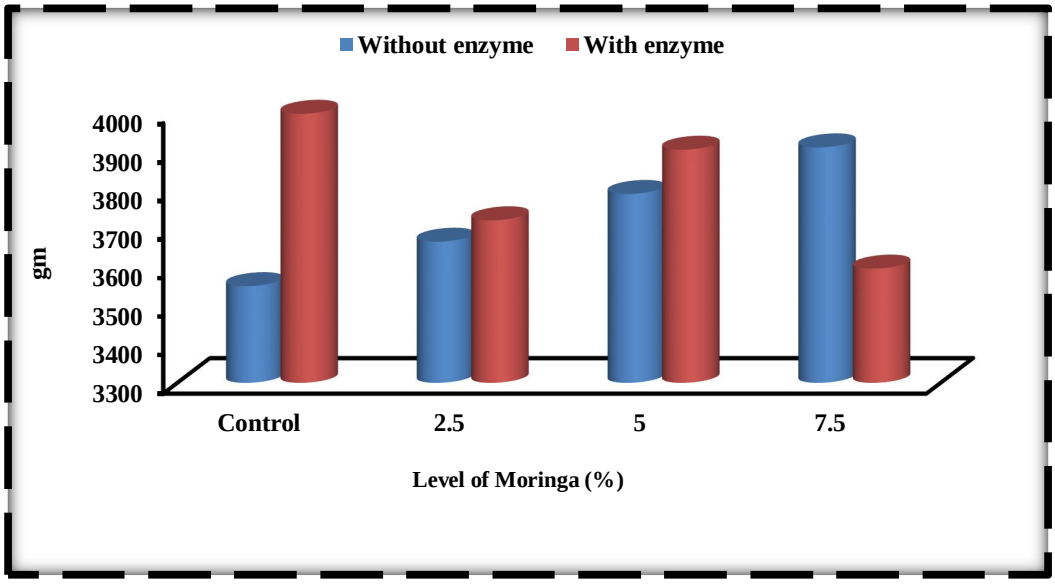

Fig. (2): Overall mean of feed intake

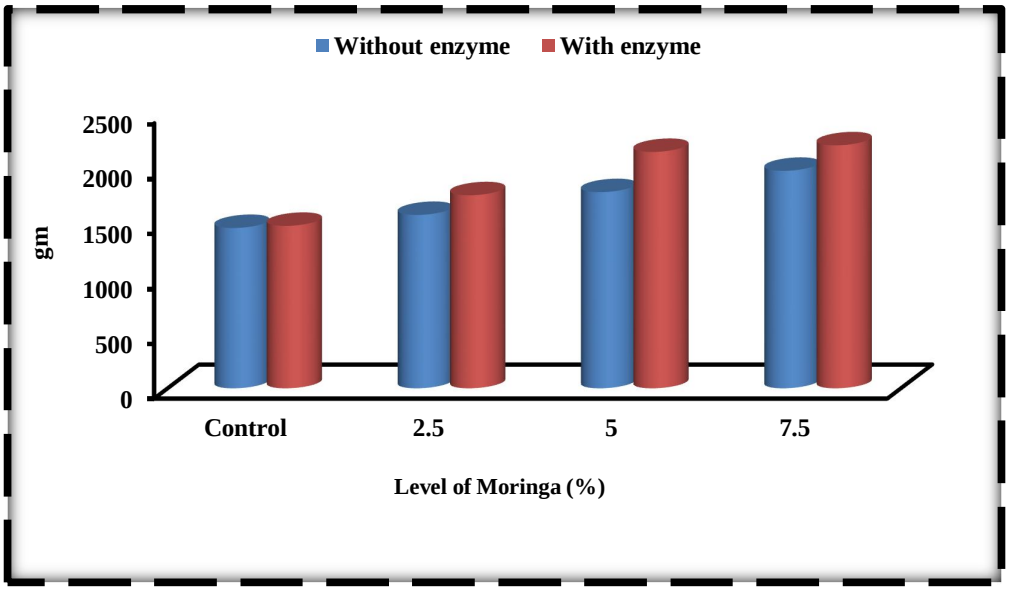

Fig. (3): Overall mean of weight gain

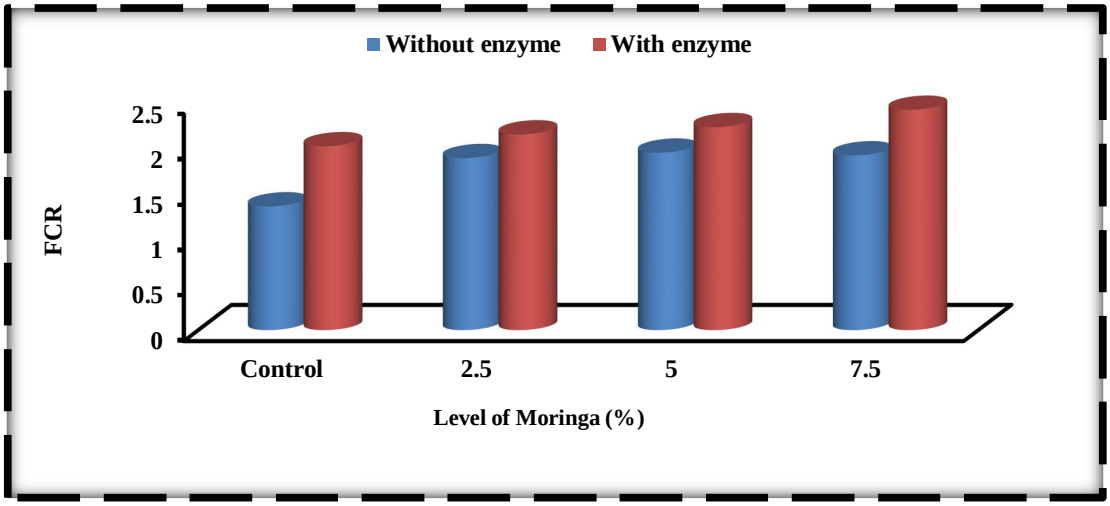

Fig. (4): Overall mean of feed conversion ratio

Table (4.2): Effect of adding different levels of Moringa oleifera leaf meal and treatment of enzyme on commercial cuts (GM.)

Level of Moringa (%)	Heart wt.		Fat wt.		Leg wt.		Frot wt.	
	Enzyme							
	Without	With	Without	With	Without	With	Without	With
Control	22.00^{a} ±1.00	8.33^{b} ±2.89	15.00^{a} ±0.0	21.67^{a} ±7.64	0.0^{b} ±0.0	76.67^{a} ±5.77	1661.67^{a} ±103.96	1176.67^{b} ±137.69
2.5	8.33^{b} ±2.87	8.33^{b} ±2.87	15.00^{a} ±0.0	26.67^{a} ±12.58	76.67^{a} ±10.41	76.67^{a} ±5.77	1280.00^{b} ±241.09	1281.67^{b} ±132.51
5.0	6.67^{b} ±2.87	10.00^{b} ±0.0	16.67^{a} ±2.89	8.33^{a} ±14.43	73.33^{a} ±10.41	85.00^{a} ±13.23	1253.33^{b} ±35.47	1421.67^{b} ±80.05
7.5	8.33^{b} ±2.89	10.00^{b} ±0.0	18.33^{a} ±3.53	16.67^{a} ±5.77	73.33^{a} ±10.41	75.00^{a} ±13.23	1245.67^{b} ±158.13	1268.33^{b} ±147.81
$Lsd_{0.05}$	3.997^{*}		$16.76^{n.s}$		$16.7^{n.s}$		244.8^{*}	
SE±	1.333		5.59		5.559		81.64	

Values are mean± SD.

Mean two value (s) sharing same superscript (s) are not significantly different (Pleav≤0.05)

