An-Najah National University
Faculty of Graduate Studies

Performance of Awassi Lambs' Fed Agricultural Waste Silage

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Committee Decision

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This thesis was defended successfully on the 21st June 2003 and approved by:

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بسم الله الرحمن الرحيم

الإهداء

إلى شهداء الحرية في وطني الحبيب فلسطين
وإلى شهداء الأمة العربية
لكل طفل فلسطيني حمل حجرا في وجه الطغيان
ولكل طفل عراقي عانى ويلات الحصار والدمار
إلى ست الحبايب والدتي العزيزة التي طالما انتظرت ثمرة تعبها وسهر لياليها
إلى صاحب الزنود السمراء والدي الغالي الذي كافح طوال سنين عمره المديدة (إن شـــاء الله)
من أجل أن أصل إلى أعلى درجات العلم والمعرفة.
الى اخوتي وأخواتي الأحباء.
إلى زوجتي وأولادي محمود وآيات وغفران ولمى وأحمد الذين ضحوا بأجمل أوقات فـــرحهم
ولهوهم مع والدهم من أجل إنجاح هذا العمل.

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Abstract

This research was conducted to investigate the utilization of silage made from some agricultural by – products (poultry manure, wheat straw, tomato) for the growth and finishing of Awassi lambs. Silage was made by mixing of poultry manure, wheat straw, and damaged tomato fruit at rates of 50, 25 and 25% respectively. Sugar was added to the mixture at 3 percent to increase the rate of fermentation. Six months later, silage was analyzed for its chemical and physical characteristics. These examinations proved the quality of the silage and it was ready for use in fattening rations. Twenty Awassi lambs were used in the experiment. Lambs were divided into four equal groups. The first group were fed a commercial concentrate (80%) plus (20%) vetch hay. The second, third and fourth groups were fed the commercial concentrate and silage at rate of 15, 30 and 45%, for these groups, respectively. Silage was used to replace hay and partial amount of concentrate. Lambs were fed their rations for 60 days on group basis and their daily feed intake was recorded. Lambs were weighed individually on weekly basis. At the time of termination the trial, three lambs from each group were slaughtered and eviscerated, weight of carcass, visceral organ gastrointestinal tract component, and content were recorded. The performance of lambs fed the 30% silage diet showed more yield than that of other groups.

Average daily gain in lambs was 0.34, 0.33, 0.37 and 0.31 kg for lambs fed the control diet to 45% silage, respectively. Similar trends were observed in feed conversion ratios which were 4.8, 4.5, 4.5 and 5.3 kg feed/kg gain for lambs fed the control diet to 45% silage, respectively. The cost of gain was significantly ($P < 0.05$) the highest in lambs fed the commercial diet and the lowest in lambs fed diet containing 45% silage. Lambs fed diet containing 30% silage had heavier gastrointestinal tract components and contents. They had heavier ($P < 0.05$) weights of head and legs and longest small intestine, compared to lambs in other groups. Lambs fed diet containing 15% silage had the lowest weights of the measured items. However, lambs fed the commercial diet had the heaviest ($P < 0.05$) weights of the items measured.

Chapter I
Introduction

1.1 Introduction

Human population is increasing at a high rate in Palestine. The population growth rate is estimated to be 3.5% (Palestinian Central Bureau of Statistics). The growth is accompanied by harsh economic conditions and long dry periods. Growth of the human population has been accompanied by a simultaneous increase in the demand of animals for feed materials, resulting in deterioration of pastures, leading to a marked decrease in animal performance. The sustained efforts to increase the output of animal products, in order to meet animal's requirement, has greatly boosted the demand for conventional feed resources leading to an increase in the quantities of imported concentrates and roughage.

It is of great importance to consider this situation and recognize that importance of feed can be reduced by utilizing agricultural by – products and animal waste specifically suited to ruminant livestock feeding.

To achieve greater and improved use of by-products there is need to know the quantity, type, seasonal- availability, alternative uses and relative costs of different by-products. Utilization of by-products as feed for ruminants need more research and precautions in order for the by- product to be safe for animals to consume. Among the best methods for utilizing by-products as feed for ruminants without harmful effects is making silage. This is due to the elimination of pathogens, and reducing the effect of drugs

and pesticides (destructive) which are used locally nearly without control or discipline (Hadjipanayiutou, 1989).

Silage either made of certain field crops or agricultural by-products is considered as good type of feed ingredient. It is used in wide ranges in livestock operations world wide, especially in feedlot operations (Abo Omar *et al.*, 1994).

The fattening operations are among the important activities within animal production sector. The income from such operations is estimated to be 61% of the total income of animal production (PMOA, 2000).

In Palestine, feed contributes about 75% of the total cost of animal production, where most of ingredients are imported from foreign sources at high cost (Abo Omar and Gavoret, 1995). Then attempts for utilizing by – products as components of animal feeds would decrease the total cost of feeding, which could increase the profitability to livestock producers.

Large amount of local agricultural by-products are available. It varies in amounts, nutritive value and location. Among these is the fresh poultry manure, cereal hay and damaged tomato fruits. Each of these ingredients is available in the local market. The tomatoes under focus are the fruits that are the damaged and those which could not fit for market. The estimated amount of local poultry manure is one ton /1000 chickens during a raising period of 50 days, the amount of hay is 200 kg/dunum while the a mount of

damaged tomato fruit is 300 kg/dunum (Ministry of Agriculture records, 2000).

Several types of agricultural by-products are fed to animals individually with variable effects on performance. However, little or no information is available on utilizing silage made of local by-products in livestock operation. Silage from these by-products when mixed together at different percentage could be a potential feed for lambs.

The objectives of this project were, to investigate the effect of feeding silage made of different agricultural by-products on the performance of Awassi fattening lambs, on lambs visceral organ mass, and carcass composition.

1.2 Literature review

1.2.1 Fattening projects in Palestine

Recent data showed that about 250,000 lambs were fattened during the year 2000(Hammad, 2001). Such fattening projects are important in the animal production sector which account for about 63% of the animal production value (PMoA, 2000).

The majority of lambs in fattening operations are the Awassi breed. These operations face many challenges, mainly the high cost of manufactured feeds. The majority of fattening operations which belong to rely upon concentrates feeding under an intensive system (Hammad, 200).

1.2.2 Silage

It is a fermented feed resulting from the storage of high moisture crops, usually green forages under anaerobic conditions in a structure called a silo (Cullison, 1979).

It refers to the product of a controlled, anaerobic fermentation of green forages or fermentation in the absence of air (Heath *et al.*, 1999). The primary purpose in ensiling is storing of the green forages crop to preserve a material palatable to the animal with minimum loss of its nutrients

1.2.2.1 Silage on the basis of moisture level

1.2.2.1. A Direct-Cut Silage

Grass and legumes forages harvested and stored without field drying are likely to contain more than 70% moisture. The higher the moisture content, the more critical is the need for a low pH to obtain a good preservation.

1.2.2.1. B Wilted Silage

The forage is cut and permitted to wilt in the swath and/or windrow until the moisture reaches approximately 65%. Silage produced by this method undergoes fermentation depending upon the lactic acid produced for preservation. However, there is less fermentation than in direct –cut materials, consequently, a pH of about 4.5 is indicative of good quality fermentation in wilted silage (Heath *et al.*, 1999).

1.2.2.1. C Low- Moisture Silage

Low-moisture silage (40%- 60% moisture) has limited bacterial growth and fermentation. Fermentation is of minor concern since little acid is produced and pH is not always a useful criterion of quality. The important factor is the establishment and maintenance of air-free conditions (Heath *et al.*, 1999; Harbe *et al.,* 1999).

Infiltration of air into the silage mass will allow growth of yeast and molds resulting in an increase in temperature. Temperatures above 35°C for a few days will cause certain proteins to form products that are not digestible. This can be measured as protein insoluble in an acid detergent solution and is termed (bound) protein (Heath *et al.*, 1999). However, if the temperature in the mass exceeds 55°C, protein digestibility will be reduced (over heated silage). The silage will be dark brown or even black in color it may be palatable to animals but is of low nutritional value because of excessive oxidation of soluble nutrients (McDonald *et al.*, 1981).

1.2.2.2 Principle of preservation

Silage making is a means of preserving feeds for livestock and is evaluated in terms of the efficiency of preservation and the value of the product taken from the silo to the animals. The ensiling process is governed by the interaction of three factors. The chemical composition of the

material placed in the silo, the mount of air entrapped or allowed to enter the silage mass and the activity of the bacterial population (Heath *et al.*, 1999; McDonald *et al.*, 1981).

The ensiling process involves a series of qualitative and quantitative changes in the silage mass. The type and extent of fermentation varies with the chemical composition of the material.

When we start making silage a large number of aerobic bacteria present on the surface of the material will increase in number as long as oxygen is present. Several hours later, depending upon the amount of air entrapped, the oxygen is depleted and anaerobic conditions prevail. This permits lactic acid bacteria, found initially in small numbers on the materials, to grow and within two or four days they increase to several hundred million organisms per gram of silage.

The bacteria convert the readily available carbohydrate to lactic acid, thereby reducing pH in the silage mass. A low pH inhibits bacterial growth and enzyme action and preserves the silage.

Silage with a pH of 4.2 or less is considered stable and may be kept for years if air is excluded. Drier silages stabilize at a higher pH until exposed to air (Heath *et al.*, 1999).

