بسم الله الرحمن الرحيم

Sudan University of Science and Technology
College of Agricultural Studies

Effect of Roast Processing with the Supplementation of Moringa Leaf Meal on the Nutritional Value of Full Fat Soya bean in Broiler Chicks Diets

تأثير المعالجة بالتحميص مع إضافة مسحوق أوراق المورينقا علي القيمة الغذائية لفول الصويا كامل الدهن في تغذية الدجاج اللاحم

A Thesis submitted in partial fulfilment for the requirements of Sudan University of Science and Technology for the degree of Master of Science in Animal Production

By:

Fadwa Mohammed Salih Abakar
B.Sc. Animal Production
University Of Elgezira

Supervisor:

Prof. Dr. Mohamed Eltigani Salih

Department of Animal Production,
College of Agricultural Studies
Sudan University of Science and Technology

January (2017)

الآيـة

قال تعالى

بسم الله الرحمن الرحيم

﴿ وَمَا مِن دَآبَّةٖ فِي ٱلۡأَرۡضِ وَلَا طَٰٓئِرٖ يَطِيرُ بِجَنَاحَيۡهِ إِلَّآ أُمَمٌ أَمۡثَالُكُمۚ مَّا
فَرَّطۡنَا فِي ٱلۡكِتَٰبِ مِن شَيۡءٖۚ ثُمَّ إِلَىٰ رَبِّهِمۡ يُحۡشَرُونَ ﴾

صدق الله العظيم

سورة الأنعام(الأية38)

DEDICATION

To my mother, my angel and the candle of my life

To my Brothers and Sisters

To the beautiful colleagues I had, who I learnt from them the real meaning of solidarity and cooperation

ACKNOWLEDGMENT

First of all, I would like to thank Allah for his mercy and blessing, and giving me the patience and strength to complete this study and make it reality.

I am deeply indebted to my supervisor, Prof. Dr. Mohamed Eltigani Salih, for his kindness support, guidance, recommendations and professional supervision, who helped and supported me by revising the text and giving me valuable advices. May Allah bless him.

My appreciations are extended to the staff members of Animal Production Department and all my friends.

I would like to express my sincere gratitude to and all the staff members of Algar Company, for allowing me to use the facilities

Finally, I would like to thank my family unlimited support and encouragement they provided me through my entire life, and thanks for all those who helped me and couldn't remember individually.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract

A total of hundred and five day old broiler chicks were used to evaluate the effect of feeding different levels of full fat soya bean on their performance. Three dietary treatments containing 0%, 12% and 15% full fat soya bean, to the 15% full fat soya bean 1% Moringa leaf meal was added in the Finisher diet as antioxidant. Each treatment was replicated five times with seven birds per replicate. The study lasted for six weeks. Parameters measured was feed intake, body weight, body weight gain, Feed Conversion Ratio (FCR), pre-slaughter weight, dressing percentage and the relative weight of the pancreas. Result revealed that inclusion of full fat soya bean at 15% with supplementation of moringa leaf meal significantly ($p<0.05$) improved the performance of birds in comparison to birds fed diet containing 12% full fat soya without supplementation. This improvement may be attributed to the antioxidant roll of moringa in protecting the fat content of full fat soya bean as well as fat-soluble vitamin from destruction. As consequence this antioxidant protection result in better feed palatability and a significant improvement in feed intake, efficacy dressing percentage in comparison to the group of birds fed 12% full fat soya bean.

Although supplementation of moringa leaf meal overcome the negative effect of full fat rancidity; but does not protect the pancreas from enlargement. This indicate that the processing method of roasting usually used in Sudan is not efficient for destroying the anti-nutrients in full fat soya bean.

ملخّص الدراسة

أستخدمت في هذه الدراسة عدد مائة وخمسة كتكوت لاحم عمر يوم غير مجنس, لتقييم تأثير تغذية مستويات مختلفة من فول الصويا كامل الدهن في أداء الدجاج اللاحم , تم إضافة ثلاثة معاملات غذائية تحتوي علي (0%, 12% و15%) فول الصويا كامل الدهن, تمت إضافة 1% من مسحوق اوراق المورينقا إلي المعاملة 15% فول الصويا كامل الدهن في عليقة الناهي كمضاد للأكسدة . كل معاملة تم تقسيمها إلي خمس مكررات بكل مكرر عدد 7 كتكوت . إستمرت الدراسة لفترة ستة أسابيع . تم فيها قياس كل من (إستهلاك العلف, وزن الجسم , الوزن المكتسب, معدل التحويل الغذائي, الوزن الحي (قبل الذبح), نسبة التصافي، الوزن النسبي للبنكرياس. أظهرت النتائج أن هنالك إختلاف معنوي ($p<0.05$) في تحسين أداء الكتاكيت التي تم تغذيتها علي عليقة تحتوي علي 15% فول الصويا كامل الدهن مع مسحوق أوراق المورينقا بالمقارنة مع الكتاكيت التي غذيت علي العليقة المحتوية علي 12% فول صويا كامل الدهن من غير إضافة مسحوق أوراق المورينقا. يعزي هذا التحسين في الأداء الي دور المورينقا كمضاد تأكسد في حماية محتوي الدهون في فول الصويا كاملة الدهن وكذلك االفيتمينات الذائبة في الدهون , كما ان نتيجة هذه الحماية من مضاد الأكسدة ادي إلي أفضل استساغة للعلف وتحسين معنوي كبير في كمية العلف المستهلك, نسبة التصافي بالمقارنة مع مجموعة الكتاكيت التي تم تغذيتها علي12% فول صويا كامل الدهن.

علي الرغم من تغلب إضافة مكملات مسحوق أوراق المورينقا علي الأثر السلبي لعملية تزرنخ دهن فول الصويا الكامل الدهن إلا أنها لم تحمي البنكرياس من التضخم . هذا يشير إلي أن الطريقة التي تستخدم في معالجة عملية تحميص الصويا بالسودان عادة ليست كافية أو فعالة لتحطيم معادات التغذية الموجودة في فول الصويا كامل الدهن.

CHAPTER ONE

INTRODUCTION

During the last decade poultry industry experienced rapid growth in the Sudan. The rise in poultry production and consumption due to increased in population, rise in living standard and change in food habits, preference to white meat.

Soy beans are the main components in poultry nutrition, and it is one of the most common legumes in the world, Soya bean is an excellent source of protein for poultry. Grain legumes contain different type proteins. All legumes are a good source of lysine, but deficient in amino acids that contain sulfur. The high content of lysine in protein legumes is very important from the standpoint of a balanced diet and is probably more important than the total protein content, since it makes a significant addition of legume proteins in the diet with cereals, which are known for lysine deficiency. Methionine is the first limiting amino acid for poultry in soya bean meal and must be added to diets containing legumes, soya bean is also a rich source of carbohydrates, fiber, oligosaccharides, izoflavonida and minerals. Soya bean contains 19.5% crude fat and relatively high content of lipids and carbohydrates, as well as the high protein content in grain approximately 38%,also a rich source of energy (19.4 MJ / kg). Value of legume protein is significantly reduced due to the presence of toxic proteins and other anti-nutritive factors (ANF), because they reduce the utilization of proteins from these grains, and limit the use of both soya beans and other legumes, Inclusion of raw full fat soya bean not only a negative effect on growth of chickens, but also leads to an increase in the relative weight of digestive organs, particularly the pancreas. Most of anti nutrition factors (ANF) are heat labile and destroyed by different thermal treatment processes which include extrusion. The extent to which trypsin inhibitor activity is destroyed depends upon the heating temperature and time, and the particle size and moisture content of the soya bean meal.

In Sudan poultry diets depend on local feed ingredients mainly sorghum as a source of energy and groundnut meal as source of protein together with imported concentrate which is the main source of lysine and methionine, since both sorghum and groundnut meal are deficient in these essential amino acids. The imported concentrates is very expensive and its availability sometimes as uncertain together with poor storage condition under very high temperature during summer.

The objective of this study to evaluate the effect of two level of Full fat soya bean on performance of the broiler chicks when added with or without moringa oleifera leaf meal supplementations anti-oxidant in high level of full fat soya bean.

CHAPTER TOW

LITERATURE REVIEW

2.1 Agronomic and nutritional potential of Soya bean as animal feed

Soya bean (Glycine max, L) is an annual crop that belongs to the Fabaceae or Leguminosae family. It originated from East Asia, but now grown over a wide geographical area worldwide with United States of America, Brazil and Argentina being the leading producers. It is used primarily for production of vegetable oil and oilseed meal for animal feeding. The surge in the use of soya bean meal in feeding animal as replacement protein source for animal protein feeds has been the main driving force in soya bean production.

Table (1)

Production and consumption of soya bean:

Countries	2009/2010		2010/ 2011	
	Production	Consumption	Production	Consumption
China	37.42	35.82	41.71	40.36
United States	37.31	27.22	35.41	27.58
Argentina	27.13	0.70	29.95	0.60
Brazil	24.41	12.80	25.42	13.38
EU	9.85	31.49	9.77	32.30
India	4.85	2.85	6.08	3.08
Other	20.58	49.60	21.30	51.20
World total	161.63	159.77	169.64	167.89

Source: FAS/USDA (2009)

2.2 The chemical composition of soya bean meal:

There are variations in the reported chemical composition of soya bean meal that can be attributed to differences in processing methods. Also, genetic variations have been observed in the soya bean biotypes of Glycine (Yen *et al*., 1971),(Gu *et al*., 2010).Where may vary in their chemical compositions, the use of soya bean products in non-ruminant diets can give reasonable performance only if diets are formulated correctly and their ANFs removed. In this regard, nutrient levels, bioavailability and ANFs and their effects on animal performance must all be considered in determining the usefulness of any of the soya bean products as a feed ingredient. (Table2) shows composition of some soya bean products commonly used in animal feed, it was clear that soya bean is a source of high protein content and quality as well as energy with little or no ANFs. It appears that quality of soya bean proteins improves when subjected to multiple processing procedures, which were shown by increases in concentrations of limiting essential amino acids such as lysine and methionine for monogastric animals. However, the cost of such improved products may limit their use in animal feeds.

Table (2)

Percent composition of some soya bean products used in animal feed:

Composition	Full Fat	Soyabean Meal	Soya bean Protein Concentrate	Soy Protein Isolate
Dry Mater	89.4	87.6 - 89.8	91.8	93.4
Crude Protein	37.1	43.9 - 48.8	68.6	85.9
Crude Fat	5.1	3.4 – 6.3	1.7	1.3
Ether extract	18.4	1.3 – 5.7	2.0	0.6
Ash	4.9	5.7 – 6.3	5.2	3.4
NDF	13.0	10.0– 21.4	13.5	-
ADF	7.2	5.0 – 10.2	5.4	-
ADL	4.3	0.4 – 1.2	0.4	-
Starch	4.7	3.3 – 7.0	-	-
Total Sugars	-	9.1- 9.3	-	-
Gross Energy(mj/kg)	20.95	17.2-17.41	17.89	22.45
Lysin	2.34	2.85-3.50	4.59	5.26
Methaionin	0.52	0.62-0.80	0.87	1.01
Cystine	0.55	0.68-0.77	0.89	1.19
Tryptophan	0.49	0.56-0.74	0.81	1.08
Calcium	0.26	0.27-0.31	0.24	0.15
Phosphorus	0.57	0.64-0.66	0.76	0.65
Linoleic Acid	9.7	0.6 -2.9	-	-
Urease Activity	2.0	0.05 – 0.5	< 0.05	< 0.05
Trypsin Inhibiter(mg/g)	45-50	1 – 8	2	< 1
Glycol(pap)	180.000	66000	< 100	-
β –Conglycin(ppm)//	760.000	16000	< 10	-
Lectins(ppm)	3.5000	10-200	< 1	0
Oligosaccarides	14	15	3	0
Saponins%	0.5	0.6	0	0

Data are adapted from NRC (1994), INRA (2004), and Peisker (2001)

2.3 Toxicity of soya bean

The toxicity of raw soya beans mainly attributed the presence or number of anti-nutritional factors. Protease inhibitor and lectin are the two main factors in the soya beans which affect the broiler performance (Michele *et al*., 1999). Other anti-nutritional factors are anti-vitamins, saponins, tannins, non-starch oligosaccharides and polysaccharides, and phytate (Dourado *et al*., 2011). These anti-nutrition factors depress the feed intake, growth performance, and digestibility of nutrients (Liener, (1994); Perilla *et al*., (1997); Palacios *et al*., (2004); Valencia *et al*., (2009)). The growth depression observed when trypsin inhibitors (TI) are ingested may be a combined effect of endogenous loss of essential amino acids and decreased intestinal proteolysis (Clarke and Wiseman, 2007).

2.3.1 Anti-nutritive factors (ANFs):

ANFs are natural compounds in feed stuffs that impair utilization of nutrients with consequent undesirable effects on animal performance. The ANFs in soya beans exert a negative impact on the nutritional quality for animals Table (3), Fortunately, those ANFs with significant impact such as trypsin inhibitors and lectins are easily destroyed by heat, of lesser significance are the anti-nutritional effects produced by relatively heat stable factors such as goitrogens, tannins, phytoestrogens, oligosaccharides, phytate and saponins(Liener, 1994). Heat stable ANFs with the exception of oligosaccharides and the antigenic factors are low in soya beans and not quite likely to cause problems under practical feeding conditions. The removal of the oligosaccharides and antigens in the manufacture of soya bean protein concentrates further improves the nutritional value.