Table (4.3): Effect of adding different levels of Moringa oleifra leaf meal and treatment of enzyme o (gm) of broiler chicks.

Level of Moringa (%)	Cold weight		Breast		Meat		Bone		Thigh		Meat		
	Enzyme												
	W_o	W	W_o	W	W_o	W	W_o	W	W_o	W	W_o	W	W
Control	1650.00^{a} ±108.97	1190.00^{b} ±130.29	321.67^{a} ±52.04	216.67^{b} ±24.66	260.00^{a} ±88.88	188.33^{a} ±18.93	26.6^{a} ±13.33	25.00^{a} ±8.66	138.33^{a} ±14.43	100.00^{b} ±5.00	66.67^{b} ±23.09	80.00^{ab} ±5.00	20. ±8.
2.5	1286.67^{b} ±218.31	1290.00^{b} ±121.66	245.00^{b} ±60.00	231.67^{b} ±44.81	208.33^{a} ±48.05	193.33^{a} ±30.14	31.67^{a} ±15.28	25.00^{a} ±15.00	115.00^{ab} ±15.00	123.33^{ab} ±32.53	91.67^{ab} ±15.28	86.67^{ab} ±17.56	15. ±5.
5.0	1276.67^{b} ±45.09	1430.00^{ab} ±82.61	225.00^{b} ±31.22	275.00^{ab} ±13.23	200.00^{a} ±26.46	241.67^{a} ±27.54	25.00^{a} ±8.66	28.33^{a} ±10.41	106.67^{ab} ±2.89	120.00^{ab} ±5.00	93.33^{ab} ±5.77	103.33^{a} ±2.89	16. ±5.
7.5	1248.33^{b} ±167.51	1266.67^{b} ±151.77	213.33^{b} ±16.07	225.00^{b} ±10.00	186.67^{a} ±18.93	195.00^{a} ±18.03	22.00^{a} ±6.08	36.67^{a} ±2.89	110.00^{ab} ±18.03	108.33^{ab} ±27.54	95.00^{ab} ±10.00	90.0^{ab} ±26.46	13. ±5.
$Lsd_{0.05}$	238.00^{*}		62.51^{*}		$71.41^{n.s}$		$18.73^{n.s}$		31.40^{*}		26.97^{*}		
SE±	79.39		20.85		23.82		6.248		10.47		8.995		

Values are mean± SD.