1.2.2.3 Biochemical changes during ensilage

1.2.2.3. A Microbial effect

A desirable fermentation is dependent upon the proliferation and activity of bacteria producing lactic acid. These bacteria can be classified into two types Homo fermentative, the principal end product is lactic acid and hetero fermentative, which produce lactic acid, acetate, sorbitol and methanol. One of the primary factors affecting the type of fermentation and the keeping quality of silage is the activity of bacteria belonging to the genera (Clostridium), which are involved in spoilage. An indication of clostridial action is the production of butyric acid.

In some cases, yeast may be a problem following opening of the silo. Silage with poor keeping qualities is more susceptible to yeast growth than are high-quality silage on exposure to air. In these silages fungal infestation may follow yeast activity (Heath *et al.*, 1999).

1.2.2.3. B Chemical changes

Chemical changes occur in silage material during the preservation of materials through fermentation. Basically the carbohydrate are converted through anaerobic fermentation into organic acids, which serve to lower pH, the products produced influence the acceptability and value of the product to the animals.

Lactic acid producing bacteria act on the readily available carbohydrates in the silage to produce lactic acid and some acetic, propionic, formic and succinic acid. When 1g of glucose is converted by bacteria to 2 moles of lactic acid, only about 3.1%of the energy is lost. The loss of energy in converting silage glucose to butyric acid is 22.7% of the original energy (Heath *et al.*, 1999, McDonald, *et al.*, 1981).

Concentration of lactic acid in silage may reach 8-10% of the dry mater under favorable conditions. When there is not enough carbohydrate available in silage to produce all the lactic acid needed, sugar-supplying materials such as molasses can be added at ensiling (Habeib, *et al.*, 1986, Heath *et al.*, 1999).

During the ensiling process, protein is converted into various non-protein nitrogen (NPN) compounds, so that 40-75% of total nitrogen in the silage mass may be present as (NPN). High protein materials are more difficult to ensile because they require more acid to change the pH (McDonald, *et al.*, 1981, Habeib, *et al.*, 1986, Heath, *et al.*, 1999).

1.2.2.4 Silage quality

No single criterion exists for classifying silage as good or poor, but a series of factors commonly associated with a given quality of material are known (Habeib, *et al.*, 1986, Heath, *et al.*, 1999). The subjective classification of silage's is difficult, but much useful information can be

obtained by carefully noting the color and smell of the silage and combining this knowledge with information on the nature of the material ensiled. Lowering the moisture content of the material is often used to produce high quality silage. High temperatures may occur in the silo and should be avoided because of the potential damage to the protein and energy value of the silage.

Reduced protein and energy values are attributed to the nonenzymatic browning reaction, also termed Mallard Reaction. In this reaction heat above (60°C) causes carbohydrate to combine with protein to produce an insoluble product, decreasing digestibility of both protein and energy (McDonald *et al.,* 1981, Heath *et al.,* 1999, Rogers and Poore, 1994).

European countries determined the quality of the silage by:

1- Noting color, smell, taste, feel, and present or absence of foreign materials.

2-Determination the pH

A- Super silage with pH 3.5-4.25

B- Good silage with pH 4.26-4.9

C-Poor silage with pH >4.9

3-Present and quality of organic acid (Sevkovic, 1983)

Generally we can characterize the high quality silage from the followings:

1- Utilizing a good material with high chemical composition

2- A pH of about 4.2 or below for high-moisture silage and about 4.5 for wilted silage and the pH is not an important criterion for low-moisture silage

3- Between 5+10% lactic acid on dry basis in high moisture silage

4- Freedom from molds and objectionable odors such as ammonia and butyric acid

5- Absence of caramelized or (tobacco like) odors and brown or black color.

6- A firm texture, with no sliminess

7- Absence of dead birds or insects that may be a hazard for animals

1.2.3 Dried Poultry Litter

Animal excreta can be used as partial replacement for conventional energy and/or protein feed resources. The economic value of animal excreta, including bedding and associated material, is 3 to 10 times greater than its value as a plant nutrient. The greatest monetary value of excreta being obtained when is used as protein source rather than energy source. The level of inclusion of excreta in the finished diet depends on the quality of the excreta and the stage of production of the animal. Dried poultry litter was used up to the rate of 30% in concentrate mixtures fed to fattening lambs, kids, calves, and lactating ewes and goats (Hadjipanayiotou, 1989).

In intensive feeding systems, litter should not exceed 20% of the daily ration. Dried poultry litter can be used for fattening lambs, because lambs have the unique digestible system of ruminants. This results in decreased cost of red meat production and reduces the harmful effect of large amounts of poultry litter to the environment.

1.2.3.1 Safety Consideration

An obstacle to the feeding of animal excreta to livestock is pathogenic organisms present in the litter. It must be born in mind, however, that problems do not relate to wastes alone, conventional feeds may also contain large numbers of contaminants in the form of phytotoxins, pesticides, pathogens and other xenobiotics.

Decontaminated, well processed and preserved animal excreta products that are incorporated in nutritionally balanced rations do not cause any ill effects to animals consuming the ration. Animal products from animals fed diets containing animal excreta are safe for human consumption.

It has been shown that animal wastes can be rendered free of pathogens by autoclaving, fumigation, and dry heat alone or in combination with paraformaldihyde. Furthermore, other methods of processing such as ensiling and deep staking have also been effective in eliminating or killing pathogens.

The selection of the processing procedure should be done after taking into consideration their advantages and disadvantages according to the prevailing local conditions and production system. However, that the ensiling technique is safe, simple, and low cost for small, medium, and large farms of this region has been documented (Rogers and Poore, 1994; Ruffin and McCaskey, 1995; Hadjipanayiotou, 1984).

It is interesting to note that the studies reviewed by the US Food and Drug Administration (FDA) concerning the inclusion of animal wastes in diets for livestock did not show any change in the composition of edible tissues. The palatability and acceptability of meat from animals fed processed waste were found not to differ from control animals.

1.2.3.2 Nutritional Value of Dried Poultry Litter

Dried poultry litter components determine its nutritional value. Generally poultry litter is composed of wood shavings, feathers, feed residual and uric acid. Therefore, many factors or parameters determine the type of litter, such as: Primary material; Number of birds; Management of the farm and the litter moisture

The chemical composition of the litter must be known before utilizing it in fattening operations, especially protein and energy. Many researchers found poultry litter to have high protein content (25-40%), and a good

source of energy (8-13 MJ/Kg) (Rogers and Poore, 1994; Ruffin and McKaskey, 1995; Harb *et al.*, 1999).

Several research reports showed the possibility and feasibility of using silage made of manure accompanied with various agricultural by-products in livestock rations (Lee *et al.*, 1987; El-Basiony *et al.*, 1994).

1.2.4 Wheat Straw

Wheat straw is classified as a bulky food and characterized by its low unit weight. It consists of the stems and leaves of plants after the removal of the seeds by threshing. This by-product is low in nitrogen, digestibility coefficient and mineral, sulfur is especially low which is needed to allow the fermentive microorganisms to live and produce enzymes for digestion of cellulose and hemicellulose (Harb *et al.*, 1999; McDonald *et al.*, 1981).

The chemical composition of wheat straw is influenced by stage of maturity of the crop, environmental conditions and the cultivar grown.

1.2.4.1 Nutritive Value of Wheat Straw

The crude protein content of the dry matter is low, usually between 3-4% and the apparent digestibility of the crude protein is also very low. The major component of the dry matter is the fiber, which contains a relatively high proportion of lignin. It is also rich in calcium and phosphorus (Habieb, *et al.*, 1986).

The major disadvantage of feeding wheat straw is the low intake obtained when it is fed to ruminant animals. A cow will consume up to 10 Kg of medium-quality hay however, it will eat only about 5 Kg of straw (McDonald *et al.*, 1981).

Improvement in both digestibility and intake can be obtained by the addition of nitrogen in the form of protein or urea (Abo Omar *et al.*, 1997, Abo Omar and Shanti, 1998). An alternative method of improving the nutritional value of straws is treatment with sodium hydroxide (McDonald *et al.*, 1981; Hadjipanayiotou, 1999).

Supplementation feeding is another method for improving straw intake, and utilization. Supplementation of straw with soybean meal or molasses – urea mixture resulted is an increase of straw intake (Hadjipanayioton, 1999; Abo Omar *et al.*, 1997; Abo Omar and Shanti, 1998).

1.2.5 Tomato

Utilizing intact tomato fruit in livestock rations has never been popular. Almost nothing is mentioned in scientific literature. However, there is lots of information regarding feeding tomato pomace or tomato pulp to animals. Whole tomato is high in nitrogen content and has a high digestibility coefficient (Harb *et al.*, 1999). Tomato pulp, a mixture of peel

and seeds, accounts for about 4.5% of the fresh weight, and has a good nutritional value (8.9 MJ ME/Kg and 23.5% CP), (Hadjipanayioton, 1999).