2.3.1.1 Protease inhibitors (Trypsin & Chymotrypsin)

Chemical Substances capable of inhibiting trypsin and chymotrypsin (protease inhibitors) are present in many plants but their levels are usually low, such legume seeds as soya beans, however, tend to contain higher levels of protease inhibitors, other legume seeds with protease inhibitors include lima beans, kidney, navy, pinto and common garden beans, cow peas, fava beans, and green peas .In general, protease inhibitor content in cereals is much lower than in legume seeds. The protease inhibitors present in soya beans have been extensively studied and are usually used as models for all other plant protease inhibitors. The biochemistry and physiological significance of the trypsin inhibitors present in soya beans was reviewed by (liner 1994). The protease inhibitors found in soya beans have been grouped into two main groups. The first group includes proteins with an average molecular weight of about 20,000 with two disulfide bridges, and with specificity mainly against trypsin (Kunitz inhibitor). The second groups of proteins include those having an average molecular weight of 8,000 with a relatively high number of disulfide bridges and with specificity towards both trypsin and chymotrypsin (Bowman – Birk inhibitor). The Kunitz inhibitor has one active site that combines with trypsin in a stoichiometric irreversible manner. The Bowman – Birk inhibitor has two different active sites: a trypsin-binding site and a chymotrypsin-binding site. Inhibition of trypsin activity affects protein digestion since trypsin is the common activator of all the pancreatic enzymes that are secreted as zymogens, Ruiz *et al*., (2004) reported that the trypsin Inhibitors and urease activity (UA) are significantly correlated to body weight and feed conversion ratio. The negative effect of trypsin inhibitors probably depends on the trypsin inhibitors range in the diet and up to a certain level of trypsin inhibitors the negative effect does not occur. The level of 4 mg/g trypsin inhibitors activity is assumed to have a minimum adverse effect on birds although the basis for such recommendation is questionable (Clarke and Wiseman, 2007). Inclusion of extruded full fat soya beans (EFFSB) in a pelleted broiler diet made the chicks performance equal or superior to that of dehulled solvent extracted soya bean meal (ESBM), and extruded soya beans could partially or completely replace soya bean meal(SBM) without any adverse effects on body weight, feed conversion, and mortality provided the diets are nutritionally balanced (Subuh *et al*., 2002).

2.3.1.2 Lectins

Lectins are sugar-binding glycoproteins, which are classified as toxic (Phaseolus vulgaris, Canavaliaensiformis), growth inhibitory (Glycine max, Amaranthuscruentus, Phaseoluslunatus, Dolichosbiflorus) (Grant, 1989), or essentially non-toxic or beneficial (seeds of Vignasubterranea, Vignaumbellata and Vignaunguiculata) (Grant *et al*., 1995). Lectins occur depending on the development stage and on the part of the plant. Toxic lectins generally coagulate the erythrocytes, which can affect the immune system (Jeroch *et al*., 1993), or disrupt nutrient absorption in the intestines by shedding the brush border membrane of the enterocytes (Makkar, 2007). Lectin activity can be removed by heat, with moist better than dry.

2.3.1.3 Saponins

Saponins are found in Brachiariadecumbens, B.brizantha (Brum*et al*., 2009), Amaranthushypochondriacus, Chenopodium quinoa, A triplex hortensis (Cheeke&Carlsson, 1978), and Medicago sativa (Pedersen *et al*., 1972). They are heat-stable, form a soapy froth when mixed with water, and alter the cell wall permeability, leading to hemolysis and to photosensitization (Brum *et al*., 2009). They depress growth in chicks
(Jeroch *et al*., 1993), but there are conflicting results in pigs, with a positive effect on both sows and piglets (Hauptli&Lovatto., 2006), compared with fewer stillborn piglets but reduced growth performance (Ilsley&Miller., 2005).

2.4 Processing of raw Soya bean to Primary soya products for animal feeding:

Figure (1) shows a schematic processing of soya beans into various high quality protein products, the processes involved either reduce or eliminate the ANFs in the beans and improve the nutritional value substantially for all classes of animals. Several steps involved in processing these products can have either positive or negative effect on the quality of the protein depending on the conditions used in processing. The heat applied in processing is identified as the single most important factor that affects soya bean meal protein quality, proper processing conditions such as which results in improved performance when fed to monogastric animals (Araba, 1990). High processing temperatures of oilseeds has deleterious effects on proteins and amino acids due to formation of Maillard reaction products (Hurrell, 1990) or denaturation (Parsons *et al*., 1992).

2.4.1 Full-fat soya beans

These are whole soya beans in which the oil is not extracted, these products are produced by a variety of processes such as extruding (dry or wet), cooking/autoclaving, roasting/toasting, micronizing and jet-sploding to inactivate the ANFs, all of these processes have a different impact on the nutritive value of the products depending on heat damage or degree of inactivation of ANFs. Normally, soya beans are processed into defatted meals for feed formulation, particularly for poultry and pigs; however, the amount of full fat soya beans used has been increasing in the livestock industry due to development of new varieties with limited number or levels of ANFs (Gu *et al*., 2010) Also, the properly processed. Full fat soya beans are a valuable feed ingredient for animal feeding because of their high energy content.

2.4.2 Soya bean meal

Soya beans yield 18.6% of oil and 78.7% of soya bean meal with the rest being waste (FEFAC, 2007). The oil can be extracted either mechanically or by solvent means. There are two main types of soya bean meal, the de-hulled soya bean meal and soya bean meal, depending on whether the testa (seed coat) is removed or not. Both products vary in their nutrient composition, but are quite high in protein content with a good amino acid balance except methionine, low in fiber, high in energy, and have little or no ANFs when properly processed.

The amino acid profile of soya bean meal is close to that of fishmeal, except methionine (INRA, 2004). This deficiency can easily be corrected in monogastric diets using synthetic source of methionine. Also, soya bean meal is superior to other vegetable protein sources in terms of crude protein content and matches or exceeds them in both total and digestible amino acid content. Soya bean meal protein digestibility in poultry is approximately 85% (Woodworth *et al*., 2001), ranging between 82% and 94% for individual amino acid digestibility. Among the vegetable protein sources, soya bean meal is used to meet the animal's requirement for limiting amino acids in cereal-based (e.g. maize) diets, because it is usually the most cost-effective source of amino acids (Kerley and Allee, 2003). The carbohydrates in soya bean meal are incompletely digested by colonic micro biota in monogastrics (Kerley and Allee, 2003). Thus removal of raffinose and stachyose improved metabolisable energy content by 12% (Graham *et al*., 2002).

2.4.3 Soya bean protein concentrates (SPC)

SPC is produced from the defatted flakes by the removal of the soluble carbohydrates. This can be achieved by two methods, either by ethanol extraction or enzymatic degradation. SPC is valuable as milk replacer feed for calves and as piglet pre-starter feed. This is because it contains only traces of the heat stable oligosaccharides and the antigenic substances in milk replacer feed, it has been largely substituted for dried skim milk; whilst in pig starter feeds it can replace dried skim milk, whey powder and fishmeal.

2.4.4 Soya bean oil

Soya bean oil is produced primarily for human consumption. However, it has become a useful source of feed-grade fat for animals due to a need to formulate high-energy diets for modern breeds. Feed-grade soya bean oil is popularly used in high energy diets, particularly for poultry, because of its high digestibility and metabolisable energy content compared with other vegetable fats/oils. It is used widely in rations for broiler chickens and growing turkeys as a feed-grade fat to increase energy density of feeds and improve efficiency of feed utilization (Sell *et al*., 1978). The high energy value of soya bean oil is attributed to its high percentage of (poly) unsaturated fatty acids, which are well absorbed and utilized as a source of energy by the animal (Huyghebaert *et al*., 1988). Also, the high polyunsaturated fatty acids (PUFA) in soya bean oil appears to have an energy independent effect on improving reproduction in dairy cattle (Lucy *et al*., 1990),(Kerley and Allee, 2003), and this has been attributed to the role of linoleic acid in reproduction (Staples *et al*., 1998).

2.5. Processing techniques of soya bean

Forage plants can be processed to enhance palatability, intake, and digestibility, to conserve, detoxify the anti-nutritional factors, or concentrate nutrients (Akande *et al*., 2010), (Close, 1993). All this should be achieved without decreasing the nutritive value of the feed.

2.5.1 Heat treatments

Heat treatment includes sun- and oven- drying, roasting, autoclaving, and boiling, which usually reduces the content of heat-labile anti-nutritional factors. Sun-dried cassava leaves (Mani hot esculenta) had 20mg/kg hydrogen cyanide in the leaf meal compared with 190mg/kg in the meal of fresh leaves (Phuc *et al*., 1995). Laying hens fed sun-dried Gliricidiasepium performed better than those fed with the oven-dried legume (Montilla *et al*., 1974), although it is not clear how the type of drying affects the feeding quality. Drying reduces the volume and increases total dry matter intake, which can more than double in pigs (Leterme *et al*., 2010) given adequate amounts of water. Thermal treatment considerably reduced the trypsin inhibitory activity of seeds of Glycine max (Liener, 1994),Cajanus cajan (Muangkeow, 1994), Arachishypogaea(Hira& Chopra, 1995), and Psopho carpustetragonolobus (Igene *et al*., 2006). In the latter, roasting also completely removed haemagglutinin. Roasting or autoclaving seed of Phaseolus vulgaris reduced its tannin content by 30 – 40%; this was surpassed by dehulling (Borges *et al*., 1998). Dry heat (Siddhuraju*et al*., 1996) and autoclaving (Vijayakumari*et al*., 1996) significantly reduced the content of L-DOPA in seeds of Mucunapruriens. Autoclaving gives mixed results. Broilers performed better on autoclaved seed meal of Psophocarpustetragonolobus than on raw meal (Gerpacio&Princesa, 1985). However, it does not remove haemagglutinin, trypsin inhibitors, tannins, or phytins (Igene *et al*., 2006). Boiling Canavaliaensiformis seeds for 60 min gave better broiler performance than either the raw seeds or boiling for 30 min (Aquino *et al*., 1985), yet it may reduce the mineral content by solubilisation (Igene *et al*., 2006). Boiling significantly increased apparent and true metabolisable energy of Cajanuscajan seeds (Muangkeow, 1994). In contrast, boiling reduced the lysine content of Vignaradiata seeds by 43% (Bhatty *et al*., 2000), but significantly increased starch digestibility (Antu&Sudesh, 2009). Boiling removes part of water-soluble nutrients and minerals of legume seeds in contrast to autoclaving (Apata& Ologhobo, 1994). Compared with roasting, boiling improved the nutrient availability and utilisation of Lablab purpureus beans in pigs (Laswai *et al*., 1998).

Soya bean autoclaved in stem sterilizer at $120c^0$and 1.1kg $/cm^2$ stem pressure, Timing began when the autoclave champer reached $100c^0$ upon completion of the allotted time of heat treatment, the soya bean were removed promptly from the autoclave and spread on to a cool, flat concentrate floor.

Observations by (Borchers *et al*., 1947), and (claudinin, 1947) who reported reduced trypsin inhibitors content with increased duration of autoclaving. However (claudinin, 1947) and (Borchers *etal*., 1947), give different recommendations for optimum duration of heat treatment (4 – 15min) versus 20min at 6.82kg and $120c^0$ respectively, and (Herke leman *et al*., 1991), said that soya beans treated at (120 degree c^0 for 80 – 100 mints reduced the activity of trypsin inhibitors less than 5mg / kg, and for 40 – 45 mints improve the body gain of the birds . Heat treatment destroys the enzyme Lipase and Lipooxygenasecan cause rancidity long term storage may require an antioxidant.

2.5.2 Grinding/ milling

Milling dried forages reduces the volume substantially and is an affordable way to reduce animal selectivity Also, animals utilize nutrients better from feeds ground to small particle size (Mosenthin& Sauer, 2011), (Kim *et al*., 2009).

2.5.3 Pelleting

Feeding texture determines voluntary feed intake and influences nutritive value. Weaned pigs tend to prefer pellets to meal (Laitat *et al*., 2004, 2000). Pelleting increases the digestibility in chicks of protein and starch and apparent metabolisable energy values of Viciafaba (Lacassagne *et al*., 1988).

2.5.4 Hulling/husking

Some ANFs such as tannins are mainly concentrated in the seed coat, so that hulling is a simple method to remove those (Vadivel&Janardhanan, 2005). In Phaseolus vulgaris seeds, dehulling reduced the tannin content from 22.0 to 5.3mg/100g (Borges *et al*., 1998). This method might be an option for farmers, such as coffee growers, who have other uses for a dehulling mill. Other opportunities for small-scale milling are explained by (Jonsson *et al*., 1994).

2.5.5 Soaking

Soaking grains in water for 18 h reduced the phytate content of Mucunamonosperma by up to one-third of the original content (Vijayakumari *et al*., 1996). Farmers in Laos soak Leucaenaleucocephala leaves for at least three hours, which improves their feeding value for pigs (Tiemann, personal observation). Soaking reduces phytic acid content of Lablab purpureus seeds (Jain *et al*., 2009).