Any two mean value (s) sharing same superscript (s) are not significantly different (P≤0.05).

Table (4.4): Effect of adding different levels of Moringa oleifera leaf meal on non- carcass character (gm)

Level of Moringa (%)	Pre-slaughter wt.		Heart wt.		Gizzard wt.		Fat wt.		Liver w	
	Enzyme									
	Without	With	Without	With	Without	With	Without	With	Without	Wi
Control	2250.00^{a} ±236.43	1531.67^{c} ±275.97	8.43^{b} ±1.00	8.33^{b} ±2.89	28.67^{a} ±10.44	25.00^{b} ±0.0	15.00^{a} ±0.0	18.67^{a} ±7.64	34.00^{a} ±5.29	33. ±2.
2.5	1921.67^{abc} ±318.58	1811.33^{bc} ±145.60	8.33^{b} ±2.87	8.33^{b} ±2.87	28.33^{b} ±2.89	30.00^{b} ±0.0	15.00^{a} ±5.00	17.67^{a} ±12.58	33.33^{b} ±2.87	41. ±1 1
5.0	1835.00^{abc} ±78.58	2095.00^{ab} ±135.92	6.67^{b} ±2.87	10.00^{b} ±0.0	28.33^{b} ±2.89	26.67^{b} ±2.89	16.67^{a} ±2.89	18.33^{a} ±14.43	35.00^{b} ±5.00	36. ±2.
7.5	1865.00^{abc} ±210.18	1961.67^{ab} ±229.80	8.33^{b} ±2.89	10.00^{b} ±0.0	28.33^{b} ±5.77	26.67^{b} ±7.64	18.33^{a} ±3.53	16.67^{a} ±5.77	3.33^{b} ±2.89	35. ±1 0
$Lsd_{0.05}$	375.1*		3.997*		3.997*		16.76$^{n.s}$		12.98*	
SE±	125.1		1.333		1.333		5.59		4.304	

Values are mean± SD. Any two mean value (s) sharing same superscript (s) are not significantly different (P≤0.05).

Table (4.5): Serum analysis of experimental chicks

No	Glucose my\dl	T. protein g\l	Cholesterol my\dl	Urea my\l
B_2wo	200	34	78	8
B_1w	197	43	66.5	7
C_2wo	218	35	83.5	9.3
C_1w	207	41	72	8
D_2wo	181	44	92	10.5
D_1w	207	28	50.5	8
A_1w	205	23	95.5	7.5
A_2wo	179	50	80	10.7

Without any figure to indicate the significant ,Colum without letters are significant

Table (4.6): Effect of adding different levels of *Moringa oliefera* leaf meal and treatment of enzyme on sensory

Level of Moringa (%)	Leg		Meat		Bone		Wing	
	Enzyme							
	Without	With	Without	With	Without	With	Without	With
Control	101.67^{a} ±2.89	85.00^{a} ±20.21	108.33^{a} ±20.21	63.33^{b} ±7.64	20.00^{a} ±0.00	20.00^{a} ±0.00	73.33^{a} ±2.89	75.00^{a} ±8.66
2.5	93.33^{a} ±15.28	95.00^{a} ±8.66	68.33^{b} ±14.43	70.00^{b} ±8.66	20.00^{a} ±5.00	18.33^{a} ±7.64	80.00^{a} ±13.23	80.00^{a} ±10.00
5.0	83.33^{a} ±5.77	95.00^{a} ±8.66	70.00^{b} ±5.00	71.67^{b} ±7.64	18.33^{a} ±5.77	21.67^{a} ±2.89	73.33^{a} ±10.41	88.33^{a} ±5.77
7.5	86.67^{a} ±16.07	90.00^{a} ±15.00	65.00^{b} ±13.23	70.00^{b} ±8.66	20.00^{a} ±5.00	20.00^{a} ±8.66	73.33^{a} ±10.41	81.67^{a} ±12.58
$Lsd_{0.05}$	$18.70^{n.s}$		20.14^{*}		$9.182^{n.s}$		$^{16.94}n.s$	
SE±	6.236		6.719		3.063		5.652	

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different (P≤0.05).