1.2.5.1 Nutritional value of tomato fruits

The major factors governing the use of tomato are the chemical composition, digestibility, and voluntary intake that determine its nutritive value. Harb *et al.*, 1999 reported the chemical composition of tomato as the following, crude protein 16.4%, net energy for maintenance (NEm) 6.45 MJ/Kg and net energy for gain (NEg) 3.96 MJ/Kg. Digestibility of tomato pomace has been studied by several researchers. They found that the digestibility coefficient of dry matter varied between 61%-72% (Kalaboni, 1996, Harb *et al.*, 1999). The total digestible nutrient (TDN) for whole tomato was 69% (Harb *et al.*, 1999). Kalaboni (1996) mentioned that the voluntary intake decreased when tomato pomace was increased in the ration. This is in agreement with reported data by Jayal and Johari 1993, who found that dry matter intake decreased 16% when tomato pomace was fed to sheep along with 300 g of wheat straw or a similar amount of concentrate. The nutrient digestibility of rations containing tomato pomace was decreased except that of the crude fat fraction which was increased (Kalabni, 1996).

1.2.6 Visceral Organ Mass

It has been reported by different researchers that dietary fiber levels have an influence on the gastrointestinal tract and its accessory organs (Abo Omar *et al.*, 1994; Abo Omar, 1995; Johnson, 1985; Rabayaa, 2000).

Roughage level can vary in ruminant's diets ranging from zero to 100%. Typical roughage is considered to be approximately 50% neutral detergent fiber. On high roughage diets, ruminal fiber digestion seldom exceeds 60%. When low roughage diets are fed, high rates of passage and low pH frequently inhibit cellulytic bacteria, which limit fiber digestion. Significant amounts of fiber escape rumen digestion and may cause fiber effects in the lower gut similar to those observed in nonruminants.

Luminal nutrition plays a major role in maintaining stimulation of both small intestinal mucosal structure and enzyme levels (Johnson, 1985). Dunaif and Sheeman (1981) reported that the activities of several enzymes in the rat intestine are changed in response to fiber addition. Different sources of protein, carbohydrates and lipids did not change or influence the growth of small intestine, cecum or colon of rats but some types of fiber did exert an influence (Younoszai *et al.*, 1978).

It was reported that various levels of mucosal surface changes included distorted and damaged cells when 15% fiber from four different sources were fed to rats. Alfalfa diets at level of 50% when fed to pigs caused heavier colon, rectum, kidney and total tract weights and tended to

increase cecum, small intestine, pancreas and liver weights when compared to pigs fed regular corn-soy diet (Pekas *et al.*, 1983).

Chapter II
Materials and Methods

2.1 Making silage

The three agricultural by products used in this experiment (poultry manure, wheat straw, and tomatoes) were obtained from local sources. Poultry manure (PM) was sun-dried for 30 days. Wheat straw (WS) was obtained directly after threshing. Tomato fruit (TF) were used as whole fruit. The three materials were mixed together at rates of 50, 25 and 25% of PM, WS and TF, respectively. Table sugar was added to the mixture as the following 30g of plain sugar in 100ml water/kg of the ingredient mixture. Physical examinations proved that addition of sugar at this level was the most appropriate. The mixture was squeezed in big plastic drums for 6 month and then samples were taken from silage to examine the physical and chemical characteristics of the silage, especially pH, color, smell, and texture.

2.2 Fattening trial

Twenty weaned male Awassi lambs were obtained from a commercial market. Soon after reaching the experimental site, lambs were treated against both internal and external parasites and were vaccinated against enterotoxemia. Animals were assigned into weight categories and randomly divided into four groups of five lambs each in a complete randomized design. Lambs were allowed to adapt for the new environment and diet for one week. Lambs in the first group were fed a ration composed

of 80% concentrate and 20% vetch hay. In the second, third and fourth groups silage was fed at rates of 15, 30 and 45%, respectively (Table 1). Silage was added to rations to replace hay and partial amount of concentrate. Each diet was considered as treatment and the treatments were arranged into completely randomized design (CRD).

Animals were fed adlibitum in-groups and had free access to water and salt blocks. Lambs were individually weighed on a weekly basis throughout the 60 day feeding trial. The daily feed intake was recorded and animals were observed for abnormalities, health problems and comments about all these were recorded. The weight gain cost of gain and feed efficiencies were calculated and recorded.

2.3 Visceral Organ Mass

Upon termination of the feeding trial, three lambs from each group were randomly selected for slaughter. Lambs were slaughtered in the evening before they consumed their evening meal. Lambs were slaughtered according to Islamic law during the same day by a routine procedure practiced in municipal slaughterhouses. Animals were bled, skinned and eviscerated. The rectum and esophagus were tied off to prevent loss of gastrointestinal tract (GIT) contents before viscera were removed from the carcass. The liver and gall bladder were removed from the body. Lungs,

without trachea, were removed and weighed, and the total weight for kidneys and their fat was recorded.

The lower gut and abomasum were tied off at the pylorus, the omasal abomasal junction and the ileo-cecal junction. The viscera were then placed into a plastic lined offal tray ready for dissection. After the total GIT weights were taken, the tract was tied and sectioned into esophagus, reticule- rumen, omasum, abomasum, small intestine, cecum and large intestine. The spleen and pancreas were removed first and weighted.

The external fat was removed from each organ of the foregut (rumen, omasum, and abomasum) and the cecum. The full fat-free organ weight was recorded. The rumen was emptied, scraped as clean as possible without washing, and then weighed. Rumen contents were homogenized and a one-liter sample was taken for dry matter analysis. The rumen was washed and weighed. The wet weight of the washed tissue and dry weight of each segment (organ) was determined.

The omasum and abomasums were opened, emptied of their contents and washed. Their contents and their washed tissues were sampled for dry matter analysis. The weight of contents was calculated as the difference between the full and washed weights. The large and small intestine was separated from the alimentary tract leaving some mesentery fat. The contents were removed, weighed and sampled. The fat was removed from the intestines leaving only the tissue, which was weighed.

The length of these organs was then measured. Approximately 10cm of small intestine samples was removed from a point approximately 30cm from the pylorus and approximately one half the distance from the pylorus to the ileo-cecal junction. The legs and heads were weighted and recorded.

As soon as the tissues and digesta were taken, samples were placed in freezer at –20°C and stored until later analysis. The tissue samples from each organ were stored in an 11X20cm whirl-Pak bags.

The dry matter analysis of the samples was conducted following the completion of the slaughter. The digesta dry matter was determined by thawing for 12hours then homogenized and a sample of each organ's digesta taken from every individual animal. The samples were dried at 60°C for 48hours.

2.4 Chemical Analysis

Chemical composition of the feed ingredients used in the experiment (dry matter-DM, crude protein-CP, crude fat-CF, Ash, crude fiber, Calcium, and Phosphorus) were determined in duplicates according to A. O. A. C. 1995), see tables 1-3 and appendices.

2.5 Statistical Analysis

Data were analyzed by the one way ANOVA Test using SPSS package to determine the effect of experimental rations on feed intake,

body weight gain, feed conversion, visceral organ mass, gastrointestinal tract components and contents.

Table 1. Silage components and its chemical composition*

ITEM	%	DM %	ME MJ/kg	CP %	C fat %	CF %	Ash %	NFE %	Ca %	P %
Poultry Manure	50	84	8.3	29.6	2.4	17.2	15.2	35.6	2.7	1.4
Wheat straw	25	90	5.5	3.6	1.8	41.5	11.6	41.5	0.4	0.3
Tomato	25	6	8.9	16.4	3.9	9.1	8.85	61.75	0.2	0.5
Total	100	66	7.75	19.8	2.6	21.3	12.7	43.6	1.5	0.9

*These values are an average of two results.

Table 2. Concentrate components and its chemical composition

Ingredients	Percent %
Corn	40
Wheat	15
Wheat Bran	16
SBM	17.5
Barley	7.5
Premix(vitamins and minerals)	4
Chemical composition	%
CP	18
CF	6.1
C. fat	3.3
Ash	5.2
Ca	1.2
P	0.6
ME (MJ/Kg)	12
Moisture	12

Table 3. Chemical composition of Vetch hay

Item	%
DM	91
CP	19.9
ME(MJ/KG)	8.9
C fat	1.7
CF	19.5
Ash	7.4
Ca	1.2
P	0.3

Chapter III
Results and discussion

3.1 Diets component and chemical composition

Average values of different components and chemical composition of the four experimental diets are shown in table (4) and table (5). Diets were formulated to have similar contents of different nutrients. However, they vary in its crude fiber and dry matter content.