2.5.6Extraction/chemical treatment (cold)/extrusion cooking/expanding

Extraction of Canavaliaensiformis beans with KHCO3 followed by either autoclaving or microwaving reduced canavanine concentration compared with simple soaking (D'Mello& Walker, 1991).Extrusion cooking inactivated the haemagglutination of Canavaliaensiformis, but in feeding chicks other unidentified ANFs seemed to be active (Melcion*et al*., 1994). Leaf meal of Leucaenaleucocephala treated with either acetic acid or NaOH raised the rate of nitrogen retention in pigs (Echeverria *et al*., 2002). Extraction, extrusion cooking, or chemical treatment are unlikely methods for smallholder farmers, even though urea and sodium hydroxide treatment were adopted for improving roughage quality on-farm in feeding ruminants (Kayouli *et al*., 1982), (Sourabie *et al*.,1995); (Chenost&Kayouli., 1997). Expanding grains is a hydrothermal process, which like extrusion, can be run at different temperatures. It's important in soya bean processing for its cheapness and for conserving lysine (van Zuilichem*et al*., 1998). Expanding lupine seeds decreased anti-nutritional factors and significantly improved apparent nutrient digestibility in pigs compared to grinding (Yang *et al*., 2007).

Marsman *et al*., (1997). Reported that heat treatment can reduce the incidence of anti-nutritional factors. Extrusion significantly improved feed conversion ratio and apparent ileal digestibility of crude protein (CP) and non-starch polysaccharides, (Lesson and Atteh, 1996). Explain Extrusion of soya beans at 140°C improved the feed intake in comparison with extrusion at lower temperatures. However, there were no significant ($P > 0.05$) effects of the extrusion temperature on weight gain, feed gain ratio or mortality rate.

The Metabolizable energy (ME) and feed conversion efficiency of birds fed diets with the full-fat seed were worse than in birds fed the meal plus oil diets (Lee *et al*., 1991). This indicates poorer availability of energy when oil in diets is bound to cells, thus growth performance can be lower than if oil is added to diets. In the study of fed different level of (EFFSB) significantly lower ($P > 0.05$) fat digestibility was found in group that was fed 120 g/kg EFFSB in comparison with groups containing control and 40 g/kg EFFSB.

Grant *et al*., (1995). Reported that in Long-term exposure to a soya bean diet induced an extensive increase in the relative and absolute weights of the pancreas and caused an increase in the incidence of macroscopic pancreatic nodules and possibly pancreatic neoplasia.

Perez-Maldonado *et al*., (2003). Explained that when fed different level of (EFFSB) (40, 80, 120, 160g/kg) Pancreas weight increases with increasing inclusion of both raw and Kunitz trypsin inhibitor Soya bean, suggesting that trypsin inhibitor (TI) is causing the depression in performance. Minimum pancreas weight was observed when chickens were fed extrude full fat soya bean extruded at 140°C (Perilla *et al*., 1997). The weight of pancreas and its share in body weight (BW) significantly ($P < 0.05$) increased after inclusion EFFSB at the level of 120 and 160 g/kg. And trypsin activity was consequently significantly ($P < 0.05$) higher in group 160 in comparison with group 0.also Foltyn *et al*., (2013). Reported that, there was no observed significant ($P > 0.05$) difference in AIAAD between the groups 80, 120 and 160 for all amino acids. In Lys, Thrionin, and Pheno significant differences in their digestibility between groups 0 and 160 were registered. The higher digestibility in group 160 than in groups 40, 80 and 120 was probably caused by higher weight of pancreas in these chickens and, consequently, by significantly ($P < 0.05$) higher trypsin activity. On the other hand, the live weight of chickens in the group 160 was the lowest. The fat digestibility slightly decreased with the increasing level of extruded full fat soya beans (EFFSB). Asignificant difference ($P < 0.05$) was observed only between control and 40 in comparison with group 120.

2.5.7 Fermentation

Under anaerobic conditions microbes ferment carbohydrates into organic acids and/or alcohols. Ensiling is a suitable fermentation method for both grains and whole crop forage. Lactic acid fermentation reduced trypsin and α-amylase inhibitor activity and tannins in Sphenostylisstenocarpa seeds by up to 100% in contrast to cooking (Azeke*et al*., 2005), and reduced cyanogenic glycosides and alpha-galactosides by 85% compared with only 10-20% by cooking. Fermentation of Phaseolus vulgaris grains and grain meal increased in-vitro protein digestibility, affected different vitamin fractions, and decreased minerals (Granito *et al*., 2002), reducing α- galactosides, trypsin inhibitory activity, and tannin content in seed meal. Fermenting Mucuna to temperature, a traditional Indonesian food reduced L-DOPA by 70% and hydrolyzed 33% of phytic acid (Higasa *et al*., 1996; Sudarmadji & Markakis, 1977). Solid state fermentation of Cicerarietinum gave higher digestibility of lysine and protein, reduced phytic acid content to 10 %, and tannin content to 13% of raw chickpea flour (Reyes-Moreno *et al*., 2004).Ensiling Leucaenaleucocephala shoots reduced mimosine content from 7% to 2% (Liu & Wang, 1990). Ensiled cassava leaves lost 77% of their hydrogen cyanide and increased digestibility for growing pigs (Borin*et al*., 2005), although sun-drying was more effective (Bui Huy*et al*., 2000). Good fermentation management (Niven *et al*., 2006; Olstorpe *et al*., 2010; Marcinakova *et al*., 2008), which is feasible for smallholders,is required to avoid substantial losses of lysine and tryptophan (Blandino *et al*., 2003), or even benefit from increased lysine content (Gerez *et al*., 2006). Further information on ensiling and silo types is available in (FAO 2000), (Heinritz *et al*., 2012), (Reiber *et al*., 2008), and (Reiber *et al* 2009).

2.5.8 Use of enzymes

There have been various attempts to mix different enzymes into feeds to reduce anti-nutrients (Table 6). The only successes are phytase (Varley *et al*., 2011) and NSPases (Ao *et al*., 2010). Enzymes are currently unlikely to be suitable for smallholders due to cost and their limited availability.

2.5.9 Germination

Germination activates endogenous enzymes, which attack most anti-nutrients (Campbell & van der Poel,1998) (Table 6) and enhance the nutritional value of grains (Muzquiz *et al*., 1998).But germination can be difficult to manage as seedlings tend to attract moulds and are easily spoiled. The germinated seeds have to be fed immediately or dried, which increases their cost. Germination reduces trypsin inhibitors, phytic acid, galactosides, and certain lectins in Glycine max (Bau *et al*., 1997) and, compared to raw seeds, improves the in-vitro starch digestibility in Cicerarietinum, Vignaunguiculata and Vignaradiata, similar to the improvement through fermentation and pressure cooking (Urooj&Puttaraj, 1994). Germination, preceded by soaking, reduced trypsin inhibitory activity of Phaseolus vulgaris and Cajanuscajan seeds by 26–53 %,phytic acid by 41–53%, and condensed tannins by 14–36 %, while the in-vitro protein. Digestibility, vitamin C and thiamine content increased significantly, and the mineral composition was modified (Sangronis& Machado, 2007). Germination of Lupinusalbus for 96 h gave peak phytase activity, while in Lupinus lute us it increased until 120 h (Muzquiz *et al*., 1998).

`

2.6 Soya bean in nutrition of non-ruminant (Monogastric)

The use of raw soya beans by monogastric animals is not efficient due to the presence of heat labile trypsin inhibitors and other anti-nutritional factors (Yen *et al.*, 1973). Trypsin inhibitors reduce the activity of trypsin and chymotrypsin (Rackis, 1974). Reduced growth rate and pancreatic enlargement in chickens are associated with the presence of trypsin inhibitors (Schema and Gallaher, 1986) These inhibitors are, however, readily destroyed by heat treatment (Rackis.,1974).(Anderson *et al*.,1992).(Anderson *et al*., 1992). Found that raw beans of the low trypsin inhibitor type still need to be cooked to improve broiler performance. One method of heat processing raw soya beans is dry roasting in which the beans pass through a rotating chamber while they are directly exposed to a flame. A number of farms have these capacity as well as commercial grain-roasting units. Waldroup and Cotton (Waldraup and T.L, 1974) reported similar 0- to 28-d weight gains by broilers.

2.7 Soya bean full fat in the nutrition of broiler

A.Popescu and Criste,R (2003) Reported That The use of diets based on full fat soya bean and destined to Arbor Acres fattening is leading to a higher daily and total gain, a higher final live weight, a lower food consumption under an increasing fattening profitableness.

Inclusion of full-fat soya beans to the diets for broilers had an effect on villus height and crypt depth. Group 0 without full-fat soya beans had significantly ($P <$ 0.05) longer villi and crypt depth than groups 40, 80, and 120. However, the more Extruded full fat FFSB in the diet, the longer villi were found. Group 160 had similar villi height as 0 groups. Villus height and crypt depth ratio increased with increasing level of extruded full fat soya bean (EFFSB) in the diets and there was a significant ($P < 0.05$) difference between control and group 40 compared to group 160.Villus height, crypt depth, and villus /crypt ratio.

Heat treatment can reduce the incidence of anti-nutritional factors. Extrusion significantly improved feed conversion ratio and apparent ileal digestibility of CP and non-starch polysaccharides (Marsman *et al*., 1997).

Extrusion of soya beans at 140°C improved the feed intake in comparison with extrusion at lower temperatures. However, there were no significant ($P > 0.05$) effects the extrusion temperature on weight gain, feed : gain ratio or mortality rate (Lesson and Atteh, 1996).The metabolizable energy (ME) and feed conversion efficiency of birds fed diets with the full-fat soya bean seeds were worse than in birds fed the meal plus oil diets (Lee *et al*., 1991). This indicates poorer availability of energy when oil in diets is bound to cells, thus growth performance can be lower than if oil is added to diets. In this study significantly lower ($P > 0.05$) fat digestibility was found in group that was fed 120 g/kg EFFSB in comparison with groups containing 0 and 40 g/kg EFFSB.

Table (3)

2.8 Anti-nutritional aspects and metabolic diseases

Anti-nutritional factor	Mode of Action	Method of Detoxification
Protease inhibitors	Combines with trypsin or chymotrypsin to form an inactive complex and lower protein digestibility cause's hypertrophy of the pancreas counter acts feedback inhibition of pancreatic enzyme secretion by trypsin.	Head Treatment Germination fermentation
Lactins (phytohaemagglutinin)	Agglutinates red blood cells	Heat treatment
Anti-vitamin factors	These factors render certain vitamins (vita A, B12, D3and E) Physiologically inactive.	Kooking, supplementation of vitamins
Goitrogens	Enlargement of the thyroid	Heat treatment in some cases administration of Iodide
Metal-binding factors (phytate)	These factors decrease availability of certain minerals (P , Cu , Fe, Mn ,Zn)	Heat treatment Addition of chelating agents use of enzymes
Saponins	Bitter taste ,hemolyze red blood cells	Fermentation
Estrogens	Cause anlargement of reproductive tract.	
Cyanogens	Cause toxicity through the poisonous hydrogen cyanide	Cooking
Oligosacchrides	Impair digestion(intestinal cramps ,diarrhea flatulence)	Ethanol / Water extraction

Sorcese Data are adapted from NRC (1994), INRA (2004), and Peskier (2001)

2.9 Moringa oleifera leaf meal

Moringaoleifera is widely grown crop in India, Ethiopia, the Philippines, and Sudan .the tree is being grown in West, East and South Africa, and in tropical Asia, Latin America, the Caribbean,Florida, and the Pacific IslandsFahey,2005). Many researchers have notice its nutritional and medicinal benefits (Dahot.,1988), (Makkar and Becker.,1997),(Anwar and Bhanger.,2003),(Anwar *et al*.,2007).

2.9.1. Mode of action of Moringa oleifera leaf meal

Antimicrobial and antioxidant effects of Moringa oleifera were discussed by some researchers. Jabeen *et al*., 2008 mentioned that the antimicrobial properties of the Moringa oleifera seed extracts may be due to lipophilic compounds. These compounds may attach to the cytoplasmic membrane. The authors also suggested that extracts of Moringaoleifera seeds may contain antibiotic metabolites, such as carboxylic acid, 2,4-diacetyl phloroglucinol, and cell wall-degrading enzymes and chitinases. The antioxidant effect of Moringa oleifera leaf extract and fruit was explained by (Luqman *et al*., 2012). Who noticed that it was due to the presence of polyphenols, tannins, anthocyanin, glycosides, and thiocarbamates, which remove free radicals, activate antioxidant enzymes, and inhibit oxidases.

2.9.2Effect of Moringa leaf meal on the performance of broilers

Olugbemi *et al*.,(2010) found that an addition of 5% Moringa oleifera leaf meal to cassava-based broilers' diet (20% and 30%) had no significant ($P > 0.05$) effect on weight gain, feed conversion ratio, final body weight, and feed cost per kilogram of weight gain when compared to a diet free of cassava and free of Moringa oleifera leaf meal, diet containing 20% cassava and 0% Moringa oleifera leaf meal, and a diet containing 30% cassava and 0% Moringa oleifera leaf meal. However, levels above 5% ofMoringaoleifera leaf meal decreased broilers' performance. In contrast to these findings, (Juniar *et al*., 2008) reported that the inclusion of Moringa oleifera leaf meal at level up to 10% did not produce significant (P > 0.05) effects on feed consumption, body weight, feed conversion ratio, carcass weight, production efficiency factor, and income over feed cost. Disagreement may be due to the inclusion of Moringa oleifera leaf meal in the cassava-based broiler diet in the previous study.