Table (4.7): Economic evaluation

	Control		2.5%		5%		
	W_o	**W**	**W_o**	**W**	**W_o**	**W**	**W**
Feed cost	12.129	12.892	8.542	7.384	7.26	8.044	8.5
Chicks cost	4.5	4.5	4.5	4.5	4.5	4.5	4.
Management	2.0	2.0	2.0	2.0	2.0	2.0	2.
Total cost	18.629	19.392	15.042	13.884	13.76	14.544	15.0
A carcass wt	1.165	1.79	1.28667	1.29	1.27667	1.43	1.24
Price/ kg	26.0	26.0	26.0	26.0	26.0	26.0	26
Total revenue	30.29	30.94	33.4534	33.54	33.1934	37.18	32.45
Profit	11.661	11.548	18.4114	19.656	19.433	22.636	17.4
Profitability	1.0	0.99	1.579	1.686	1.666	1.941	1.4

Table (4.8): Effect of adding different levels of Moringa oliefera leaf meal and treatment of enzy ratio (bird/week) of broiler chicks

Level of Moringa (%)	Weeks							
	1st		2nd		3rd		4th	
	Enzyme							
	Without	With	Without	With	Without	With	Without	With
Control	0.17^{c} ±0.02	0.27^{b} ±0.06	0.19^{e} ±0.01	0.33^{d} ±0.06	0.24^{d} ±0.06	0.43^{a} ±0.10	0.22^{d} ±0.08	0.39^{b} ±0.14
2.5	0.25^{b} ±0.05	0.26^{b} ±0.07	0.34^{d} ±0.10	0.37^{b} ±0.08	0.33^{c} ±0.08	0.32^{c} ±0.02	0.33^{c} ±0.09	0.35^{bc} ±0.05
5.0	0.33^{b} ±0.06	0.29^{b} ±0.01	0.36^{bc} ±0.12	0.40^{a} ±0.08	0.26^{d} ±0.04	0.25^{d} ±0.01	0.36^{b} ±0.05	0.37^{b} ±0.12
7.5	0.32^{a} ±0.10	0.25^{b} ±0.07	0.35^{bc} ±0.04	0.20^{e} ±0.06	0.25^{d} ±0.04	0.37^{b} ±0.08	0.53^{a} ±0.19	0.31^{c} ±0.00
Lsd $_{0.05}$	0.0421^{*}		0.0227^{*}		0.0656^{*}		0.0342^{*}	
SE±	0.0079		0.0085		0.0018		0.0071	

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different ($P \leq 0.05$).

Table (4.9): Effect of adding different levels of Moringa oliefera leaf meal and treatment of enzyme (gm/bird/week) of broiler chicks

Level of Moringa (%)	Weeks							
	1st		2nd		3rd		4th	
	Enzyme							
	Without	With	Without	With	Without	With	Without	With
Control	186.43^{b} ±25.21	161.38^{e} ±42.13	214.76^{a} ±23.52	149.00^{d} ±31.26	385.71^{b} ±91.29	307.62^{e} ±130.72	551.15^{a} ±127.92	342.62^{c} ±63.33
2.5	168.95^{d} ±32.77	193.95^{d} ±59.70	181.43^{e} ±23.52	146.19^{e} ±36.40	258.09^{f} ±26.05	237.86^{h} ±68.42	318.57^{e} ±53.56	297.28^{g} ±53.78
5.0	141.52^{h} ±16.92	152.57^{f} ±10.18	150.48^{d} ±48.25	127.43^{g} ±25.09	331.19^{c} ±28.03	320.86^{d} ±26.72	311.67^{f} ±40.37	323.09^{d} ±52.51
7.5	146.57^{g} ±23.85	182.81^{c} ±40.18	136.90^{f}	206.67^{b} ±66.04	398.81^{a} ±114.37	253.57^{g} ±46.16	268.01^{h} ±115.70	372.14^{b} ±48.25
Lsd $_{0.05}$	3.1088^{*}		2.6257^{*}		4.5874^{*}		3.875^{*}	
SE±	0.9375		1.2161		1.1868		0.9964	

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different ($P \leq 0.05$).