Table 4. Composition percentage of the experimental diets

Ingredients	Control	Diet (1)	Diet (2)	Diet (3)
Concentrate	80	85	70	55
Vetch hay	20	0	0	0
Silage	0	15	30	45
TOTAL	100.0	100.0	100.0	100.0

Table 5. Chemical percentage composition of experimental diets

Item	Control	Diet (1)	Diet (2)	Diet (3)
DM	88.6	84.7	81.4	78.1
CP	18.4	18.3	18.5	18.8
Cfat	2.98	3.2	3.1	3.0
CF	8.78	8.4	10.7	12.9
Ash	5.64	6.3	7.5	8.6
NFE	64.5	63.8	60.2	56.7
Ca	1.2	1.2	1.3	1.3
P	0.54	0.6	0.7	0.7
M.E (MJ/kg)	11.4	11.4	10.7	10.1

3.2 Lambs performance

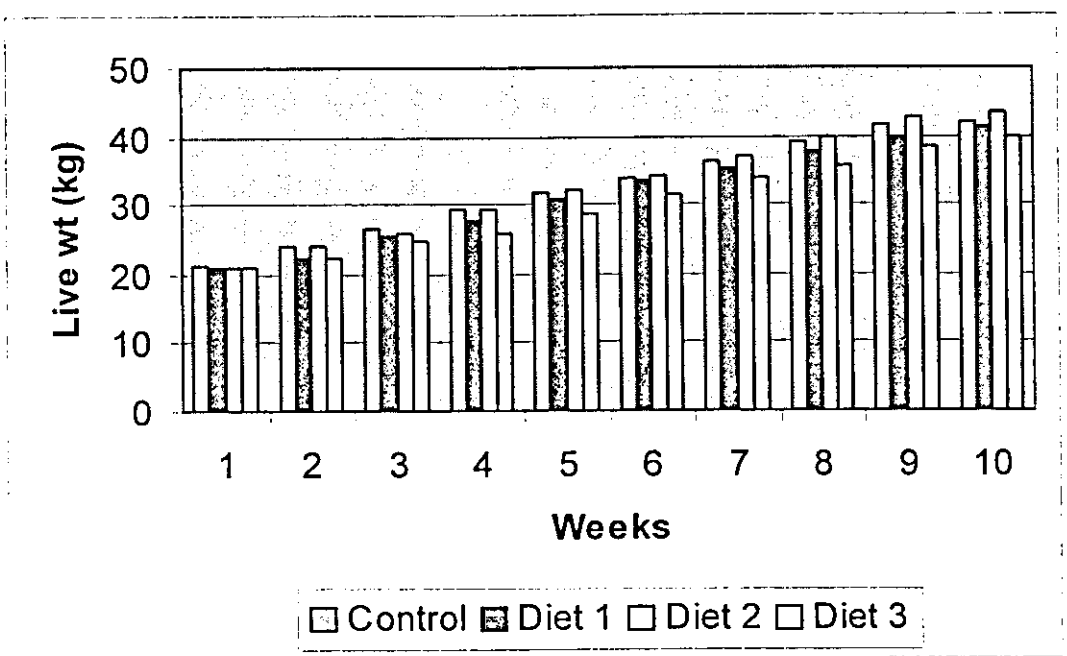
Data presented in table 6 shows the overall performance of lambs utilizing the various experimental diets. It is obvious that there was a noticeable difference in total gain using different diets (Figure 1). The lambs gained 20.6, 21.0, 22.3 and 18.6Kg in groups from one to four, respectively. The highest gain was observed among lambs fed the 30% silage. Similar trend was observed in lamb's average daily gain. The average daily gain ranged from 0.31kg in lambs consuming 45% silage to 0.37kg in lambs consuming 30% silage. Average daily gain in lambs fed the commercial ration and 15% silage were 0.34kg and 0.34kg, respectively. These values were similar to what was reported by other researchers in lambs fed commercial fattening diets (Abo Omar and Gavoret, 1995, Harb, 1986). Miron *et al.*, 1995 noted that silage made of poultry manure and other farm by-products caused an improvement in lambs general performance. The best performance was observed in lambs consuming 30% silage. The diet characteristics as palatability and texture, at this level, might be the reason for that improved performance. Similar levels exerted similar effects when fed to lambs (Miron *et al.*, 1995) and when fed to cattle (Tokkonen *et al.*, 2000). Incorporation of poultry in silage recipe had effects in reducing levels of neutral detergent fiber, hemicellulose and cellulose (Shahid *et al.*, 1995).

Table 6. Results of fattening trail

PARAMETER	(Control)	Diet (1)	Diet (2)	Diet (3)
Average initial wt. -Kg	21.18	21.02	21.02	21.06
Average final wt. –Kg	41.8	41.2	43.4	39.7
Average total gain –Kg	20.62	20.18	22.38	18.64
Mean daily gain -Kg	0.34	0.33	0.37	0.31
Daily feed intake – Kg	1.64	1.49	1.68	1.63
Feed con. effe. Kg feed / Kg life wt.	4. 82	4.52	4.54	5.25
Cost of total gain –NIS	98.48	91.00	76.42	62.59*
Cost of diet - NIS/Kg	1.00	1.03	0.76	0.64
Cost of one Kg gain –NIS	4.78	4.51	3.41	3.36

* Statistically significant at $P = 0.05$
Rows with different letters are significantly different at ($p<0.05$) level. According to (DNMR)
NIS= New Israeli Shekel

Figure 1. Average lambs weight during the fattening trial



3.3 Feed intake

The average feed intake of lambs fed the four diets was the same (table 7, figure 2). The average daily intakes were 1.64, 1.49, 1.67, 1.63 kg for lambs fed the diets from 0% silage to 45% silage, respectively. These values of feed intake were similar to feed intake observed in many other fattening trails (Abo Omar and Gavoret, 1995, 1986, Hammad, 2000).

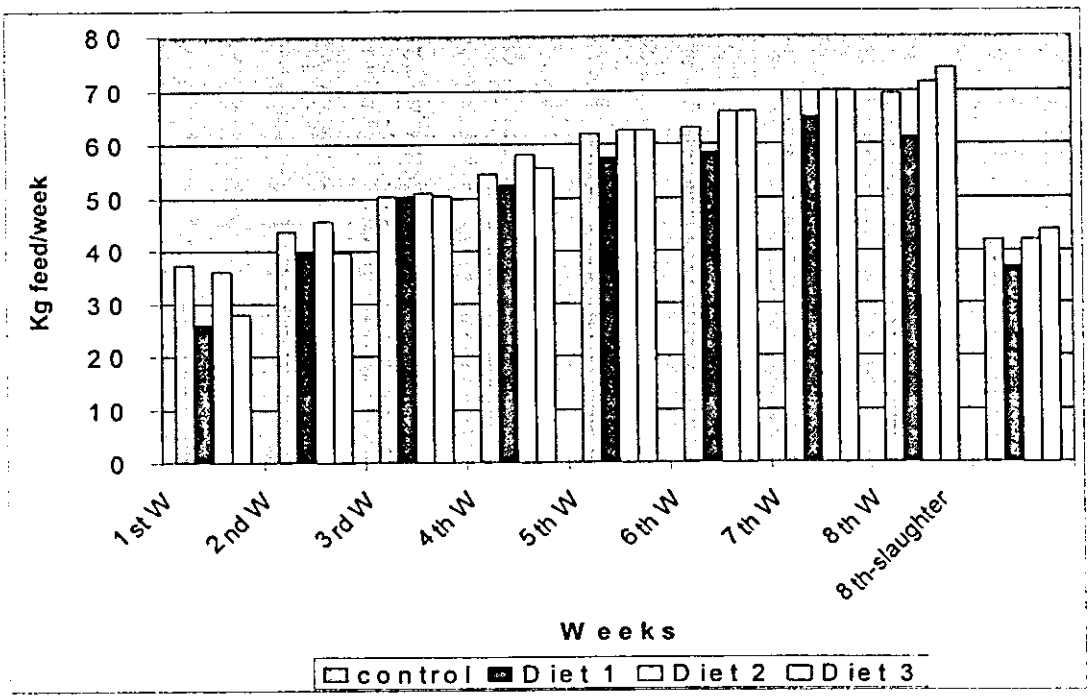
The pattern of intake observed indicated that bulkiness of diets had no effect on intake. This could be explained by the increased palatability as a result of increasing the level of silage in diets.

Table 7. Average weekly feed intake (Kg) of lambs fed on experimental diets

Weeks	Control	Diet No. (1)	Diet No. (2)	Diet No. (3)
	Feed Intake (Kg)			
1st	37.25	26	36	28
2nd	43.75	39.5	45.71	39.5
3rd	50.5	50.5	51	50.5
4th	54.5	52.5	58	55.5
5th	62	57.5	62.5	62.5
6th	63	58.5	66	66
7th	70	65	70	70
8th	69.4	61.3	71.5	74
8th - slaughter	42	36.8	42	44

See appendix 10

Figure 2. Weekly feed intake Kg/week/group



3.4 Body Weight Gain

The average total gain in lambs fed the four diets was 20.6, 20.1, 22.3, 18.6 Kg for the four diets from 0 to 45% silage, respectively (Table 8). Differences between these values were not significant ($p>0.05$). The highest gain was noted in lambs fed the 30% silage. After the third week of feeding the experimental diets, lambs fed 30% silage had the leading role in the increase of gain. Gains observed in this experiment were similar to other gain observed by several researches (Hammad, 2001, Abo Omar, 2001, Abo Omar and Gavoret, 1995, Harb *et al.*, 1986).

Table 8. Average body weight (Kg) of lambs fed the experimental diets

Weeks	Control	Diet No.(1)	Diet No.(2)	Diet No.(3)
	Body weight (Kg)			
In. weight	21.8	21.02	21.02	21.06
1st	24.0	22.3	24.2	22.3
2nd	26.6	25.6	26.0	25.0
3rd	29.5	27.7	29.3	26.0
4th	31.7	30.7	32.1	28.8
5th	33.9	33.5	34.4	31.3
6th	36.4	35.3	36.9	33.8
7th	39.2	37.6	40.0	35.8
8th	41.6	39.8	42.6	38.6
Slaughter Wt.	41.8	41.2	43.4	39.7

3.5 Body gain

The average daily gain in the four diets was 0.34, 0.33, 0.37 and 0.31Kg in lambs fed silage from 0% to 45%, respectively (Table 9). These gains were not significantly different ($p>0.05$) among lambs in different groups except for the 1st-3rd weeks.