CHAPTER THREE

MATERIAL AND METHODS

3.1 Materials and Methods

This experiment was conducted during winter (8 December 2015 to 18 January 2016). The experiment was carried out in the department of animal production, faculty of agricultural studies, Sudan University of Science and Technology. The Weekly average minimum and maximum temperatures were 16 °C and 30 °C. Appendix (1)

3.2 Experimental Diets

Three experimental starter diets were formulated such that dietTRT1: a typical sorghum and groundnut meal diet, served as control diet with no (FFSB) added, while TRT2 and TRT3 contained 12% and 15% FFSB respectively. All diets were formulated to meet all the bird's dietary nutrient requirements for starter (8 - 21 days) and finisher (21 - 42 days) phases. For TRT3 1% moringa leaf meal was added during the grower phase as an antioxidant. Ingredient and nutrient composition of these rations are presented in Table (4).

Table (4)

Composition of the experimental diets used Kg

Feed	**0%FF (control)**		**12% full fat %**		**15% full fat %**	
	Starter	Finisher	Starter	Finisher	Starter	Finisher
Sorghum	64.5	64.86	30.5	61.30	29.26	60.32
Groundnut cake	24.36	23	10.2	19.30	9.25	15.70
Lime	1.6	1.60	.6	1.20	.93	1.80
Broiler Super concentrate	5	5	0	0	1.25	2.5
Wheat bran	3.94	1.97	0	0	0	0
Di calcium	0.1	.10	1	1.99	.38	.10
Salt	0.3	.30	.15	.30	.15	.30
Oil	1.5	2.33	.78	2.33	.75	2.5
Anti Toxins	.05	.10	.1	.20	.05	.10
Vitamin &minerals(premi	0	0	.13	.25	.13	.25
Lysine	.58	.58	.42	.83	.28	.56
Methionine	.18	.17	.28	.28	.09	.17
Soya bean full fat	0	0	12	12	7.5	15
Moringa Oleifera leaf mea	0	0	0	0	0	1

Table (5)

Chemical Composition of the calculated analysis

Component	0%full fat(control)	12%full fatsoya	15%full fat Soya +MLM
Dry matter	94.83	94.63	95.54
Crude protein	19.25	21.0	21.0
Crude fat	6.17	4.57	8.3
Crude fiber	9.13	16.96	10.1
Ash	6.56	5.54	6.66
EE	6.17	4.57	8.3
Moisture	5.17	5.37	4.46

*Analyzed by Biochemistry Laboratory Faculty of Veterinary University of Khartoum

Table (6)

Chemical Composition of the experimental control diets used

Component	**Control**	**12%full fat Soya**	**15% full fat Soya+MLM**
M E Kcal/Kg	3123	3113	3116
Crude protein	22.16	22.08	22.11
Lysin	1.43	1.37	1.43
Methaionin	0.53	0.47	0.47
Ca	1.01	0.95	1.08
Av p	0.45	0.45	0.41

Table (7)

Chemical composition of Soya full fat

COMPONENT	PERCENTAGE
M E kcal	2768
Crude protein	38.5
Dry matter	95.71
Crude fat	19.9
Crude fiber	16.76
Ash	4.74
Phosphor	0.5
Lysine	2.4
Methaionine	0.54

*Analyzed by Biochemistry Laboratory Faculty of Veterinary University of Khartoum

Table (8)

Composition of Broiler Super Concentrate

SPECIFICATIONS	PERCENTAGE
Metabolizable Energy / (KG)	1900
Crude protein	35.00%
Crude fat	2.50%
Crude fiber	3.00%
Sodium	3.00%
Calcium	6.50%
Phosphorous (available)	6.50%
Lysine	11.00%
Methionine	4.20%
Methionine &Cystine	4.50%
***Vitamins & Minerals**	Added

*Added Vitamin & Minerals:

Table (9)

Chemical composition of Moringa oleifera leaves meal on dry matter

COMPONENT	**PERCENTAGE**
Carbohydrate	38.6
Crude protein	27.2
Crude fat	17.1
Moisture	5.9

Reported by Yameogo *et al*. (2011)

3.3 Experimental Birds and Management

One hundred and five unsexed day old Ross 308 broiler chicks, obtained from Algar Company farm for chick's production, Khartoum North, Khartoum State, The chicks were kept during the first week as an adaptation period and fed the pre-starter feed., On day eight all chicks were weighed individually and distributed randomly to the three experimental diets with 35 birds per treatment. Each group was further subdivided into five replicates of 7 birds each. The birds were housed in deep litter pens. They were reared under similar managerial conditions, and were given the experimental diets from the end of the first week (8th day) to the 42th day. The experimental diets and clean drinking water were supplied to the birds ad libitum throughout the study period.

3.4 Parameters:-

Bodyweight (BW), weight gain (BWG) and feed intake (FI) of chicks was recorded at the beginning of each week, starting from the weight at placement until weight before and after slaughter. Feed conversion ratio was calculated by dividing the feed intake by weight gain.

3.5 Vaccination program

Chicks were bought vaccinated against Marek's. On- farm, they were vaccinated against Infection Bronchitis (IBD) and Newcastle (ND) disease at age of One day old in Hatchery and 17 days in drinking water. And Gumborovaccin at 14 and 21 days of age in drinking water. Soluble multi-vitamins (Vitamina AD_3A Complex) were given during the first 3 days of age and 24, 25 and 26 of age and before and after vaccination to protect from stress.

3.6 Carcass preparation

At the end of experiment, one bird from each replicate was randomly selected, individually weighted after an overnight fast except from water, slaughtered and allowed to bleed, they were scale and defeathered manually, washed and drained after evisceration and weighted the hot carcass was weight, the individual organs, pancreas, gizzard, abdominal fat and intestine, also the length of intestine and pancreas.

3.7 Statistical analysis

Statistical analysis was based on the pen as replication unit with five replications per treatment used completely randomized design.Data were analyzed by using the Statistix10 trial according to (**Statistix 2013**).statistical procedures. The analysis of variance a one way (ANOVA) was used to compare between groups.

CHAPTER FOUR

RESULT AND DISCUSSION

Full fat soya bean has been utilized in poultry diets around the world due to its high nutritional value (protein quality and energy source). Raw Full fat soya bean contains toxicological or anti-nutritional factors such as protease (e.g. trypsin) inhibitors and lectins. Protease inhibitors alter the normal regulatory process of the exocrine pancreatic secretion, while lectins cause death of the intestinal epithelial cells that reduce food intake, growth rate, and efficiency of food utilization in birds and make it unfit for feeding of monogastric and immature ruminant animals. Processing of the raw full fat soya bean by means of heat and mechanical treatment destroys the anti-nutrients. Several reports show that properly processed whole soya beans can be used effectively in broiler (Parvu *et al*., 2001) and layer (Sakomura *et al*., 1998) diets as a partial or complete replacement for soya bean or other protein meals.

4.1 Effect of full fat soya bean in body weight / Body Weight gain

In the present study body weight of birds fed 15%full fat soya bean plus MLM (tables 10 and 11,Figure 2 and 3) show significantly increase body weight and body weight gain in comparison to birds fed 12% full fat soya bean during the grower phase. However, this high level of full fat soya bean plus MLM resulted in significantly low performance in comparison with the control diet as measure by body weight and body weight gain(tables 10 and 11,Figure 2 and 3) during the grower phase. This low performance of the two full fat soya treatments is attributed to heat roasting. (Sakomura et al., 1998) reported that the processing method led to differences in the performance of laying hens, extruded soya beans being superior to toasted soya beans. In addition, these researchers showed higher utilization of oilwhen included in the diet as extruded soya beans or soya bean meal plus added soya bean oil than as toasted soya beans.

4.1.1 Body weight /b/d

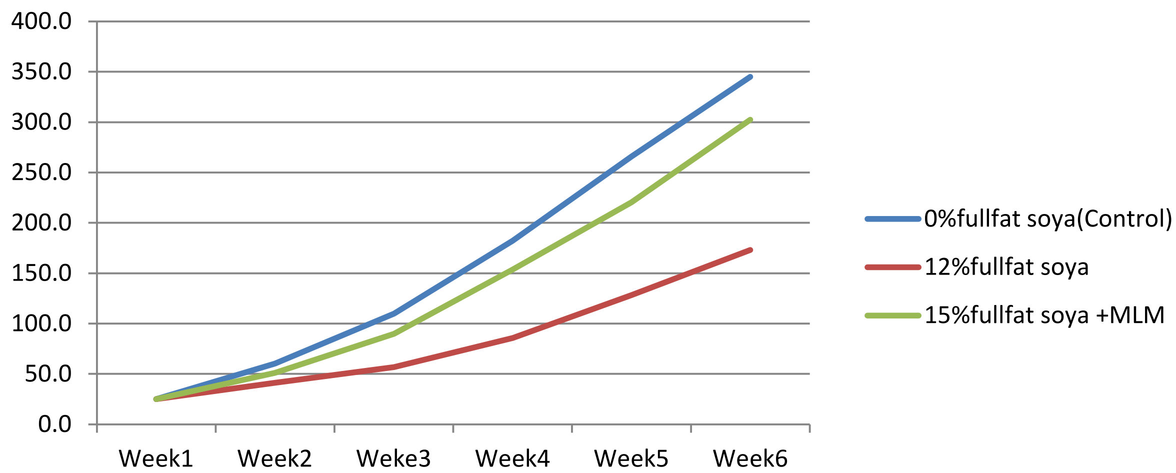
TABLE (10)Body weight (g) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation

Treatment	Week1	Week2	Weke3	Week4	Week5	Week6
Control	25.0 [a]	60.2 [a]	109.9 [a]	182.3 [a]	265.7 [a]	345.0 [a]
12%Fullfat Soya	24.9 [a]	41.1 [c]	56.9 [c]	85.7 [c]	128.4 [c]	173.0 [c]
15% Full fat Soya+ MLM	25.0 [a]	51.1 [b]	90.0 [b]	153.8 [b]	220.4 [b]	302.5 [b]

[a, b] Values within a column bearing different superscripts differ significantly (P<.01) (Duncan's multiple range test)

Figure (2)

Fig(2). Body weight (g) of broiler fed groundnut meal, 12%full fat soybean or 15%full fat soybean with moringa leaf meal supplementation



4.1.2 Weight gain/b/d

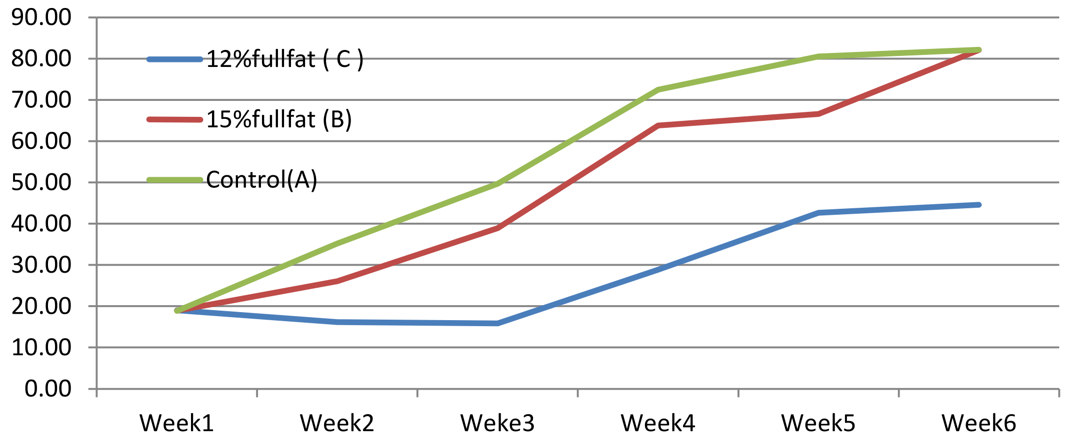
TABLE (11) Body weight gain (g) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation

Treatment	Week1	Week2	Weke3	Week4	Week5	Week6
Control	19[a]	35[a]	50[a]	72[a]	81[a]	82[a]
12%fullfat Soya	19[a]	16[c]	16[c]	29[b]	43[b]	45[b]
15%fullfat Soya+ MLM	19[a]	26[b]	39[b]	64[a]	67[ab]	82[a]

[a,b] Values within a column bearing different superscripts differ significantly (P<.01) (Duncan's multiple range test)

Figure (3)

Fig 3. Body weight gain (g) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation



4.2 Effect of soya bean in Feed Intake and Feed Conversion Ratio

In spit the fact that TRT3 contain the highest level of full fat soya bean and resulted in the highest pancreas weight per kg body weight, this diet improved significantly the performance of birds in comparison to control group. This improvement may be attributed the increase of feed intake Table (12) due the addition of moringa leaf, which act in the feed as an antioxidant preventing its oxidation and as consequence result also in improvement in the efficacy of feed conversion Table (13) in comparison the group of birds fed lower level of full fat soya bean but no moringa leaf meal added to it.