Table (4.10): Effect of adding different levels of Moringa oliefera leaf meal and treatment of enzym bird/week) of broiler chicks

Level of Moringa (%)	Weeks							
	1st		2nd		3rd		4th	
	Without	With	Without	With	Without	With	Without	With
Control	214.28^{c} ±0.00	414.30^{ab} ±0.00	285.71^{d} ±0.00	331.70^{bcd} ±12.50	617.62^{ab} ±16.32	780.90^{a} ±181.39	768.57^{a} ±29.72	921.20^{a} ±189.14
2.5	410.8^{b} ±6.10	419.00^{b} ±8.25	409.80^{a} ±74.28	358.80^{abc} ±34.66	592.60^{ab} ±107.05	528.30^{b} ±126.26	708.10^{a} ±82.11	749.05^{a} ±221.82
5.0	414.30^{ab} ±0.00	410.80^{b} ±6.10	352.30^{ab} ±19.37	369.30^{ab} ±29.44	576.90^{ab} ±99.18	584.50^{ab} ±78.38	777.14^{a} ±71.55	800.00^{a} ±129.22
7.5	410.80^{b} ±6.10	414.30^{ab} ±0.00	303.10^{cd} ±15.84	290.20^{d} ±10.11	572.20^{ab} ±63.39	720.47^{ab} ±190.91	870.54^{a} ±189.89	821.19^{a} ±106.20
Lsd $_{0.05}$	8.205*		56.30*		209.30*		245.90^{ns}	
SE±	0.1184		2.3267		5.1048		9.8871	

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different (P≤0.05).

Table (4.11): Effect of adding different levels of Moringa oliefera leaf meal and treatment of enzym evaluation

Level of Moringa (%)	Quality attributes						
	Tenderness		Flavour		Colour		Juici
	Enzyme						
	Without	With	Without	With	Without	With	With
	Scores						
Control	6.70^{ab} ±0.17	5.90^{cd} ±0.08	6.30^{ab} ±0.12	5.40^{d} ±0.03	5.70^{d} ±0.06	6.00^{bc} ±0.09	5.0 ±0.0
2.5	6.80^{a} ±0.19	5.60^{e} ±0.05	5.10^{e} ±0.01	5.60^{c} ±0.05	5.40^{e} ±0.03	6.10^{b} ±0.11	5.50 ±0.0
5.0	6.40^{b} ±0.13	6.40^{b} ±0.13	5.60^{c} ±0.05	6.40^{a} ±0.13	6.10^{b} ±0.11	5.90^{c} ±0.08	4.7 ±0.0
7.5	5.80^{d} ±8.07	6.00^{c} ±0.09	5.60^{c} ±0.05	6.00^{b} ±0.09	6.60^{a} ±0.15	5.20^{f} ±0.02	5.8 ±0.0
$Lsd_{0.05}$	0.08526^{*}		0.07415^{*}		0.09637^{*}		
SE±	0.003349		0.00238		0.00451		

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different ($P \leq 0.05$).

Table (4.12): Effect of adding different levels of *Moringa oliefera* leaf meal and treatment of enzym

Level of Moringa (%)	Weeks							
	1st		2nd		3rd		4th	
	Without	With	Without	With	Without	With	Without	With
Control	379.00^{a} ±87.16	323.60^{a} ±50.61	518.60^{ab} ±48.28	452.30^{30} ±60.56	864.30^{a} ±131.78	723.50^{b} ±9.55	1415.00^{a} ±126.06	1054.00^{b} ±78.05
2.5	38.50^{a} ±37.41	380.20^{a} ±8.46	504.50^{ab} ±60.95	527.0^{ab} ±42.38	825.80^{ab} ±71.81	763.50^{ab} ±60.02	1143.00^{b} ±124.01	1063.00^{b} ±108.35
5.0	330.20^{a} ±4754	373.40^{a} ±11.27	480.90^{abc} ±0.75	405.60^{c} ±57.75	797.40^{ab} ±21.00	827.90^{ab} ±37.18	1108.00^{b} ±59.08	1150.00^{b} ±25.15
7.5	362.30^{a} ±17.79	338.00^{a} ±5.97	503.30^{ab} ±28.08	544.80^{a} ±18.86	845.50^{a} ±19.36	798.30^{ab} ±51.42	1170.00^{b} ±40.67	1170.00^{b} ±74.34
Lsd $_{0.05}$	83.77^{ns}		77.41*		107.80*		150.50*	
SE±	0.1184		2.3267		5.1048		9.8871	

Values are mean± SD.

Any two mean values (s) sharing same superscript (s) are not significantly different (P≤0.05).

4-2 Discussion

Results of feeding broiler chicks on different levels of Moringa 1eaf meal with and without Zylmase enzyme revealed that the consumption did not affected significantly by' the levels of the Moringa leaf meal in the diet, although, the enzyme supplementation recorded improvement in feed intake. this might be due to the high level of fiber in Moringa leaf meal or for the better taste of hull and that the leaves had some anti-nutritional factors such as Tannins, phenö1 **(Güpi *et al.,* 1989).** saccharides raffinose and sfàchyose which produce flatulence in monogastrus also nitrate, oxalate and phytate, however, phytate decrease the bio availability of minerals in monogastric **(Reddy *et al*; 1982).** however the zylmase enzyme supplementation increase the starch and protein digestibility and minerals availability.

