An – Najah National University

Faculty of Graduate Studies

IMPROVING LIVESTOCK FARMERS INCOME THROUGH REDUCING FEEDS COSTS: INCORPORATION OF SOME MAJOR AGRICULTURE WASTES IN LIVESTOCK RATIONS

By

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This Thesis\Dissertation was Defended Successfully on 10/2/2022 and approved by

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Dedication

This thesis is lovingly dedicated to my respective parents and brothers, sister, wife and sons who have been constant source of inspiration. They have given me the drive and discipline to tackle any task with enthusiasm and determination without their support and love this project have not been achieved.

Acknowledgment

I am extremely grateful to Professor Dr. Jamal Abo Omar and all professors of An- Najah University for providing me the opportunity of working under their guidance. During my stay at An- Najah University I had the chance to learn from their varied experience. Deep appreciation to my graduation committee, Drs. Badran and Zaazaa. I gracefully acknowledgment their able guidance, help, periodic review of my work, valuable suggestions and the time and energy devoted by them. I also would like to thank the farmer Mr. Rami Sawalha. I would like to thank all my colleagues, friends, and acquaintances that I had a chance to interact and learn from during my study period. Special thanks to Eng. Muayad Selman, Baher Gazal and Wael Halawa for their efforts during field an analytical period.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

IMPROVING LIVESTOCK FARMERS INCOME THROUGH REDUCING FEEDS COSTS: INCORPORATION OF SOME MAJOR AGRICULTURE WASTES IN LIVESTOCK RATIONS

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: moin Hamed ahmad shtayeh

Signature: 

Date: 10.2.2022

List of Contents

List of Tables

List of Figures

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ABSTRACT

The aim of this study was to investigate the effects of feeding different forms of date palm leaves (DPL) and almond hull (AH) on the performance of fattening lambs and the economic feasibility of this practice. Both (DPL and AH) were incorporated in the fattening diets as raw ingredients, ensiled and alkali treated. The study was conducted in al nassareyeh village 17 kilo meter east Nablus, the precipitation rain ranges 260 ml with 17 thousands dounme of high quality of pastures areas. Twenty-eight crossbred lambs were used in this study, Lambs were stratified into seven groups, four lambs in each group were considered as replicate. The group (G1) was a control comprising 85% concentrate and 15% wheat hay, for the experimental groups G2 to G7, the tested ingredients were added to diets to replace half of the wheat hay. Digestion trial was performed at the termination of the trial at 87 days.The measurement of blood metabolites were conducted also at the end of the fattening trial. Results of the study showed that form of ingredients used had no effect on performance parameters (feed intake, FI; weight gain, WG; feed conversion ratio, (FCR). Nutrient digestibility was not affected by type of diet. Similarly, carcass cuts and visceral organs were not affected by type of treatment compared to control. The different forms of date palm leaves (DPL) and almond hull (AH) had no effect on blood metabolites. Feeding of the different forms of DPL and almond hull AH reduced the cost feed up to 20%. It can be concluded that feeding DPL and AH in its raw form or treated (ensiled, alkali treated) is of good advantage as reducing the feed cost of fattening operation as well as protecting the environment. However, best treatment and inclusion level in diets should be investigated.

Chapter One

Introduction

Animal breeding is considered as an important sector in the world specially to provide meat, milk and its products, Palestine is one of the main countries which depends on animal breeding especially goat, cattle and sheep's, there are two main breeds of sheep, A ssaf breed that is concentrated as intensive system, and a wassi which its presence and concentrated in Jordan valley and mountains areas depending on semi extensive system. According to the (PCBS, 2013) the number of sheep and goat is around 730,894 heads, 91.7% in west bank and 8.3% in Gaza strip, the number of cattle is (33,980) head, 75.4% in west bank and 24.6%in Gaza strip, and the number of goats in Palestine is 215.335 head 95.2% in west bank and 4.8% in Gaza strip. 90.6% from farmers work in animal sector in Palestine 83.3% in west bank and 16.7% in Gaza strip.

The population in Palestine is increasing at high rate, the population growth rate was estimated at 2.5% (Palestinian central bureau of statistics, 2013), this growth is accompanied by harsh economic condition and general change in climate. Growth of human population is also accompanied by a simultaneous increase in demand for feed ingredients. This has already resulted in the deterioration of naturel grazing areas, In addition to raising the price of raw material used in the manufacture of feed, which is controlled by the occupation side of Israel, and leading to a marked decrease in animal performance. It is therefore important to study the utilization of agriculture by- products as feed animals especially in ruminants.

The majority of the sheep in Palestine is Awassi breed. Awassi breed graze on range lands, in order to cope with the lack of feed resources and high cost of sheep can be fed on agro – industrial wastes. large amount of agro industrial wastes are available locally where olive cake or green houses, date palm leave and almond hull are the most abundant and the highest of cost to study the utilization of agriculture by –products as feed ingredient s for farm animals especially in ruminant's feed.

Dumping or burning wastes of agro – industrial by – products presents potential air and water pollution problems, also high moisture wastes are difficult to burn, Consequently,

it is very important for both economic and ecological reasons that such as a high quality of byproducts of the local plant production and processing be included in animal feed. many by- products have a substantial potential value as animal feedstuffs.

Ruminates have the unique capacity to utilize fiber, because of their rumen microbes, this means that cereals can be largely replaces by these by – products in ruminant ration. consequently, he competition between human and animal nutrient cab be decreased.