4.2.1 Feed intake/b/d

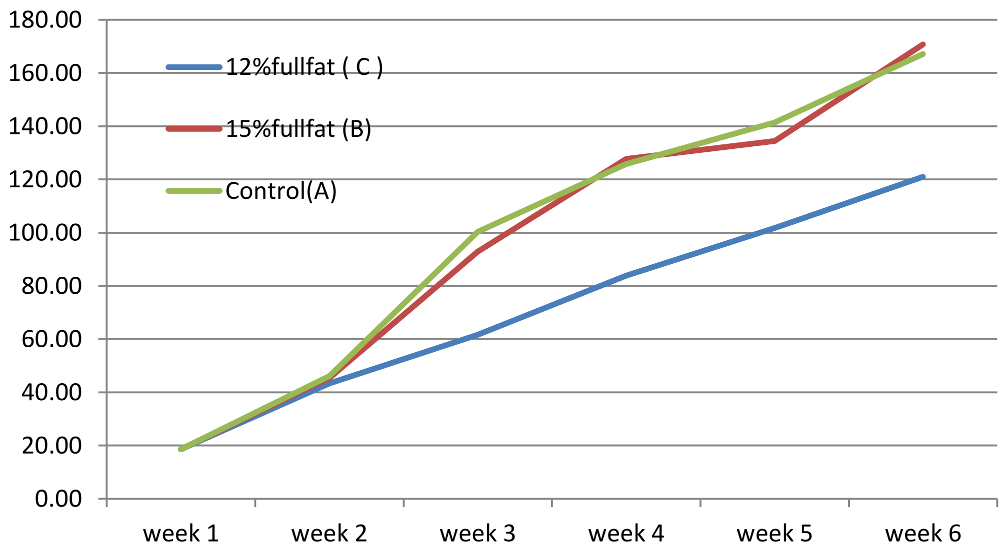
TABLE (12) Feed intake (g/bird/day) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation

Treatment	week 1	week 2	week 3	week 4	week 5	week 6
Control	8.57 [a]	6.06 [a]	00.26 [a]	25.78 [a]	41.41 [a]	67.13 [a]
12%fullfat soya	8.57 [a]	3.41 [a]	1.63 [b]	3.82 [b]	01.78 [b]	21.04 [b]
15%full fat soya+MLM	8.57 [a]	5.45 [a]	2.88 [a]	27.67 [a]	34.41 [a]	70.71 [a]

[a,b]Values within a column bearing different superscripts differ significantly (P<.01) (Duncans multiple range test)

Fig (4): Feed intake/b/d

FIG 4. Feed intake (g/bird/day) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation



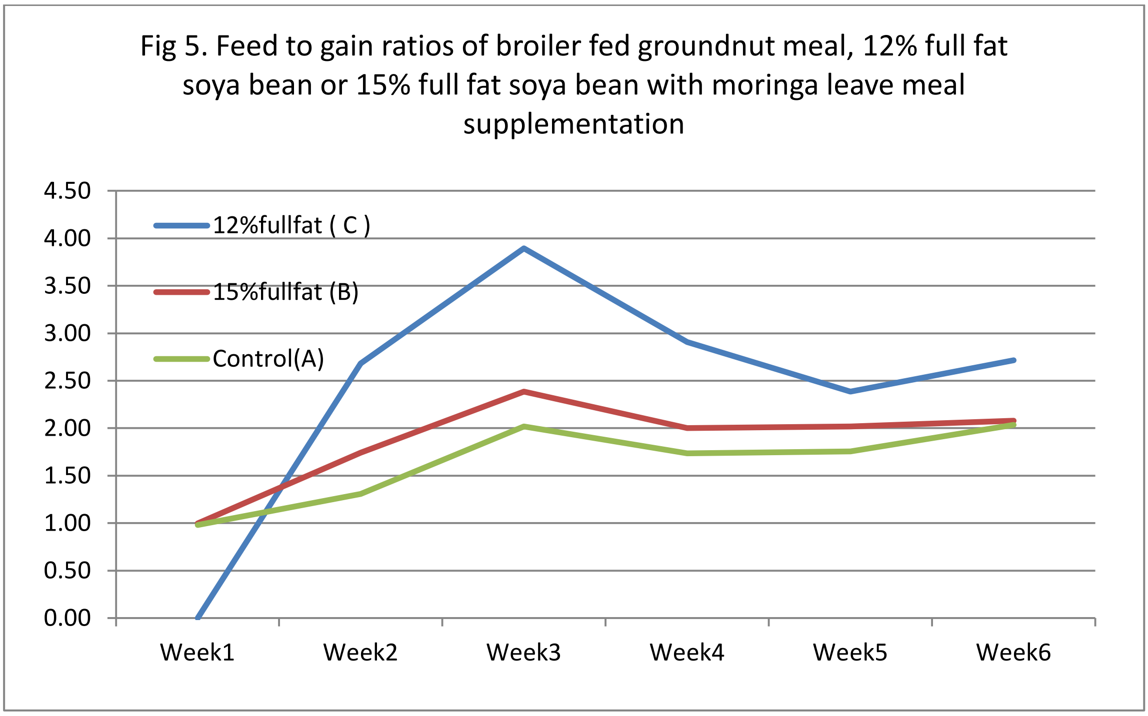
4.2.2 Table (13) Feed Conversion Ratio

TABLE: (13). Feed to gain ratios of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation

Treatment	Week1	Week2	Week3	Week4	Week5	Week6
12%fullfat (C)	0.99[a]	2.68[a]	2.89[a]	2.91[a]	2.39[a]	2.72[a]
15%fullfat (B)	1.00[a]	1.74[b]	2.39[b]	2.00[b]	2.02[b]	2.08[b]
Control(A)	0.98[a]	1.31[c]	2.02[c]	1.74[b]	1.76[b]	2.03[b]

[a,b] Values within a column bearing different superscripts differ significantly (P<.01) (Duncans multiple range test)

Figure (5)



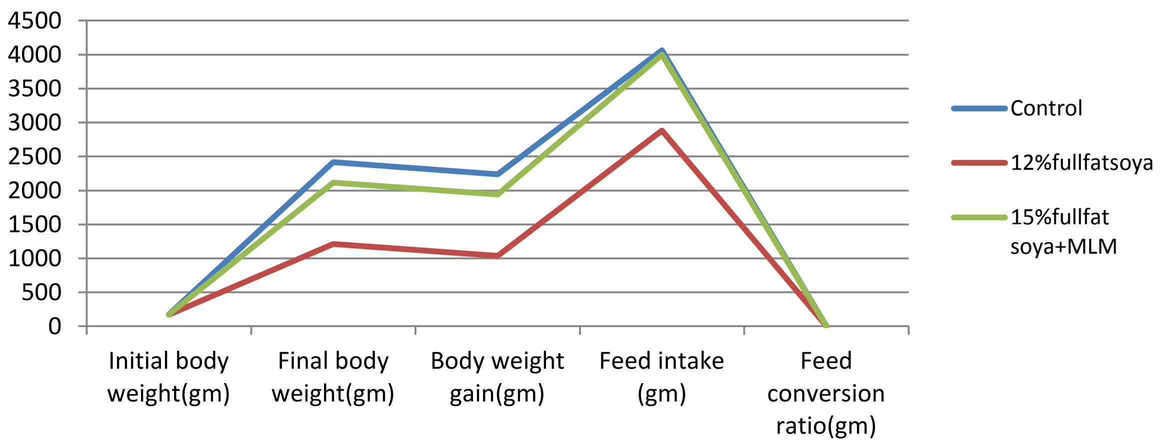
4.3 Effect of full fat soya bean in overall means (performance) of whole period.

Table (14): final body weight (gm), body weight gain (gm), feed intake (gm) and feed conversion ratio of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation.

Items	Control	12%fullfatsoya	15%fullfat soya+MLM
Initial body weight(gm)	**175 [a]**	**174 [a]**	**175 [a]**
Final body weight(gm)	**2415 [a]**	**1211 [c]**	**2117 [b]**
Body weight gain(gm)	**2240 [a]**	**1037 [b]**	**1942 [a]**
Feed intake (gm)	**4064 [a]**	**2881.7 [b]**	**3997.9 [a]**
Feed conversion ratio(gm)	**1.8 [a]**	**2.8 [b]**	**2.1 [a]**

[a, b] **Values within a column bearing different superscripts differ significantly (P<.01) (Duncan's multiple range test)**

FIG 6. Over all in final body weight (gm), Body Weight gain (gm), feed intake (gm) and feed conversion ratio) of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation



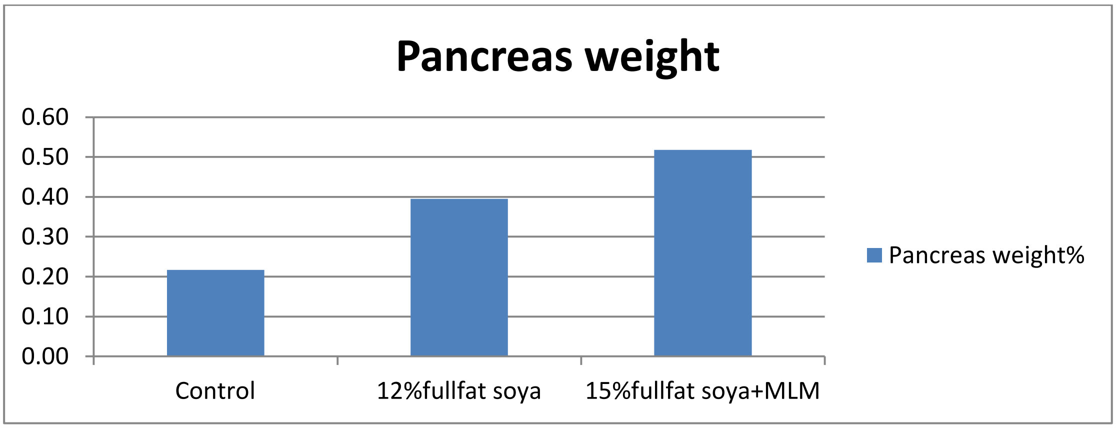
4.4 Effect of full fat soya bean in Pancreas weight%

Perilla *et al* (1997) reported that broiler fed a diet containing 41% raw soya beans had an average pancreas weight of 5.6g/kg body weight, while birds fed a similar diet containing 41% wet-extruded soya beans had an average pancreas weight of 1.8 g/kg body weight. In the present study TRT2 and TRT3 resulted in average pancreas weight of 0.4 g/kg and 0.52 g/kg respectively, while broiler fed the control diet without full fat soya beans had an average pancreas weight of 0.22 g/kg (table 14 and Figure 7). This demonstrates that the heat roasting of full fat soya bean was not effective enough for destruction of the anti-nutritional factors (ANFs).

Table (15): **Pancreas weight% of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation**.

Treat meant	0%fullfat(Control)	12%fullfat soya	15%fullfat soya+MLM
Pancreas weight	0.22[b]	0.40[ab]	0.52[a]

Figure (7)



4.5 Effect of full fat soya bean in dressing percentages %

Table (15) Dressing percentages of broiler fed groundnut meal, 12% full fat soya bean or 15% full fat soya bean with moringa leave meal supplementation.

Treat meant	Control	12%fullfatsoya	15%fullfat soya+MLM
Dressing %	67.95[a]	59.19[c]	65.64[b]

Figure (8)

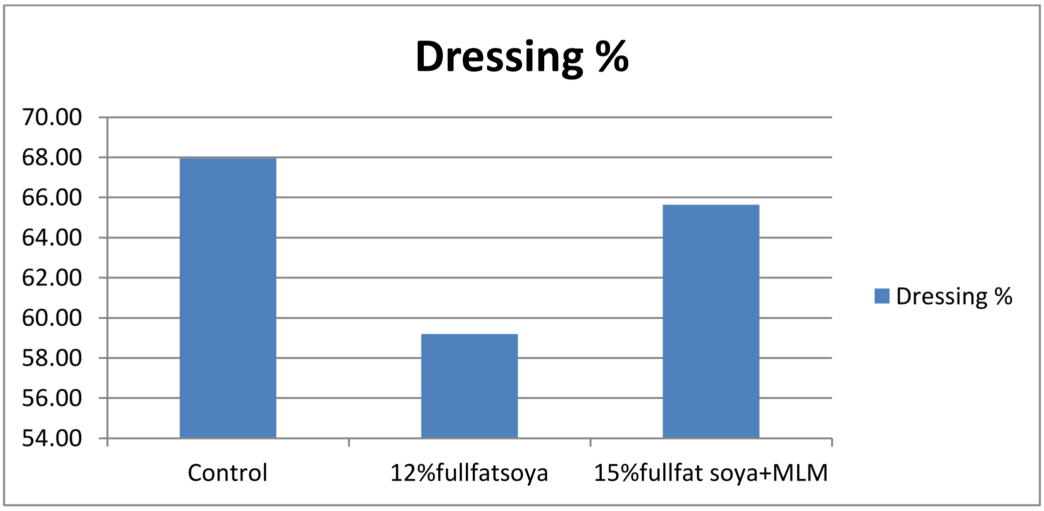


Figure (8)

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

- Processing conditions adjusted to quality control parameters that support optimum digestibility and bird performance.

.

- Full fat Soya bean meal must be produced from carefully monitored and managed soya beans.

- Full fat Soya bean meal manufacturing plants need accurately controlled processing conditions.

- Using local supplies of soya beans, roasted at local facilities, could be economical and provide the poultry industry with an alternative feed ingredient that can be easily incorporated into poultry.