The inclusion of Moringa oleifera leaf meal at different levels with and without enzyme delivered final body weight and weight gain.This-might be due to the reduction in feed intake the inclusion of moringa leaf meal reduced significantly the FCR value. Compared to the control group, however, enzyme supplementation. improved FCR as evidenced by the variation in weight gained in different treatment feed consumption results was in line with findings of **(Olugbemi *et al*; 2010 and Cariaso) 1988)** these results were similar to that obtained by **(Olugbemi *et al.,* 2010)** who found a reduction in broiler chicks performance when the level of moringa leaf meal increased beyond 5% the results was supported by the findings from studies of substitution sunflower seed meal with moringa leaf meal in diets of laying hens by **(Kakengi *et al*; 2007 and Cariaso I988)** when fed chicks on high levels of Moringa oleifera leaf meal (7.5%- 10%) these results were on contrast with those obtained by **(Melesse *et al.,* 2011)** who, found significantly high in BW, BWG and feed efficiency for chicks fed on moringa oleifera leaf meal up at 5% compare to control group.

The experiment chick fed on *Moringa oleifera* leaf meal showed yellow coloration of body parts, the coloration increased with the increase moronga leaf meal in the diets, it was attributed to the presence of xanthophylls and carotenoid pigments in *Moringa oleifera* leaf meal as in the tree and shrub leaf as in agreement by **(Austic and Neishen., 1990).**

Feeding broiler chicks on different levels of *Moringa oleifera* leaf meal with and without zylamae enzyme did not affect on non carcass components (Gizzard, heart, neck, abdominal, fat and liver) commercial cuts value, wing weight and blood characteristics. These results were confirmed with the finding of **(Oun *et al.*, 2011)** who fed chicks on the different levels of *Moringa oleifera* leaf meal(o,2.5,5, and 7.5% he reported that (MOLM)could be included up to 7.5 % without any deteriorus effect on performance and carcass characteristics of broiler.

Result were on contrast with the finding of **(Gadziryi *et al.*, 2012)** who recorded significant difference in carcass yield between the different treatments on birds fed on different moringa leaf meal. (0, 2.5, 5, 7.5% reported that (MOLM) could be included up to 7.5% without any deterious effect on performance and characteristics of broiler.

Inclusion of *Moringa oleifera* leaf meal decreased the blood cholesterol; this is might be due to the glycosides find in the *Moringa oliefera* leaf meal **(Faizi *et al.*, 1995 and Murakami *et al.*, 1998)**. Treatment for cancer on chronic conditions such as high cholesterol and atherosclerosis **(Chumark *et al*; 2008 and Ghasi *et al*; 2001)** Plant glycoside can be used as treatments for cancer on chronic conditions such as high cholesterol and atherosclerosis **(Chumark *et al*., 2008 and Ghasi *et al*., 2000).**

4-5 Conclusion

Based on the study conclude that:

To investigate of supplementation of broiler diets with *Moringa oliefera* leaf meal with and without enzyme in different levels had benefit effect in the average of body weight gain. Blood serum, economical study and carcass cut.

Moringa olifera leaf meal is potential plants protein supplement and could be used up to 7.5% in broiler diets without any adverse effect on broiler performance.

The suitable supplement dietary concentration of *Moringa oliefera* leaf meal with and without enzyme in broiler diets in this study due to favorable high moringa conversion ratio, which matches also with consumer performance for checking meal noticeable pigmentation as produced with 5% *Moringa oliefera* supplementation.

The economical study of dietary (MOLM) inclusion with and without enzyeme in broiler chick's diet reveled high profit compared on both negative and positive control. However 5% of (MOLM) without enzyme recorded highest profitability ratio (1.94) compared with 5% of MoLM without enzyme (1.66) although groups fed on positive control recorded the lowest profitability ratio (0.99).

5-5 Recommendations

- According to the result obtained (MOLM) could be considered as a potential growth source that may replace the protein.
- All levels of (MOLM) supplemented on broiler diets in this study were recommended economic wise but the level 5% more profitable in the future on the possibility we need more experiments of supplementation (MOLM) with or without enzyme in broiler as well as testing it for meat production and quality.

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Appendix

Appendix(1)

Weekly temperature monitory during the period 27th September to 1 November 2014

Week	Medium temperature
1	37.45
2	35.4
3	31.95
4	28.5
5	27
6	32

Appendix(2):

Card used for judgment of subjective meat quality attributes .

Sensory evaluation card

Evaluate these sample for color ,flavor ,juiciness and tenderness .for each sample ,use the appropriate scale to show your attitude by checking at the point that dest describes your felling about the sample .if you have any question please ask . thanks your cooperation .

Name……..date……..