Table 9. Average body gain (Kg) of lambs fed the experimental diets (kg gain/lamb/week)

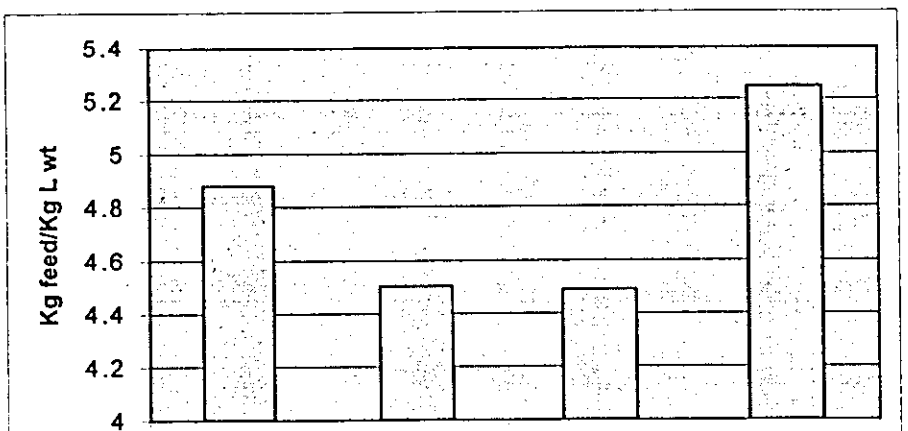
Weeks	Control	Diet No. (1)	Diet No.(2)	Diet No.(3)
	Body gain			
1st	2.8	1.3	3.2	1.2*
2nd	2.6	3.3	1.8 *	2.7
3rd	2.9	2.1	3.3	1.0 *
4th	2.2	3.0	2.8	2.8
5th	2.2	2.8	2.3	2.5
6th	2.5	1.8	2.5	1.25
7th	2.8	2.3	3.1	2.0
8th	2.4	2.2	2.6	2.8
Slaughter Wt	0.2	1.4	0.8	1.1

* Statistically significant at $P= 0.05$

3.6 Feed Conversion Efficiency

The efficiencies of feed conversion were 4.8, 4.5, 4.4 and 5.2Kg feed/Kg Wt gain lambs fed silage from 0% to 45%, respectively (table 6, figure 3). The feed conversion efficiencies were significantly higher ($p<0.05$) in lambs fed silage from 0 to 30%. Lambs fed 30% silage diets had average conversion efficiency 17% higher than lambs fed diets containing 45% silage. This indicated that feeding poultry manure, tomato and wheat straw silage at levels up to 30% proved to be practical. This was noted from the performance parameters measured. Similarly, feed conversion efficiencies observed here agree with values reported by several researchers (Hammad, 2001; Abo Omar, 2001; Abo Omar and Gavoret, 1995; Harb *et al.*, 1986; Shahid *et al.*, 1995; Miron *et al.*, 1995; Cobos *et al.*, 1996).

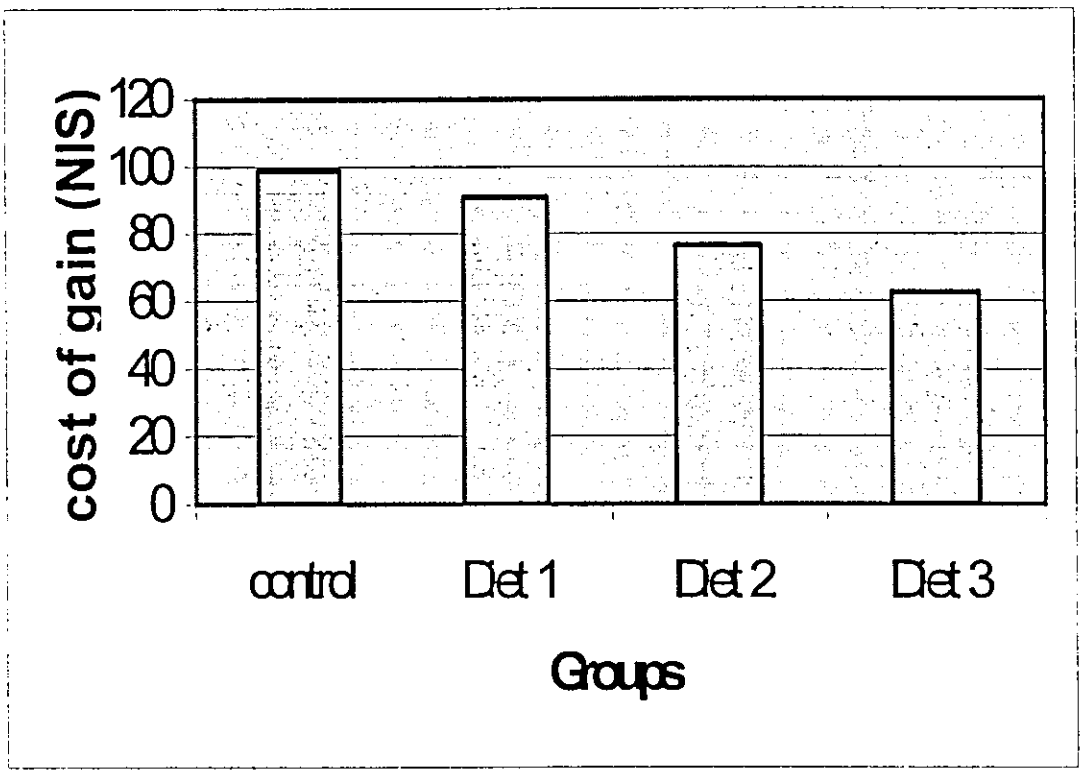
Figure 3. Feed Conversion Efficiency of the Experimental Diets



3.7 Cost of gain

The cost per kg gain is shown in (table 6, figure 4). The highest cost of gain was observed in lambs fed on control diet. Roughage prices are higher than that of concentrates in many occasions, especially in summer followed by low rainfall seasons. The lowest cost of gain was observed in lambs fed diets containing 45% silage.

Figure 4. Cost of total gain



3.8 Visceral organ mass

3.8.1 The visceral organs

The visceral organs under investigation were esophagus, trachea, lungs, heart, liver, kidneys, spleen, kidneys fat and pancreas. Table 10 shows the mean weights of these organs.

Table 10. Visceral organs mean weights in lambs fed the experimental diets (g/kg carcass weight)

Parameter	Control	Diet (1)	Diet (2)	Diet (3)
Carcass Wt.(Kg)	23.3	23.5	23.7	22.2
Liver	35.9	33.2	33.7	35.9
Heart	8.4	6.7	7.0	6.6
Lungs	17.7	15.1	18.4	17.0
Trachea	2.6*	4.9	2.9	2.9
Kidneys	6.1	4.9*	5.9	5.7
Kid. Fat	4.8	6.0	5.9	5.3
Pancreas	0.4	0.4	0.4	0.5
Spleen	3.8	3.6	4.3	2.7
Esophagus	2.3	1.9	1.8	2.1

* Statistically significant at $P = 0.05$
Rows with different letters are significantly different at levels of ($p<0.05$)

Visceral organs of lambs fed the diets had similar weights for most of the tested organs except for the weight of kidneys and trachea. Diets had variable effects ($p<0.05$) on this two organs. Similar trends have been reported by several researchers, where type of diet had variable effects on visceral organs (Abo Omar *et al.*, 1994, Abo Omar, 1995, Hammad, 2001, Johnson, 1985).

3.8.2 Gastrointestinal Tract

The type of diet consumed had no clear influence on the digestive tract components (table 11). However, lambs fed diet containing 30% silage had a higher ($p<0.05$) omasum wet weight. Similar results were reported by Abo Omar, *et al.*, (1994) in lambs fed different levels of fiber and by Younoszai *et al.*, (1978) in monogastrics fed different roughage's and by Sainz and Bently (1997) in steers.

Table 11. Effect of type of diet on gastrointestinal tract components (g/ kg carcass weight)

Parameter	Control	Diet (1)	Diet (2)	Diet (3)
Rumen wet.	39.6	34.8	38.5	38.6
Rumen dry	7.9	4.1	6.5	6.7
Omasum wet	4.0	2.5 *	5.4	4.4
Omasum dry	1.1	0.5	1.0	0.8
Abomasum wet	6.7	6.1	7.5	8.9
Abomasum dry	1.5	1.4	2.2	1.8
Small intes. Wet	25.2	22.9	29.5	28.4
Small intes. Dry	5.2	5.5	4.9	5.1
Large intes. & cecum wet	18.4	17.8	20.3	20.3
Large intes. & cecume dry	3.8	3.8	4.1	3.2
Length, small intestine (cm).	2900	2669	2966	2832
Length, large intestine (cm).	777	598*	725	707

*** Statistically significant at $P=0.05$**
Rows with different letter are significantly different at ($p<0.05$) level.

3.8.3 Gastrointestinal tract contents

Contents of the rumen and most of other gastrointestinal tract segments in lambs fed the four diets were similar (table 12), except for the contents of omasum and abomasum. The wet and dry content of these two organs were significantly ($p<0.05$) heavier in lambs fed diet containing

30% silage. These results are in agreement with other research where digestive tract content and all of its components were higher in lambs fed more fiber in their diets (Abo Omar, *et al.*; 1994; Abo Omar, 1995; Johnson, 1985).

Table 12. Effect of type of fattening diet on gastrointestinal tract contents (g/kg carcass wt.)