REFERANCES

•**A.POPESCU*,CRISTE,R.**(2003): using full fat Soya bean in broiler Diets and its Effect on the production and Economic efficiency of fattening . Journal of Central European Agriculture ISSN1332-9049

•**Akande, K. E., Doma, U. D., Agu, H. O. &Adamu,H. M.** (2010): Major anti-nutrients found in plant proteinsources: their effect on nutrition. Pakistan Journalof Nutrition, 9, 827–832.

•**Al-Nouri, F**., (1979): Chemical and nutritional evaluation of broad bean (Vicia faba) and its products development. Ph.D. Thesis. Collage of Agriculture, University of Baghdad, Iraq.

•**Anderson-Hafermann, J. C., Y. Zhang, and C. M. Parsons**.1992: Effect of heating on nutritional quality of conventional and Kuntz

•**Antu, G. & Sudesh, J. (2009).** Chemical compositionand digestibility (in vitro) of green gram as affectedby processing and cooking methods. Nutrition &Food Science, 39, 342–349.

•**Anwar F., Bhanger MI.(**2003): Analytical characterization of *Moringaoleifera*seed oil grown in temperate regions of Pakistan. J Agri Food Chem 2003; 51: 6558–6563.

•**Anwar F., Latif S., Ashraf M., Gilani AH**.(2007) *Moringaoleifera*: afood plant with multiple bio-chemical and medicinal uses.Phytother Res 2007; 21: 17–25.

•**Ao, X., Meng, Q. W., Van, L., Kim, H. J., Hong, S. M., Cho, J. H. & Kim, I. H**. (2010): Effects of Non-starchPolysaccharide-degrading Enzymes on Nutrient Digestibility,Growth Performance and Blood Profilesof Growing Pigs Fed a Diet Based on Corn and Soya beanMeal. Asian-Australasian Journal of AnimalSciences, 23, 1632–1638.

•**Apata, D. F. &Ologhobo, A. D**. (1994): Biochemical Evaluation of Some Nigerian Legume Seeds. Food Chemistry, 49, 333–338.

•**Aquino, A. G., Arce, A. M., Arganosa, A. S., Atega,T. A., Baguyo, M. A., Suryadikusamo, D. R. & Perez, J. A. (1985).** Feeding value of jackbean (Canavalia ensiformis) for broilers [Philippines]. PhilippineJournal of Veterinary and Animal Sciences, 11, 31.

•**Araba, M. and N.M. Dale**:(1990): Evaluation of protein solubility as an indicator of under processing soya bean meal. Poultry Science, 69:1749-1752.

•**ARIJA I., CENTENO C., VIVEROS A., BRENES A., MARZO F., ILLERA J. C., SILVAN G.** (2006): Nutritional Evaluation of Raw and Extruded Kidney Bean (Phaseolus vulgaris L.var. Pinto) in Chicken Diets. Poultry Science, 85, 635-644.

Available from: http://www.intechopen.com/books/recent-trends-for enhancing-the-diversity-and-quality-of soya bean- products/soya bean-as-a-feed-ingredient-for-livestock-and-poultry

•**Azeke, M. A., Fretzdorff, B., Buening-Pfaue, H., Holzapfel,W. &Betsche,T.**(2005): Nutritional valueof African yambean (Sphenostylisstenocarpa L): improvementby lactic acid fermentation. Journal of theScience of Food and Agriculture, 85, 963–970.

•**Bau, H. M., Villaume, C., Nicolas, J. P. &Mejean, L.** (1997): Effect of germination on chemical composition,biochemical constituents and ant nutritional factorsof soya bean (Glycine max) seeds. Journal of theScience of Food and Agriculture, 73, 1–9.

•**Bhatty, N., Gilani, A. H. &Nagra, S. A.** (2000): Nutritional value of mung bean (Vignaradiata) as effected by cooking and supplementation. ArchivosLatinoamericanos de Nutricion, 50, 374–379.

•**BIRK Y**. (1961): Purification and some properties of a highly active inhibitor of trypsin and α-chymotrypsin from soya beans. Biochim. Biophys. Acta, 54, 378-381.

•**Blandino, A., Al-Aseeri, M. E., Pandiella, S. S., Cantero, Borges, G., Levy-Benshimol, A. & Carmona, A**. (1998):Interaction of bean tannins with Phaseolus vulgarisproteins. In A. J. M. Jansman, J. Huisman, & A. F. B.van der Poel (Eds.), Recent advances of research inant nutritional factors in legume seeds and rapeseed.Proceedings of the third international work shop (pp.301–305). Wageningen.

•**Blandino, A., Al-Aseeri, M. E.,. Pandiella, S. S., Cantero, D. & Webb, C.** (2003). Cereal-based fermented foods and beverages. Food Research International,, 527–543.

•**Borchers, R., C. W. Ackerson and R. M. Sandstedt. (1947):** Trypsin inhibitor. III. Determination and heat destruction of the trypsin inhibitor of soyabeans. Arch. Biochem. Biophys. 12:367.

•**Borges, G., Levy-Benshimol, A. & Carmona, A.** (1998).Interaction of bean tannins with Phaseolus vulgaris proteins. In A. J. M. Jansman, J. Huisman, & A. F. B. van der Poel (Eds.), Recent advances of research in anti-nutritional factors in legume seeds and rapeseed. Proceedings of the third international workshop (pp.301–305). Wageningen.

•**Borin, K., Lindberg, J. E. & Ogle, R. B.** (2005): Effect of variety and preservation method of cassava leaves on diet digestibility by indigenous and improved pigs. Animal Science, 80, 319–324.

•**BOWMAN D. E.** (1944): Fractions derived from soy beans and navy beans which retard tryptic digestion of casein. Proc. Soc. Exp.Biol. Med, 57, 139-140.

•**BRENES A.,VIVEROS A., CENTENO C., ARIJA I., MARZO F**. (2008): Nutritional value of raw and extruded chickpeas (Cicerarietinum L.) for growing chickens. Spanish Journal of Agricultural Research, 6, 4, 537-545.

•**Brum, K. B., Haraguchi, M., Garutti, M. B., Nobrega,F. N., Rosa, B. &Fioravanti, M. C. S.** (2009):Steroidal saponin concentrations in Brachiariadecumbensdecumbens and B. brizantha at different developmental stages. Ciencia Rural, 39, 279–281.

•**Bui Huy, N. P., Ogle, B. & Lindberg, J. E.** (2000): Effect of replacing soya bean protein with cassava leaf protein in cassava root meal based diets for growing pigs on digestibility and N retention. Animal Feed Science and Technology, 83, 223–235.A

•**Campbell, G. L. & van der Poel, A. F. B**. (1998): Use of enzymes and process technology to inactivate ant nutritional factors in legume seeds and rapeseed. In A. J.

M. Jansman, J. Huisman,& A. F. B. van der Poel (Eds.), Recent advances of research in ant nutritional factors in legume seeds and rapeseed. Proceedings of the third international workshop (pp. 377–386). Wageningen

•**CAREW L.B., GERNAT A.G**. (2006): Use of velvet beans, Mucuna spp., as afeed ingredient for poultry: a review. World's Poultry Science Journal, 62,131-144.

•**Cheeke, P. R. &Carlsson, R.** (1978): Evaluation of several crops as sources of leaf meal: composition, effect of drying procedure, and rat growth response. Nutrition Reports International, 18, 465–473.

•**Chenost, M.&Kayouli, C.** (1997): Roughage utilization in warm climates. Food and Agriculture Organization (FAO), Rome.

chicks. Poult. Sci. 52:1875–1882.

•**Clarke E., Wiseman J.** (2007): Effects of extrusion conditions on trypsin inhibitor activity of full fat soya beans and subsequent effects on their nutritional value for young broilers. British Poultry Science, 48, 703–712.

•**Claudinin, D, R., W. W. Cravens, C. A. Elvehjem and J. G. Halpen**. (1947): Deficiencies in over heated soya bean oilmeal. Poult. Sci. 26:150

•**Close, W. H. (1993).** Fibrous diets for pigs. In M. Gill,E. Owen, G. E. Pollot, & T. L. G. Lawrence (Eds.),Animal production in developing countries (pp. 107–115). British Society of Animal Production Occasional Publication No 16. London.

Copyright@1985-2013.Analytical Software.

•**D. & Webb, C.** (2003): Cereal-based fermented foods and beverages. Food Research International,, 527–543.

D.C.

•**D'Mello, J. P. F. &Walker, A. G.** (1991): Detoxification of Jack Beans (Canavaliaensiformis) - Studies with young chicks. Animal Feed Science and Technology,33, 117–127.

•**Dahot MU**.(1998) Vitamin contents of flowers and seeds of *Moringaoleifera*. Pak J Biochem 1988; 21: 21–24.

Department of Animal Science, Faculty of Agriculture, University for Development Studies, Tamale, Ghana.

•**Dourado L.R.B., Pascoal L.A.F., Sakomura N.K., Costa F.G.P., Biagiotti D.** (2011): Soya beans (Glycine max) and soya bean products in poultry and swine nutrition. In: Krezhova D. (ed.): Recent Trends for Enhancing the Diversity and Quality of Soya bean Products. InTech Publishing, Rijeka, Croatia, 175–190.

•**DURMIC Z., PETHICK D.W., MULLAN B.P., SCHULZE H., ACIULLY J.M.,HAMPSON D.J.** (2000): Extrusion of wheat or sorghum and/or addition ofexogenous enzymes to pig diets influences the large intestinal microbiota but doesnot prevent development of swine dysentery following experimentalchallenge. Journal of Applied Microbiology. 89, 4, 678-686.

•**Echeverria, V., Belmar, R., Ly, J. & Santos-Ricalde,R. H.** (2002): Effect of Leucaenaleucocephala leafmeal treated with acetic acid or sodium hydroxide onapparent digestibility and nitrogen retention in pig diets. Animal Feed Science and Technology, 101, 151–159.

•**EL-KHALIK A. E., JANSSENS G.P.J.** (2010): Effect of extrusion processing on starch gelatinisation and performance in poultry. World's Poultry Science Journal.66, 53-64.

factors and their detoxification in pulses – a review. Agricultural Reviews, 30, 64–70.

•**Fahey JW.(**2005): *Moringaoleifera*: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. Trees for Life Journal 2005; 1: 5. Available at http://www.TFLJournal.org/article.php/20051201124931586.

•**FAO** (2000): Silage Making in the Tropics with Particular Emphasis on Smallholders. Proceedings of the FAO Electronic Conference on Tropical Silage, 1 September to 15 December 1999. FAO Plant Production and Protection Paper 161. FAO.

•**FAS/USDA** (Foreign Agricultural Service/United States Department of Agriculture). 2009. World soybean supply and distribution. FAS/ USDA, Washington, D.C.

•**FEFAC (European Feed Manufacturers Federation). (**2007): Industrial compound feed production, FEFAC Secretariat General, Brussels, May 2007.

•**Flaih, A., A. A-Hussain and B.M. N-Ebrahim,** 1998. The Santdrian,S., 1981. Intestinal absorption of galactose, effect of different levels of local faba bean on broiler glucose and leacine in male growing rats fed field performance. In: Iraq. J. Agric. Sci.,Vol. 29.

•**Foltyn M., Rada V., Lichovnikova M., Safarik I., Lohnisky A., Hampel D. (2013):** Effect of extruded full-fat soybeans on performance, amino acids digestibility, trypsin activity,and intestinal morphology in broilers. Czech Journal of Animal Science, 58, 470–478.

Foods. M. Friedman, ed. Plenum Press, New York.

•**Gerez, C. L., Rollan, G. C. & Valdez, G. F**. (2006): Gluten breakdown by lactobacilli and pediococci strains isolated from sourdough. Letters in Applied Microbiology, 42, 459–464.

•**Gerpacio, A. L. &Princesa, A. O.** (1985): Effects of heat treatment and fat extraction on the nutritive value of winged bean seed meal for broilers [Philippines]. Animal-Production-Technology (Philippines), 1, 33–34.

•**GERTLER A., BIRK Y., BONDI A.** (1966): A comparative study of the nutritional and physiological significance of pure soya beantrypsin inhibitors and of ethanol extracted soya bean meals in chicks and rats. The Journal of Nutrition , 358-370.

•**Graham, K.K., Kerley, M.S., Firman, J.D., and G.L. Allee.** (2002): The effect of enzyme treatment of soya bean meal on oligosaccharide disappearance and chick growth performance. Poultry Science, 81: 1014-1019.

•**Granito, M., Frias, J., Doblado, R., Guerra, M., Champ, M.&Vidal-Valverde, C.** (2002): Nutritional improvementof beans (Phaseolus vulgaris) by natural fermentation.European Food Research and Technology,214, 226–231.

•**Grant, G.** (1989): Anti-nutritional effects of dietary lectins. In J. P. F. D'Mello, C. M. Duffus, &J. H. Duffus (Eds.), Anti-nutritional factors, potentially toxic substances in plants (pp. 51–74). Warwick, United Kingdom.

•**Grant**, **G., More, L. J., McKenzie, N. H., Dorward, P. M., Buchan,W. C., Telek, L. &Pusztai, A. (**1995): Nutritional and haemagglutination properties of several tropical seeds. The Journal of Agricultural Science, 124, 437–445.

growing-finishing pigs. Tanzania Journal of Agricultural Sciences, 1, 121–130.