Tenderness	flavor	colour	juiciness
8-Extremelytender.	8-extremely intense.	8-extremely desirable.	8-extremely juicy.
7-very tender .	7-very intense.	7-very desirable .	7-very juicy.
6-moderatly tender .	6--moderatly intense.	6--moderatly desirable.	6- moderately juicy.
5-slightly tender .	5-slightly bland.	5-slightly desirable.	5-slightly juicy.
4-slightly tough .	4- -slightly bland.	4- slightly desirable.	4- slightly dry.
3-moderatly tough .	3- moderatly bland.	3- moderatly desirable.	3- moderately dry.
2-very tough .	2-very bland.	2-very un desirable.	2-very dry.
1-extremely tough.	1-extremely bland .	1-extremely un desirable .	1-extremely dry.

Serial	Sample cod	Tenderness	flavor	colour	juiciness	comments
1						
2						
3						
4						
5						
6						
7						
8						

Reagent	B	STD	S
	1ml	1ml	1ml
B	-	-	-
STD	-	0.01m-l	-
S	-	-	0.01ml

R= Reagent B= Blanket S= Sample STD= Standard

We added 0.01 ml (STD) to 1ml (R) and we added 0.01 ml (S) to (R).

$$* G = \frac{s}{STD} \times \text{Concentration of (STD)}$$

* Cholesterol was calculated with the same method above.

Reagent	B	STD	S
	1ml	1ml	1ml
B	-	-	-
STD	-	0.02m-l	-
S	-	-	0.02ml

We added0.02 ml (STD) to 1m of (R) and 0.02ml (S) to 1ml (R).

$$* T. P = \frac{s}{STD} \times \text{Concentration of (STD)}$$

* Urea:

Reagent	B	STD	S
	1ml	1ml	1ml
B	-	-	-
STD	-	0.01	-
S	-	-	0.01
R2	1ml	1ml	1ml

We added 0.01 ml (STD) to 0.01 ml (R_1) and 0.01ml (S) to (R_2), after 10 minutes we added 1ml (R_2) to (B, STD and S), after 10 minutes we calculated the urea.

$$\text{Urea} = \frac{s}{STD} \times \text{Concentration of (STD)}$$

Appendix (3):