Parameter	Control	Diet (1)	Diet (2)	Diet (3)
Rumen content, wet	118.8	88.0	119.5	119.0
Rumen content, dry	16.4	12.0	10.8	18.1
Omasum content, wet	2.0	1.4 *	5.5	2.9
Omasum content, dry	0.7	0.3*	1.2	0.5
Abomasum content, wet	8.6	2.3*	11.4	6.6
Abomasum content, dry	1.0	0.2*	1.7	1.0
Small intestine, wet	16.2	11.9	18.3	18.2
Small intestine, dry	1.7	1.5	3.6	2.5
Large intestine & cecum, wet	30.7	24.9	30.6	35.4
Large intestine & cecum, dry	5.2	3.3	5.8	6.3

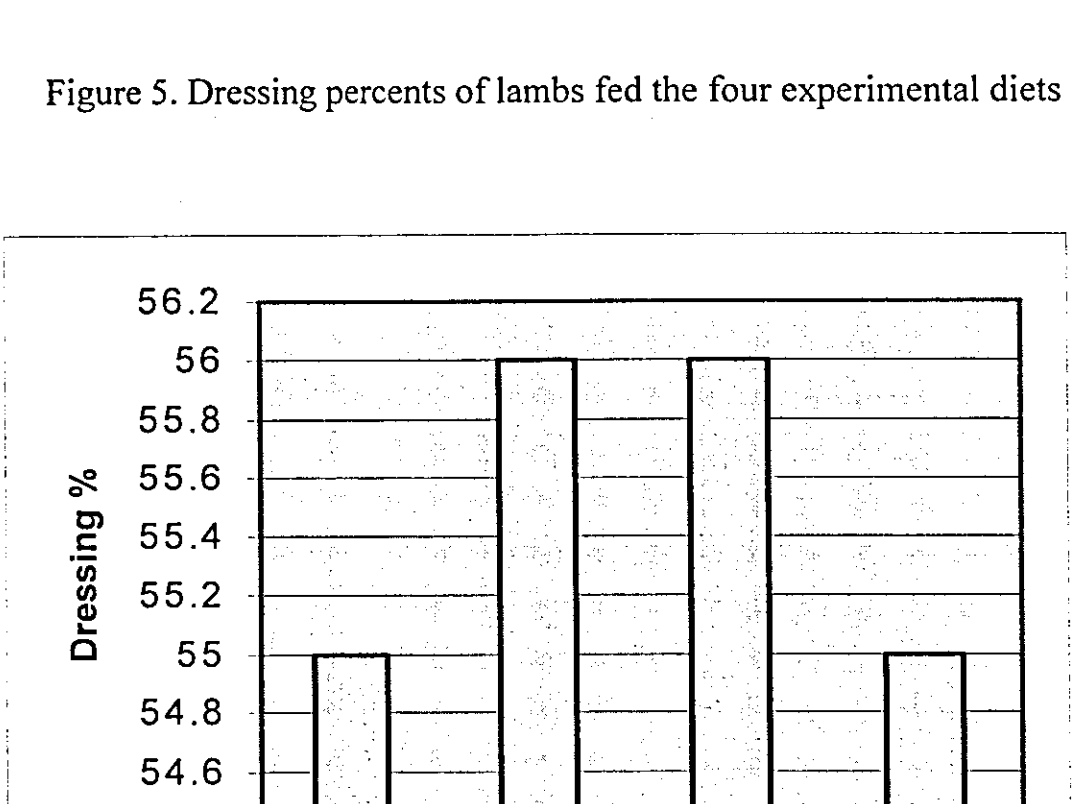
* Statistically significant at $P = 0.05$
Rows with different letter are significantly different at $p<0.05$ level.

3.9 Dressing percent

The experiment showed that the dressing percentages were 55, 56, 56 and 55% in lambs fed the experimental diets from 0 to 45% silage, respectively (figure 4). The dressing percentages observed for lambs were statistically ($p>0.05$) similar. This can be explained by the similar average weights of visceral organs, gastrointestinal components and the similar gastrointestinal tract contents observed in these lambs. The similar overall lambs body conditions and performance based on type of ration consumed

can also explain the similar dressing percentage of these lambs. In any case, the dressing percent values are higher than values observed by previous research (Abo Omar and Gavoret, 1995; Hammad, 2001).

Figure 5. Dressing percents of lambs fed the four experimental diets



3.10 Conclusion and Recommendations

3.10.1 Conclusion

Utilizing silage made of agricultural by-products as described in this study proved to be of certain advantages to local livestock raisers, especially the sheep and lamb owners. However, more research is required in this area. Utilizing of these pollutants as feed ingredients will help in protection of the environment.

The following conclusions can be stated:

1- Silage can be fed at levels up to 45% of the ration without any harmful effects on lambs. However, the best lambs performance was observed when fed 30% silage.

2- The fattening operation costs can be decreased by utilizing silage, as described in this study.

3- Ensiling of the by-products improved its individual nutritive value and its keeping quality beside the inhibition of the pathogens and drugs residual associated with by-products.

4- The cost of 1-kg gain was the lowest for lambs fed the 45% silage diet.

5- The cost of 1-kg diet was the highest for lambs fed the 15% silage diet.

6- The daily feed intake was the lowest in lambs fed 15% silage diet.

7- Feed conversion efficiency was the best in lambs fed 30% silage diet.

8- Level of silage in diets had no significant effect on visceral organ mass, gastrointestinal tract contents and components.

3.10.2 Recommendations

1- Silage made of tomato, poultry manure and wheat straw can be fed to fattening lambs at levels up to 30% without any harmful effects on lambs performance or health.

2- More research is needed before recommending any thing to farmers so as to be sure of feeding different type of silage to made.

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Appendix-1

- Determination of moisture (A.O.A.C., 1995) procedure

1. Heat the crucible for four hours in an oven at 105 C, cool and weigh.
2. Weigh by difference 2 g into the can.
3. Place it in the oven at 105 C overnight.
4. Remove the can from the oven then transfer to a desiccator.
5. Allow to cool to room temperature then weigh.

Calculation

% Moisture = (weight of can + sample before drying)-(weight of can + sample after drying) x 100% weight of wet sample

Appendix-2

- Determination of ash(A.O.A.C., 1995) procedure

1. Heat the crucible for one hour in a muffle furnace at 500°C, cool And weigh as quickly as possible.
2. Weigh by difference 2g into the crucible.
3. Place it in a cool furnace and slowly bring the temperature up to 600°C, leave to overnight.
4. Remove the crucible from furnace then transfer to a desiccators.
5. Allow to cool to room temperature then weigh.

Calculation

% Ash = (Weight of ash) X 100% Weight of sample (dry matter)

Appendix- 3

- Crude Protein Determination (Kjeldahl Method, O.A.C., 1995)

Reagents

1. Sulfuric acid (concentrated 98%).

2. Boric acid 4% solution.

Dissolve 4 g boric acid in 100 ml volumetric flask and complete to the mark.

3. Sodium hydroxide dissolve 500g sodium hydroxide in 1000ml volumetric flask cools and make up to 1000 ml.

4. Indicator solution screened methyl red indicator solution

Dissolve. 2 g methyl red in 100 ml of 96% V/V ethanol.

Dissolve. 1 g methyl red in 100 ml of 96% V/V ethanol.

5. Digestion mixture add to each digestion flask. 19 g of

CuSO4 .5 H2O and 9.7 g K2SO4 and mix.

6. Anti foaming granules.

7. Hydrochloric acid solution. 01 N.

Procedure

1. Weigh about 1.0-g sample into 100 ml Kjeldahl flask.

2. Add 20 ml of concentrated sulfuric acid, then add 10 g of digestion mixture and few antifoaming granules into the digestion flask.

3. Digestive the mixture until the solution becomes clear.

4. Transfer the digestion tube to connect the distillation unit, add

50 ml of distilled water into the cooled digestion tube.

5. Add 40 ml of sodium hydroxide 50% to digestion tube.

6. Place a receiving flask containing 30 ml of 4% boric acid with few drops of mixed indicator.

7. Allow distillation to proceed to assure ammonia is free from the sample.

8. Titrate the ammonia collected in the receiving flask with standard 0.1 N HCl solution.

Calculation

% Nitrogène = Vol. HCl X N. HCl X 14.007 X 100 X 100

100 X Weight of dry sample

% Crude protein = % nitrogen x 6.25

Appendix-4

- Crude Fat determination (Ether Extract, A.O.C., 1995)

1. Weigh 2 g sample into the extraction thimble.

2. Clean and dry solvent flasks in 105°C for one hour, then cool to room temperature and weigh.

3. Place thimble at the extraction apparatus.

4. Add 40 ml diethylether to the solvent flask.

5. Turn on water that cools the hot plates until they are in contact with the flasks and on the heaters.

6. After the extraction is completed, remove the thimble and allow the solvent to evaporate.

7. Dry the flask at 105°C for 30 minutes, cool to room temperature and Weigh.

Calculation

% Crude Fat = Wt. of flask after extraction – Weight of flask before extraction X 100 / Weight of dry sample

Appendix -5

- Crude Fiber Determination

Reagents:

1. Sulfuric acid solution 0.255 N

2. Sodium hydroxide 0.313 N

Dissolve 1.25g fresh sodium hydroxide in 100ml volumetric flask and complete with distilled water to the mark.