•**Gu, C., Pan, H., Sun, Z. and G. Qin**.(2010): Effect of soya bean variety on ant nutritional factors content, and growth performance and nutrients metabolism in rat. International Journal and Molecular Science, 11: 1048-1056.

•**H.K. Dei** (2011): Soya bean as a Feed Ingredient for Livestock and Poultry, Recent Trends for Enhancing the Diversity and Quality of Soya bean Products, Prof. Dora Krezhova (Ed.), ISBN: 978-953-307-533-4, InTech,

•**Hauptli, L. &Lovatto, P. A.** (2006): Feeding sows in gestation and lactation with diets containing saponins. Ciencia Rural, 36, 610–616.

•**Heinritz, S., Martens, S. D., Avila, P. &Hoedtke, S.(**2012a):The effect of inoculant and sucrose addition on the silage quality of tropical forage legumes with varying ensilability. Animal Feed Science and

•**Herkelman, K. L., G. L. Cromwell, and T. S. Stahly.**1991: Effects of heating time and sodium metabisulfite on the nutritionalvalue of full fat soyabeans for chicks. Journal of animal Science, 69,4477-4486.

•**Higasa, S., Negishi, Y., Adoyagi, Y. &Sugahara, T.** (1996): Changes in free amino acids of tempe duringpreparation with velvet beans (Mucunapruriens).Journal of Japanese Society for Food Science andTechnology, 43, 188–.J. Anim. Sci. 69:4477-4486.193.

•**Hira, C. K. & Chopra, N.** (1995): Effects of roasting on protein quality of chickpea (Cicerarietinum) and peanut (Arachishypogaea). Journal of Food Science and Technology-Mysore, 32, 501–503

•**Hurrell, R.F.** (1990): Influence of the Maillard Reaction on nutritional value of foods. In: The Maillard Reaction in foods processing, human nutrition and physiology, pp 245-358. BirkhauserVerlag, Basel, Switzerland.

•**Huyghebaert, G., G.D. Munter and G.D. Groote.** (1988): The metabolisable energy (AMEn) of fats for broilers in relation to their chemical composition. Animal Feed Science and Technology, 20: 45-58.

•**Igene, F. U., Oboh, S. O. &Aletor, V. A.** (2006): Nutrient and anti-nutrient components of raw and processed winged bean seeds (Psophocarpustetragonolobus). Indian Journal of Animal Sciences,

•**Ilsley, S. E. & Miller, H. M.** (2005)**:** Effect of dietary supplementation of sows with quillajasaponins during gestation on colostrums composition and performance of piglets suckled. Animal Science, 80, 179–184.

in Nutritional and Toxicological Significance of Enzyme Inhibitors in

•**INRA (InstituteScientifique de RecherchéAgronomique).** 2004. Tables of composition and nutritional value of feed materials, 2 ed. (Sauvant, D., Perez, J.M. and Tran, G., eds.),p.186. Wageningen Academic Publishers, Netherlands.

•**J. R**. (2009): Decreasing dietary particle size of lupins increases apparent ileal amino acid digestibility and alters fermentation characteristics in the gastrointestinal tract of pigs. British Journal of Nutrition,102, 350–360.

•**JabeenR., Shahid M., Jamil A., Ashraf M.**(2008):Microscopic evaluation of the antimicrobial activity of seed extracts of Moringaoleifera. Pak J Bot 2008; 40: 1349–1358.

•**Jain, A. K., Sudhir, K. &Panwar, J. D. S**. (2009): Anti nutritionalfactors and their detoxification in pulses - areview. Agricultural Reviews, 30, 64–70

•**Jeroch, H., Flachowsky, G. &Weissbach, F**. (1993)**:**Futtermittelkunde. Jena, Stuttgart.

•**Jonsson, L. O., Dendy, D. A. V., Wellings, K. &Bokalders, V.** (1994):Small-scale milling: a guidefor development workers. Intermediate TechnologyPublications Ltd

(ITP), London. Journal of Animal Science, 82,1108–1114.Perez-Maldonado R.A., Mannion

•**Juniar I., Widodo E., Sjofjan O**.(2008) Effect of *Moringaoleifera*leaf meal in feed on broiler production performance. Jurnal Ilmuilmu Peternakan Brawijaya 2008; 18: 238–242.

•**KAKADE M.L., ARNOLD R.L., LIENER I.E., WAIBEL P.E**. (1969): Unavailability of cysteine fromtrypsin inhibitors as a factor contributing to poor nutritive value of navy beans. Journal of Nutrition, 99, 34-42.

•**Kayouli, C., Cottyn, B. G., Aerts, J. V., Majdoub, A.&Sansoucy, R.** (1982): Improvement of the feedingvalue and utilization of sodium hydroxide-treatedstraw in Mediterranean zones. In Tropical animalproduction for the benefit of man. Proceedings of theInternational Colloquium, Antwerp (Belgium), 17-18Dec 1982 (pp. 435–442). Prince Leopold Institute ofTropical Medicine Antwerp, Belgium.

•**Kerley, M.S. and G.L. Allee**.(2003): Modifications in soya bean seed composition to enhance Animal feed use and value: Moving from dietary ingredient to a functional dietary component. AgBioForum, 6(1&2)14.17.

•**Kim, J., Mullan, B. P., Heo, J., Hansen, C. F. & Pluske,J. R. (2009).** Decreasing dietary particle size of lupins increases apparent ileal amino acid digestibility and alters fermentation characteristics in the gastrointestinal tract of pigs. British Journal of Nutrition,102, 350–360.

•**KUMAR V., RANI A., TINDWANI C., JAIN M.** (2003): Lipoxygenaseisozymes and trypsin inhibitor activities in soya bean as influenced by growing location. Food Chemistry, 83, 1, 79.

•**KUNITZ M**. (1945): Crystallization of a trypsin inhibitor from soya bean. Science, 101, 668-669.

•**Lacassagne, L., Francesch, M., Carre, B. &Melcion,J. P**. (1988): Utilization of Tannin-Containingand Tannin-Free Faba Beans (Viciafaba) by YoungChicks - Effects of Pelleting Feeds on Energy, Prtein and Starch Digestibility. Animal Feed Scienceand Technology, 20, 59–68.o

•**Laitat, M., de Jaeger, F., Vandenheede, M. & Nicks, B.**(2004): Factors influencing feed ingestion and performance of weaned pigs: perception and characteristics of diets. Annales de MedecineVeterinaire, 148, 15–29.

•**Laitat, M., Vandenheede, M., Désiron, A., Canart, B. & Nicks, B.** (2000): Pellets or meal after weaning: thechoice of piglets. 32èmes Journées de la RecherchePorcine en France, Paris, France, 1, 2 et 3 février2000. Journées de la Recherche Porcine en France,32, 157–162

•**Laswai, G. H., Lekule, F. P., Kimambo, A. E., Sarawatt, S. V. &Sundstol, F.** (1998): The effect of processingmethod of dolichos bean (Lablab purpureusL. Sweet) on the digestibility and performance of growing-finishing pigs. Tanzania Journal of Agricultural Sciences, 1, 121–130.

•**Lee K.H., Olomu J.M., Simt J.S.** (1991): Live performance, carcass yield, protein and energy retention of broiler chickens fed canola and flax full-fat seeds and the restored mixtures of meal and oil. The Canadian Journal of Animal Science, 71, 897–903.

•**Leeson S., Atteh J.O.** (1996): Response of broiler chicks to dietary full-fat soya beans extruded at different temperatures prior to or after grinding. Animal Feed Science and Technology, 57, 239–245.

•**Leterme, P., Londono, A. M., Ordonez, D. C., Rosales, A., Estrada, F., Bindelle, J. &Buldgen, A.** (2010):Nutritional value and intake of aquatic ferns (Azollafiliculoides Lam. and Salviniamolesta Mitchell.) insows. Animal Feed Science and Technology, 155, 55–64.

•**Liener, I.E. (**1977): Removal of naturally occurring toxicants through enzymatic processing. In: R.E. Feeney and J.R. Whitaker (Eds.), Food proteins: Improvements through chemical and enzymatic modifications (p.7-57). Advances in Chemistry Series 160. Washington,

•**LIN S., HSIEH F., HUFF H.E.** (1997): Effects of lipids and processing conditions on degree of starch gelatinization of extruded dry pet food. Food Science and Technology-Lebensmittel-Wissenschaft&Technologies, 30, 754-761.

•**Liner I.E.** (1994): Implications of ant nutritional components in soya bean foods. Food Science and Nutrition, 34, 31–67.

•**Liu, G. D. & Wang, D. J.** (1990). Detoxicationof leucaena juvenile shoots[s]. Leucaena Research Rep orts,11, 112–113.

•**Lucy, M.C., T.S. Gross and W.W. Thatcher.** (1990)**:** Effect of intravenous infusion of a soya bean oil emulsion on plasma concentration of 15-keto-13, 14-dihydro-prostaglandin F2a and ovarian function in cycling Holstein heifers. In: Livestock reproduction in Latin America. Internaqtional Atomic Energy Agency, Vienna, Austria.

•**Luqman S, Srivastava S, Kumar R, Maurya AK, Chanda D.(**2012):Experimental assessment of *Moringaoleifera*leaf and fruit for its antistress, antioxidant and scavenging potential using in vitro and in vivo assays. Evi Bas Compl Alt Med 2012; 2012:519084.

•**Makkar HPS., Becker K**.(1997): Nutrients and antiquality factors in different morphological parts of *Moringa oleifera* tree. J AgriSci 1997; 128: 311–322.

•**Makkar, H. P. S.** (2007): Plant secondary metabolites as antinutrients in monogastric nutrition. In P. Leterme, A. Buldgen, E. Murgueitio,& C. Cuartas (Eds.), Fodder banks for sustainable pig production systems (pp.67–85). CIPAV. Cali, Colombia.

•**Marcinakova, M., Laukova, A., Simonova, M., Strompfova, V., Korenekova, B. & Nad, P.** (2008): A newprobiotic and bacteriocin-producing strain of Enterococcusfaecium EF9296 and its use in grass ensiling. Czech Journal of Animal Science, 53, 336–345.

•**Marsman G.J.P., Gruppen H., van der Poel A.F.B., Kwakkel R.P., Verstegen M.W.A., Voragen A.G.J.** (1997): The effect of thermal processing and enzyme treatments of soya bean meal on growth performance, ileal nutrient digestibilities, and chyme characteristics in broiler chicks. Poultry Science, 76, 864–872.

•**Melcion, J. P., Michelangeli, C. & Picard, M.** (1994): Evaluation of the Effect of Extrusion-Cooking of Jackbean (Canavaliaensiformis L) Seed on Short- Term Feed-Intake in Chicks. Animal Feed Science

•**Michele W.D, Parsons C.M., Hymowitz T.** (1999):Nutritional evaluation of lectin-free soya beans for poultry. Poultry Science, 78, 91-95.

•**Montilla, J. J., Reveron, A., Schmidt, B., Wiedenhofer, H. & Castillo, P. P.** (1974): Leaf meal of mousetail(Gliricidiasepium) in rations for laying hens.Agronomia Tropical, 24, 505–511.

•**Mosenthin, R. & Sauer, N.** (2011): Nutritional impact of feed particle size in diets for pigs. Proceedings of the Society of Nutrition Physiology, 20, 150–156.

•**MOUGHAN P.J., RUTHERFURD S.M.** (1996): A new method for determining digestible reactive lysine in foods. Journal of Agriculture and Food Chemistry, 44, 2202-2209.

•**Muangkeow, N**. (1994): Pigeonpea (Cajanuscajan L.) seed meal in poultry diets. Ph.D. thesis University of Philippines Los Banos, Laguna, Philippines.

•**Muzquiz, M., Pedrosa, M. M., Cuadrado, C., Ayet, G., Burbano, C. &Brenes, A**. (1998): Variation of alkaloids,alkaloids esters, phytic acid and phytase activityin germinated seeds of Lupinusalbus and L. luteus.In A. J. M. Jansman, J. Huisman, & A. F. B.van der Poel (Eds.), Recent advances of research inant nutritional factors in legume seeds and rapeseed.Proceedings of the third international workshop (pp.387–390). Wageningen.

•**National Research Council**. **(NRC)** 1994: *Nutrient Requirements of Poultry, 9th .rev. ed*. National Academy Press, Washington, DC.

•**Niven, S. J., Beal, J. D. & Brooks, P. H.** (2006): The effect of controlled fermentation on the fate of syntheticlysine in liquid diets for pigs. Animal Feed Science and Technology, 129, 304–315.

•**Olstorpe, M., Axelsson, L., Schnürer, J. & Passoth, V.(2010).** Effect of starter culture inoculation on feed hygiene and microbial population development in fermented pig feed composed of a cereal grain mix with wet wheat distillers' grain. Journal of Applied Microbiology,108, 129–138.

•**Olugbemi TS., Mutayoba SK., Lekule FP**.(2010): Effect of Moringa(*Moringaoleifera*) inclusion in cassava based diets fed to broilers chickens. Inter J PoultSci 2010; 9: 363–367.

•**Palacios M.F., Easter R.A., Soltwedel K.T., Parsons C.M., Douglas M.W., Hymowitz T., Pettigrew J.E.** (2004):Effect of soya bean variety and processing on growth performance of young chicks and pigs.

•**Parsons, C.M., Hatsimoto, K., Wedeking, K.J., Han, Y. and D.H. Baker.** (1992): Effect of over processing on availability of amino acids and energy in soya bean meal. Poultry Science, 71, 133-140.