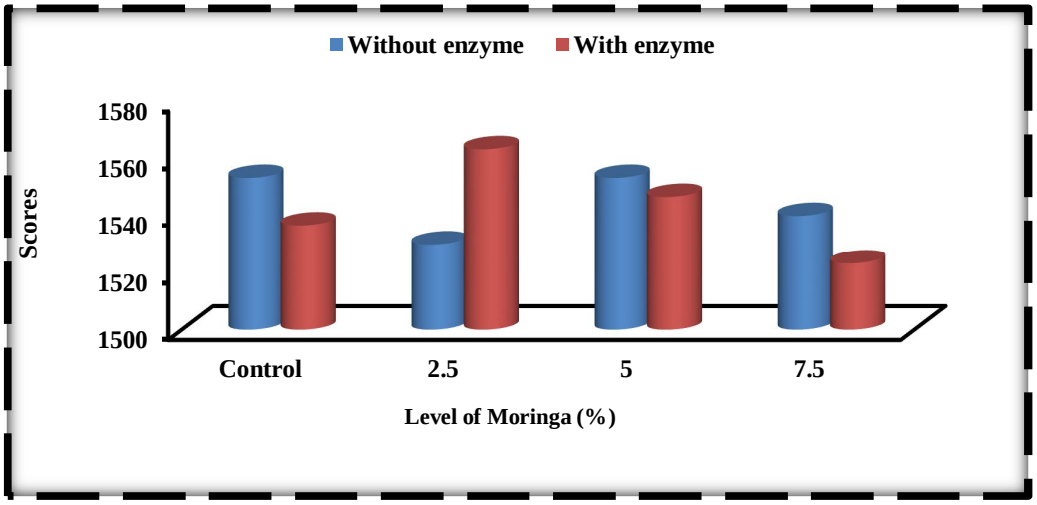

Fig. (5): Tenderness

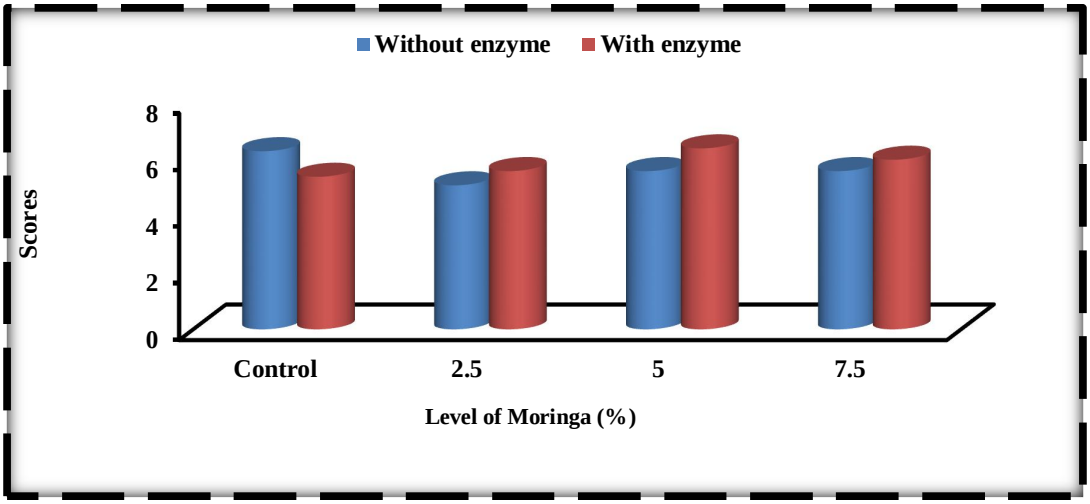

Fig. (6): Flavour

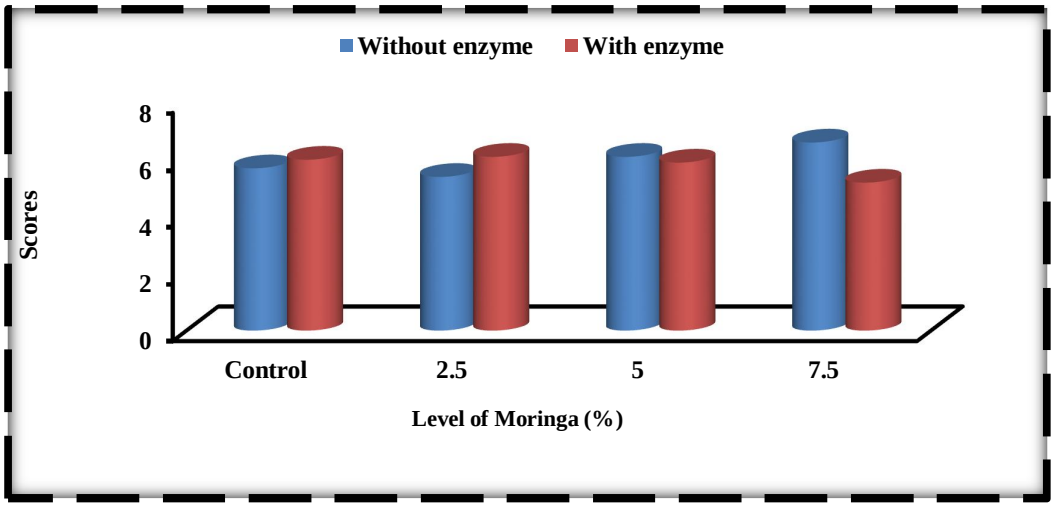

Fig. (7): Colour

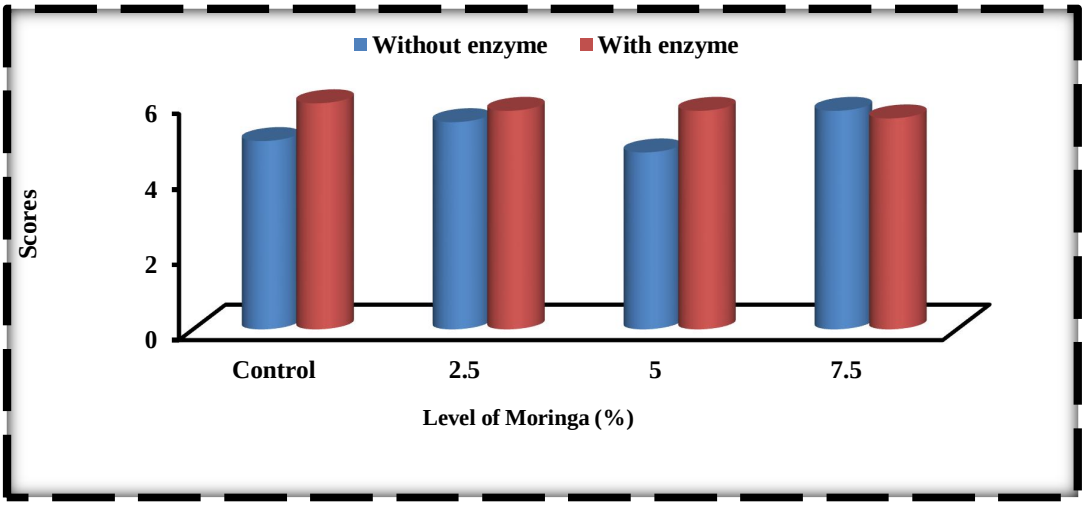

Fig. (8): Juiciness