3. Methyl alcohol and diethylether.

Procedure

1. Weigh 2 g sample and transfer to 600 ml flask.

2. Add 200 ml of 0.255 N sulfuric acid.

3. Place the beaker on the heating unit, turn heat on, and boil for exactly 30minutes.

4. Filter through filter paper.

5. Transfer to 600 ml beaker and add 200 ml 0.313 sodium hydroxide.

6. Boil for 30 minutes from the onset of boiling.

7. Filter through a new filter paper.

8. Rinse the filter with 15 ml of alcohol and then with about 15 ml of diethylether.

9. Dry the filter paper at 105°C, cool and weigh.

Calculation

% Crude Fiber = M1 – M0 X 100 / M2

Where, M0 = Weight of filter paper and the sample before drying.

M1 = Weight of filter paper and the sample after drying.

M2 = Weight of the sample (dry matter basis).

Appendix - 6

- Neutral detergent fiber (Robertson and Van Soest, 1981)

1. Neutral detergent solution

- Dissolve 18.61 g ethylene diamine tetraacetate dihydrate and 6.81g sodium borate decahydrate in distilled water

- Dissolve 30g sodium lauryl sulphate and 10ml 2-ethoxy ethanol in distilled water.

- Dissolve 6.81g disodium hydrogen phosphate in some water.

- Put all the above solutions in 1 liter volumetric flask and fill to the mark with distilled water.

- Adjust the pH to range 6.9-7.1.

Procedure

1. Weigh 1.00 gm sample and put in a beaker.

2. Add in order, 100ml neutral detergent solution, and 2ml decahydronaphthalene and 0.5g sodium sulfite.

3. Heat to boiling and reflux for 60 minutes from the onset of boiling.

4. Filter using glass crucible and rinse with hot distilled water.

5. Wash twice with acetone.

6. Dry the crucible at 105℃ overnight and weigh.

Calculation

Neutral Detergent Fiber = M1 – M0 X 100/ M2

Where, M0 = weight of the crucible.

M1 = weight of the crucible and sample after drying.

M2 = weight of the sample.

Appendix –7

- Acid Detergent Fiber (Robertson and Van Soest, 1981)

Dissolve 20g of cetylmethylammonium bromide in 1L Sulfuric acid (1 N).

Procedure

1. Weigh 1g sample and put into a 600ml beaker.

2. Add 100 ml of acid detergent solution using a measuring cylinder.

3. Add 2ml of decahhyronphalene.

4. Heat to boiling and reflux for 60 minutes from the onset of boiling.

5. Filter using glass crucibles and with hot distilled water.

6. Wash the fiber with acetone.

7. Wash the fiber with hexane.

8. Dry at 105°C overnight, cool and weigh.

9. Ash at 600°C overnight cools and weigh.

Calculation

Acid detergent Fiber = M0 – M1 X 100/ M2

Where, M0 = weight of crucible and fiber

M1 = weight of crucible and ash.

M2 = weight of sample.

Appendix- 8

- Gross Energy Content (A.O.A.C., 1984)

Gross energy was determined using bomb calorimeter.

Equipment

1. Oxygen bomb and accessories.

2. Balance with a accuracy of 1g

Reagents:

- Standard sodium carbonate solution.

- Methyl orange indicator.

- Benzoic acid composition tablets.

Procedure

1. Weigh about 1g sample.

2. Weigh the metal crucible and put sample in it.

3. Cut off a 10cm length of fuse wire, thread through the two holes of the oxygen bomb lid.

4. Assemble the bomb.

5. Fill the bomb with oxygen.

6. Press test button to see if it is ready to fire.

7. Measure 2000ml and have it always at the same temperature to 22-23°C.

8. Put the bomb in the bucket and close the cover.

9. Put the heaters on.

10. When ready to fire press the firing button.

11. Read the amount of energy value on the assembly panel.

12. Take the bomb, release the oxygen out, open it and measure the length of the remaining fuse.

13. Rinse the bomb with distilled water, collect the washings then titrate it with sodium carbonate (Na_2CO_3) with methyl red indicator.

Calculation

GE (cal/g) = final T-initial T X hydrothermal equivalent of bomb-length of fuse wire burned X cal. Na_2CO_3

Weight of dry sample

Appendix (9) Developing of body weight for lambs (Kg)

Group (1)

Weeks	Lamb No.				
	1	10	7	14	20
Initial wt.	21.4	22.9	22.6	20.8	18.2
1st	24.0	27.0	25.0	22.0	22.0
2nd	26.5	29.0	28.0	24.5	25.0
3rd	28.0	33.0	31.5	26.0	29.0
4th	29.0	36.0	34.0	29.0	30.5
5th	31.0	39.0	36.0	31.0	32.5
6th	32.5	42.0	40.0	32.0	35.5
7th	35.5	45.5	44.0	34.0	37.0
8th	37.0	48.0	45.5	36.5	41.0
Slaughter	37.0	49.0	46.5	36.5	40.0

Group (2)

Weeks	Lamb No.				
	13	2	9	5	19
Initial wt.	18.3	24.4	24.1	18.6	19.7
1st	22.5	26.0	26.5	16.0	20.5
2nd	26.0	31.0	29.0	18.0	24.0
3rd	28.0	32.5	31.0	21.0	26.0
4th	32.0	35.0	33.5	23.0	30.0
5th	34.0	37.5	36.0	27.0	33.0
6th	36.0	39.0	37.0	29.5	35.0
7th	39.5	41.0	38.0	32.5	37.0
8th	41.0	43.5	40.0	34.0	40.5
Slaughter	43.0	44.0	41.0	36.0	42.0

Group (3)

Weeks	Lamb No.				
	18	11	12	6	16
Initial wt.	16.3	23.9	20.5	21.5	22.9
1st	18.5	27.5	24.0	24.5	26.5
2nd	20.0	30.0	26.0	25.0	29.0
3rd	24.0	33.0	29.0	28.0	32.5
4th	26.5	35.0	31.5	30.5	37.0
5th	30.0	37.0	33.0	32.0	40.0
6th	32.0	40.0	35.5	35.0	42.0
7th	35.0	43.0	38.5	38.5	45.0
8th	37.0	45.0	41.0	42.0	48.0
Slaughter	38.5	46.5	42.0	42.0	48.0

Group (4)

Weeks	Lamb No.				
	15	4	17	3	8
Initial wt.	18.0	26.8	20.5	19.4	20.6
1st	20.0	26.0	23.5	20.5	21.5
2nd	22.0	28.0	26.5	23.0	25.5
3rd	24.0	30.5	27.5	24.0	24.0
4th	26.0	34.0	30.0	27.0	27.0
5th	28.5	37.0	32.5	29.0	29.5
6th	32.0	40.0	33.0	32.0	32.0
7th	34.0	42.0	35.0	34.0	34.0
8th	36.0	46.5	38.0	36.0	36.5
Slaughter	36.5	47.0	39.0	38.0	38.0

Appendix (10) Average weekly feed intake for lambs during experiment time

Group No. (1)	Feed intake Kg / week	
Weeks	Concentrate	Vetch hay
1st	29.8	7.45
2nd	34.7	9.05
3rd	40.4	10.1
4th	43.6	10.9
5th	49.6	12.4
6th	50.4	12.6
7th	56.0	14.0
8th	55.1	14.3
8th-Slaughter	33.6	8.4

Group No. (2)	Feed intake Kg/week	
Weeks	Concentrate	Silage
1st	24.1	3.9
2nd	33.6	5.9
3rd	42.9	7.6
4th	44.6	7.9
5th	48.9	8.6
6th	49.7	8.8
7th	55.3	9.8
8th	52.2	9.2
Slaughter	31.3	5.5

Group No. (3)	Feed intake Kg/week	
Weeks	Concentrate	Silage
1st	25.2	10.8
2nd	32.0	13.7
3rd	35.7	15.3
4th	40.6	17.4
5th	43.8	18.8
6th	46.2	19.8
7th	49.0	21.0
8th	50.0	21.5
Slaughter	29.4	7.2

Group No. (4)	Feed intake Kg/week	
Weeks	Concentrate	Silage
1st	15.4	12.6
2nd	20.7	17.8
3rd	27.8	22.7
4th	30.5	25.0
5th	34.4	28.1
6th	36.3	29.7
7th	38.5	31.5
8th	40.2	32.9
Slaughter	24.2	19.8

Appendix (11) Visceral organ mass study (kg)

Group No (1)			
Item	Lamb No (10)	Lamb No (14)	Lamb No (20)
Live wt.	49	36.5	40
Carcass wt.	27	21	22
Liver	.99	.72	.80
Heart	.17	.16	.25
Lungs	.48	.37	.39
Trachea	.06	.06	.06
Kidneys	.17	.13	.13
Kidneys Fat	.13	.09	.12
Wt. of total visc.	2.0	1.53	1.75
Pancreas	.01	.01	.01
Spleen	.16	.06	.06
Esophagus	.05	.05	.06
R-R with cont	4.06	3.9	3.07
OM = =	.18	.12	.13
AB = =	.38	.28	.41
SI = =	1.22	.61	1.1
LI & cecum = =	1.38	.99	1.01
RR wt. wet tissu	.96	.88	.91
OM == ==	.10	.08	.10
AB == ==	.17	.15	.15
SI == ==	.73	.44	.61
LI &ceccum ==	.51	.36	.42
RR wt. of cont.	3.1	3.01	2.16
OM wt. of cont.	.08	.04	.03
AB wt. of cont.	.21	.13	.26
SI wt. of cont.	.49	.17	.49
LI& cecum wt. of cont.	.87	.63	.66
RR dry tissue.	.18	.18	.18
OM == ==	.02	.03	.02
AB == ==	.03	.03	.05
SI == ==	.13	.10	.08
LI& cecum ==	.17	.08	.09
SI length (M)	32.2	26.3	28.5
LI length (M)	8.18	7.21	7.93
Half cold carcass(kg)	13	9.75	10.0
Head wt. (kg)	2.44	2.0	2.06
Legs wt. (kg)	1.25	.99	.99
Mesenteric	.36	.21	