•**Pedersen, M. W., Anderson, J. O., Street, J. C., Wang,L. C. & Baker, R. (1972)**. Growth response of chicks and rats fed alfalfa with saponin content modified by selection. Poultry Science, 51, 458–463.

•**Peisker, M**. (2001). Manufacturing of soy protein concentrate for animal nutrition. Cahiers Options Mediterraneennes, 54: 103-107.

•**Perez-Maldonado R.A., Mannion P.F., Farrell D.J**. (2003): Effects of heat treatment on the nutritional value of raw soya bean selected for low trypsin inhibitor activity. British Poultry Science, 44, 299–308.

•**Perilla N.S., Cruz M.P., De Belalcazar F., Diaz G.J.** (1997)**:** Effect of temperature of wet extrusion on the nutritional value of full-fat soya beans for broiler chickens. British Poultry Science, 38, 412–416.

•**Phuc, B. H. N., van Lai, N., Preston, T. R., Ogle, B.& Lindberg, J. E. (1995).** Replacing soya bean mealwith cassava leaf meal in cassava root diets for growing pigs. Livestock Research for Rural Development, 7.

•**PUGALENTHI M., VADIVEL V., SIDDHURAJU P.** (2005): Alternative food/feed perspectives of an underutilized legume maculapruriens var. utilis. A Review Plant Foods for Human Nutrition, 60, 201-218.

•**Rackis, J. J.** 1974: Biological and physiological factors in soya beans. J. Am. Oil Chem. Soc. 51:161A–174A.

REFERANSE

•**REFSTIE S., STOREBAKKEN T., ROEM A.J.** (1998): Feed consumption and conversion in Atlantic salmon (Salmosalar) fed diets with fish meal, extracted soya bean meal or soya bean meal with reduced content of oligosaccharides, trypsin inhibitors, lectins and soya antigens. Aquaculture, 162, 301-312.

•**Reiber, C., Schultze-Kraft, R., Peters, M. & Cruz, H.(2008).** Smallholder innovation and adoption of hay and silage technologies in Honduras. Guangdong People's Publishing House. Guangzhou. Pp. 1113.

•**Reiber, C., Schultze-Kraft, R., Peters, M. & Hoffmann, V. (2009).** Potential and constraints of little bag silage for smallholders-results and experiences from Honduras. Experimental Agriculture, 45, 209–220.

•**Reyes-Moreno, C., Cuevas-Rodriguez, E. O., Milan- Carrillo, J., Cardenas-Valenzuela, O. G. & Barron- Hoyos, J. (2004).** Solid state fermentation process for producing chickpea (Cicer arietinum L) tempeh flour. Physicochemical and nutritional characteristics of the product. Journal of the Science of Food and Agriculture,84, 271–278.

•**Ruiz N., de Belalcazar F., Diaz G.J**. (2004): Quality control parameters for commercial full-fat soya beans processed by two different methods and fed to broilers. Journal of Applied Poultry Research, 13, 443-450

•**SADEGHI G.H., MOHAMMADI L., IBRAHIM S.A., GRUBER K.J**. (2009): Use of bitter vetch (Viciaervilia) as a feed ingredient for poultry. World's Poultry Science Journal, 65, 51-64.

- **Sakomura, N.K., R. da Silva, A.C. Laurentz, E.B. Malheiros and L.S.O. Nakaji**. (1998): Evaluation of whole toasted and extruded soya bean on the performance of broilers. Brazil. Journal. Animal science. 27: 584- 594.

•**Sangronis, E. & Machado, C. J.** (2007): Influence of germination on the nutritional quality of Phaseolus vulgaris and Cajanuscajan. LWT - Food Science and Technology, 40, 116-120.

•**Schneeman, B. O., and D. Gallaher.** (1986): Pancreatic response

•**Sell, J.L., L.G. Tenesaca, and G.L. Bales.** (1978): Influence of dietary fat on energy utilisation by laying hens. Poultry Science, 58: 900-905.

•**Skinner, J.J., Izat , AL,ʿand Waldroup, P.W** (1991). Effect of dietary amino acids levels on performance and carcass composition of broiler 42 to 49 days of age poultry Science 70(5) : 1223 – 1230.

•**Sourabie, K. M., Kayouli, C. & Dalibard, C. (1995).** Urea treatment of roughages: a highly promising technique in Niger. World Animal Review, 82, 3–13.

•**Staples, C.R., J.M. Burke, and W.W. Thatcher.** (1998): Influence of supplemental fats on reproductive tissues and performance of lactating cows. Journal of Dairy Science, 81: 856871.

•**Statistix(2013)**. www.statistix.com, E-mail sales@statistix.com

•**Subuh A.M.H., Motl M.A., Fritts C.A., Waldroup P.W**. (2002): Use of various ratios of extruded full fat soya bean meal and dehulled solvent extracted soya bean meal in broiler diets. International Journal of Poultry Science, 1, 9–12.

Sudarmadji, S. & Markakis, P. (1977). The phytate and phytase of soybean tempeh. Journal of the Science of Food and Agriculture, 28, 381–383.

Technology, 174 (3), 201–210.

to dietary trypsin inhibitor: Variation among species. Pages 185–187

trypsin inhibitor free soya beans. Poult. Sci. 71:1700–1709.

•**Urooj, A. &Puttaraj, S.** (1994): Effect of Processing on Starch Digestibility in Some Legumes - An In-Vitro Study. Nahrung-Food, 38 (1), 38–46.

•**V., Korenekova, B. &Nad, P.** (2008): A new probiotic and bacteriocin-producing strain of Enterococcus faecium EF9296 and its use in grass ensiling. Czech Journal of Animal Science, 53, 336–345.

•**Vadivel, V. &Janardhanan, K.** (2005): Nutritional and ant nutritional characteristics of seven South Indian wild legumes. Plant Foods for Human Nutrition,60, 69–75.

•**Valencia D.G., Serrano M.R., Lazaro R., Jimenez-Moreno E., Mateos G.G. (2009):** Influence of micronization (fine grinding) of soya bean meal and full-fat soya bean on the ileal digestibility of amino acids for broilers. Animal Feed Science and Technology, 150, 238–248.

•**Van Zuilichem, D. J., Stolp, W., Wolters, I. & van derPoel, A. F. B.** (1998): Expander processing of full-fatsoya beans, a product development tool. In A. J. M.Jansman, G. D. Hill, J. Huisman, & A. van der Poel(Eds.), Recent advances of research anti nutritionalfactors in legume seeds and rapeseed. Proceedingsof the 3rd International Workshop on AntinutritionalFactors in Legume Seeds and Rapeseed, Wageningen,The Netherlands, 8-10 July 1998 (pp. 453–456).EAAP Publication 93, Wageningen Pers. Wageningen

•**Varley, P. F., Flynn, B., Callan, J. J. &O'Doherty,** J. V.(2011): Effect of phytase level in a low phosphorus diet on performance and bone development in weaner pigs and the subsequent effect on finisher pig bone development. Livestock Science, 138, 152–158.

•**Vijayakumari, K., Siddhuraju, P. &Janardhanan, K.** (1996a): Effect of different post-harvest treatments on antinutritional factors in seeds of the tribal pulse, Mucunapruriens (L) DC. International Journal of Food Sciences and Nutrition, 47, 263–272.

•**Vijayakumari, K., Siddhuraju, P. &Janardhanan, K.** (1996b): Effect of soaking, cooking and autoclavingon phytic acid and oligosaccharide contents ofthe tribal pulse, Mucunamonosperma DC ex Wight.Food Chemistry, 55, 173–177.

•**Waldroup, P. W., and T. L. Cotton**. 1974: Maximum usage levels of cooked full-fat soya beans in all-mash broiler diets. Poult. Sci.53:677680.

•**Woodworth, J.C., Tokach, M.D., Goodband, R.D., Nelssen, J.L., O'Quinn, P.R., Knabe, D.A. and N.W. Said**.(2001): Apparent ileal digestibility of amino acids and digestible and metabolisable energy content of dry extruded-expelled soya bean meal and its effect on growth performance of pigs. Journal of Animal Science, 79:1280-1287.

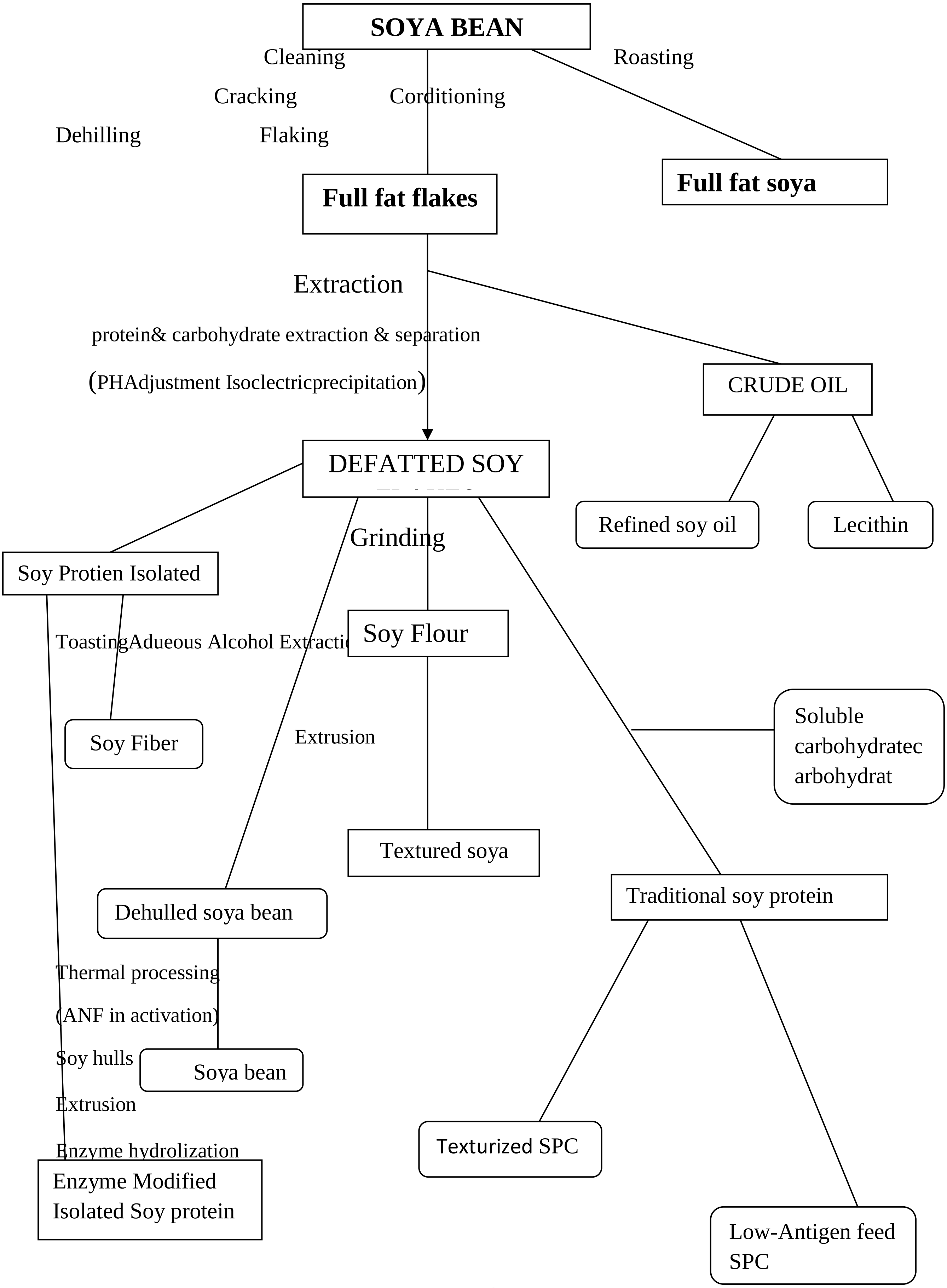
- **Yameogo CW, Bengaly MD, Savadogo A, Nikiema PA, Traore SA. (2011):** Determination of chemical composition and nutritional values Moringaoleifera leaves. Pak J Nutr; 10: 264–268.
- **Yang, Y. X., Kim, Y. G., Heo, S., Ohh, S. J. & Chae,B. J. (2007).** Effects of processing method on performance and nutrient digestibility in growing-finishing pigs fed lupine seeds. Asian-Australasian Journal of Animal Sciences, 20, 1229–1235.
- **Yen, J. T., A. H. Jenson, T. Hymowitz, and D. H. Baker**. (1973): Utilization of different varieties of raw soya beans by male and female
- **Yen, J.T., T. Hymowitz and A.H. Jensen. (1971)**: Utilization by rat of proteins from a trypsin inhibitor variant soya bean. Journal of Animal Science, 33: 1012-1017.

Appendix

Appendix (1): Environmental temperature(c) during the experiment period

WEEKS	Min	Max
First week	16	26
Second week	16	26
Third week	16	28
Fourth week	18	30
Fifth week	18	30
Sixth week	19	30

Figure (1):**2.6 processing of soya bean to improve nutritional value**



Picture(1): Soya bean

Picture(2): Housing

Pancreas

Picture (3) Pancreas of Control

Picture (4) Pancreas of 12% full fat soya

Picture (5) Pancreas of 15% full fat soya