Group No (2)			
Item	Lamb No (9)	Lamb No (13)	Lamb No (19)
Live wt.	41	43	42
Carcass wt.	23.5	14.5	22.5
Liver	.63	.91	.8
Heart	.13	.18	.16
Lungs	.29	.36	.41
Trachea	.11	.13	.11
Kidneys	.11	.13	.11
Kidneys Fat	.12	.11	.19
Wt. of total visc.	1.39	1.82	1.78
Pancreas	.01	.01	.01
Spleen	.05	.15	.06
Esophagus	.04	.04	.05
R-R with cont	2.26	3.11	3.27
OM = =	.08	.10	.10
AB = =	.21	.21	.27
SI = =	.75	.84	.86
LI & cecum = =	1.04	.77	1.18
RR wt. wet tissu	.62	.92	.91
OM == ==	.05	.07	.06
AB == ==	.14	.15	.14
SI == ==	.53	.51	.57
LI &ceccum ==	.43	.39	.43
RR wt. of cont.	1.64	2.19	2.36
OM wt. of cont.	.03	.03	.04
AB wt. of cont.	.07	.06	.013
SI wt. of cont.	.22	.33	.29
LI& cecum wt. of cont.	.61	.38	.75
RR dry tissue.	.09	.22	.15
OM == ==	.01	.02	.01
AB == ==	.05	.01	.02
SI == ==	.20	.07	.10
LI& cecum ==	.09	.08	.09
SI length (M)	28.07	24.5	27.5
LI length (M)	6.7	5.07	6.16
Half cold carcass(kg)	11.0	11.5	10.5
Head wt. (kg)	1.96	2.15	2.08
Legs wt. (kg)	1.12	.95	1.12
Mesenteric	.44	.37	

Group No (3)			
Item	Lamb No (11)	Lamb No (12)	Lamb No (16)
Live wt.	46.5	42	48.0
Carcass wt.	24.5	21	25.5
Liver	.84	.75	.78
Heart	.18	.15	.17
Lungs	.46	.37	.48
Trachea	.08	.05	.08
Kidneys	.15	.12	.15
Kidneys Fat	.12	.17	.12
Wt. of total visc.	1.83	1.61	1.78
Pancreas	.01	.01	.01
Spleen	.09	.14	.07
Esophagus	.04	.04	.05
R-R with cont	3.2	3.75	4.2
OM = =	.22	.29	.26
AB = =	.53	.33	.49
SI = =	1.31	.99	1.09
LI & cecum = =	1.13	1.3	1.13
RR wt. wet tissu	1.0	.81	.92
OM == ==	.12	.15	.11
AB == ==	.18	.16	.19
SI == ==	.76	.63	.70
LI &ceccum ==	.44	.54	.44
RR wt. of cont.	2.2	2.94	3.28
OM wt. of cont.	.10	.14	.15
AB wt. of cont.	.35	.17	.30
SI wt. of cont.	.55	.36	.39
LI& cecum wt. of cont.	.69	.77	.69
RR dry tissue.	.26	.16	.15
OM == ==	.02	.03	.02
AB == ==	.07	.05	.04
SI == ==	.12	.12	.10
LI& cecum ==	.11	.10	.09
SI length (M)	29.4	28.38	31.2
LI length (M)	7.7	6.8	7.25
Half cold carcass(kg)	12.5	11.0	13.0
Head wt. (kg)	2.57	2.24	2.05
Legs wt. (kg)	1.20	1.06	1.24
Mesenteric	.29	.51	

Group No (4)			
Item	Lamb No (3)	Lamb No (4)	Lamb No (15)
Live wt.	38.0	47.0	36.5
Carcass wt.	20.5	25.5	20.5
Liver	.77	.88	.73
Heart	.13	.18	.13
Lungs	.34	.46	.34
Trachea	.06	.07	.06
Kidneys	.12	.14	.12
Kidneys Fat	.17	.18	.07
Wt. of total visc.	1.59	1.91	1.45
Pancreas	.01	.01	.01
Spleen	.06	.07	.05
Esophagus	.05	.05	.03
R-R with cont	3.36	4.2	2.96
OM = =	.14	.24	.12
AB = =	.35	.33	.34
SI = =	1.15	1.07	.86
LI & cecum = =	1.20	1.62	.92
RR wt. wet tissu	.80	.99	.78
OM == ==	.08	.13	.09
AB == ==	.18	.20	.21
SI == ==	.64	.71	.54
LI &ceccum ==	.42	.52	.41
RR wt. of cont.	2.56	3.21	2.18
OM wt. of cont.	.06	.11	.03
AB wt. of cont.	.17	.13	.13
SI wt. of cont.	.51	.36	.32
LI& cecum wt. of cont.	.78	1.1	.51
RR dry tissue.	.12	.17	.16
OM == ==	.01	.02	.02
AB == ==	.03	.04	.05
SI == ==	.10	.14	.10
LI& cecum ==	.07	.08	.07
SI length (M)	26.6	29.15	29.2
LI length (M)	7.10	7.20	6.9
Half cold carcass(kg)	9.50	12.0	9.5
Head wt. (kg)	1.90	2.22	2.1
Legs wt. (kg)	.97	1.22	1.0
Mesenteric	.37	.49	

الملخص

كفاءة الخراف العواسي المغذى على سايلج بعض المخلفات الزراعية

يهدف هذا البحث إلى التعرف على مدى إمكانية استخدام سايلج بعض المخلفات الزراعية الكثيرة الموجودة في منطقتنا في مشاريع تسمين الخراف العواسي في فلسطين والكيفية المثلى لاستخدام هذه المخلفات. فقد تم استخدام ثلاثة مخلفات زراعية نباتية وحيوانية في تحضير السايلج ، وهي (فرشة دجاج اللحم ، تبن القمح ، حب البندورة) بالنسب التالية 25،25،50% على التوالي. وقد أضيفت كمية من السكر للخليط وذلك لزيادة التخمر وسرعته. بعد ستة أشهر من وضع الخليط في براميل بلاستيكية محكمة الإغلاق تم أخذ عينة من السايلج لفحص خصائصه الكيميائية والفيزيائية حيث تبين إمكانية استخدامه لغايات التجربة.

لقد تم إحضار عشرون خروف عواسي ذكر بعد الفطام مباشرة وقسمت إلى أربع مجموعات احتوت كل واحدة منها على خمسة خراف حيث غذيت الأولى على عليقة الشاهد وهي عبارة عن 80 % علف مركز و20 % قش البيقا، بينما غذيت المجموعات الثانية والثالثة والرابعة على علف مركز وسايلج بنسب 45،30،15 % على التوالي. وذلك لمدة ستون يوما. حيث تم تسجيل العلف المستهلك اليومي والوزن الأسبوعي للخراف في سجلات خاصة.

وعند انتهاء التجربة تم اختيار ثلاثة خراف بشكل عشوائي من كل مجموعة وتم ذبحها ونزع الأحشاء الداخلية منها وكذلك الجهاز الهضمي ومحتوياته، وبعدها تم تسجيل وزن الذبيحة وأجزاء الجهاز الهضمي ومحتوياته ووزن الأحشاء الداخلية لكل خروف وتم تسجيلها في سجلات خاصة. ومن خلال فحص القرائت التي ذكرت سابقا تبين أن الخراف التي غذيت على العليقة التي تحتوي على 30 % سايلج قد أعطت أفضل النتائج مقارنتا مع المجموعات الأخرى.

حيث كان معدل الكسب اليومي للخراف 344 ، 336 ، 373 ، 310 غم للمجموعات الأربعة على التوالي، وكذلك الكفاءة التحويلية حيث كانت 4,8 ، 4,5 ، 4,5 ، 5,3 كغم علف/ كغم

كسب للمجموعات الأربعة على التوالي. كما وظهر فرقا معنويا واضحا في تكلفة الكسب الكلي حيث كان الأعلى في مجموعة الشاهد والأقل في المجموعة الرابعة والتي تحتوي على 45 % سايلج. لقد كان لمعدل استخدام السايلج أثرا على الأحشاء الداخلية للذبيحة حيث تبين أن الخراف التي غذيت على العليقة الثالثة التي تحتوي على 30 % سايلج أنها سجلت أثقل وزنا للأحشاء الداخلية ومكونات ومحتويات الجهاز الهضمي كذلك للرأس والأقدام ، وأطول أمعاء دقيقة ، مقارنتا مع المجموعات الأخرى. هذا وقد لوحظ أن المجموعة الرابعة والتي تحتوي على 15 % سايلج قد سجلت أقل القياسات للمعايير التي أخذت ، بينما مجموعة الشاهد سجلت أعلى القياسات لنفس المعايير.