Local research provides the positive potential of these wastes as feed ingredients (Abo Omar ,2011) as date palm leaves and almond hull which was fed to fattening lambs.

Improving nutrition value for by products as silage or chemical treatment can be fed to ruminants, so silage can made of various agro industrial wastes was fed to fattening lambs with positive effects on lamb general performance (Zaazaa ,and Abo Omar , 2011). Similarly, lamb's performance and carcass merits were improved when fed on almond hull and date palm leave for fattening lambs.

There is no information about degradation of nutrients, effective degradability values and digestion kinetics of wastes used for sheep feeding in Palestine.

Accurate values are important for the feed manufacturing industry. the feed manufacturing industry and farmers performing feed mixing practices, therefore, rely on nutritive values, such as those published by research institution. Unfortunately, the accuracy of ration formulation depends on the assumption that all wastes are represented by these limited published values describing rumen degradability.

It is important to understand the concept of dietary nutrient degradability (i.e. CP) since the extent and rate of its degradation determines the nitrogen available for rumen micro–organism and un degradable CP available for digestion in the small intestine.

In recent times, it has been observed that sheep and goats' breeders have been reluctant to raise them due to high cost of feeding, that considered to be more than 70% of total production costs (Abo Omar et al. 1998). Middle East is characterized dry land farming. Depending on the regional rainfall, the availability of forages and cereal crops is highly seasonal (Abo Omar and Abdallah, 2017). The importance of roughage as a feed resource

is decreasing at the expense of cereals and agro-industrial byproducts (Abo Omar and Abdallah, 2017, Abo Omar ,2012). Food crops leave a variety of residues (straws) that are utilized for animal feeding. Poor quality roughage comprises the only part of the diet for ruminant animals in most Middle East countries, for a considerable part of the year. Such residues can supply a substantial part of the maintenance requirements of small ruminants in the Asian region (Abo Omar and Abdallah, 2017, Abo Omar et al, 2012). Many by products used in in Awassi lambs feed as citrus pulp and olive cake silage (Abo Omar and Zaazaa, 2008).

Local research proved the position potential of these wastes as feed ingredients (Abo Omar, et al, 2003). local research proved the potential of these wastes as feed ingredient such as olive cake which was fed to fattening lambs (Abo Omar et al .,2012) Crop residues, such as almond hulls (AH), date palm leaves (DPL) and many others have gained in importance due to the increasing demand of livestock feeds and to completive prices resulting from removal of feed subsidies, There are many constrains for instant use of most of the by- products due to being with variable moisture content and difficulty in handling and feeding as fresh. Another constrain is the poor nutritive value.

Almond hull (AH) and date palm leaves (DPL) has been evaluated in rations for small ruminants (Abo Omar et al, 2012) and dairy cows (Weiss et al. 1997).

Field weight of almond fruit during harvest is 23% nuts, 13% debris, 14% shells, and 50% hulls (EPA, 1995). AH can be considered as an important feedstuff for dairy cows and goats (Aguilar et al., 1984; Reed and Brown, 1988). Almond hulls are high in NDF but low in protein content (DePeters et al., 2000).

It was reported that almond hull (AH) can be fed to lactating dairy cows at level up to 25% of the total mix ration (TMR) as replacement of alfalfa hay without negative effects on performance (Aguilar et al. 1984). In contrast, Williams et al. (2018) found that feeding AH to lactating dairy cows at 17.6% of their diet resulted in a decrease in CP and NDF intake along with a decrease in the yields of milk and milk protein. The highly fermentable sugars, such as sucrose and glucose in AH could make them a better replacement for concentrates instead of forages in a lactating cow diet.

Studies of the impact of almond hull (AH) and date palm leaves (DPL) on fattening lambs is still limited and more research is needed.

Palm trees *(Phoenix dactilyfera L.*) grown in many regions of Arab countries such as Egypt, Iraq, Saudi Arabia, Kuwait, and Palestine. The main product is dates, which used for human consumption since thousand years ago. Stems used in building houses and leaves are used in some industries. A large number of date palm trees grown in Palestine with numbers increasing from year to another.

Since the population of date palm trees, this can led to large numbers of leaves becoming available annually FAO (2010).

Palm leaves were utilized in livestock rations. El-Din and Tag EL-Din (1996) used it in sheep rations and in Friesian cows' rations (Bahman et al.1997), in goat's rations (Pascual et al. 2000) and in rabbit's rations (Abdel-Azeem and El-Bordeny (2007).

In the previous feeding trials palm leaves were used to replace major roughage traditionally used in livestock regular rations, In order to reduce feed costs. The palm leaves were shredded by mechanical shredder. The shredded leaves are easily handled and stored and could be an alternative to wheat or barley hay.

Previous research showed that organic matter content of date palm leaves (DPL)to have a range from 80 to 92.3% (Arhab et al., 2006, El-Waziry et al., 2013, Pascual et al., 2000). The DPL had a variable crude protein content ranging from 1.65 to 6.40% (Pascual et al., 2000, Arhab et al., 2006, Ziaei et al., 2009, (Kafilzadeh et al., 2019, Chehma and Longo, 2001, El-Waziry et al., 2013.

The crude fiber content of DPL was found to be variable, ranging from 24.10% to 42.14% (El-Tahan et al., 2013, Pascual et al., 2000, Chehma and Longo, 2001, El- Bordeny et al., 2011, El-Waziry et al., 2013).

Values of ether extract (EE) in DPL were also found to be variable, ranging from 0.77 % to 3.5% (El-Tahan et al., 2013, El-Waziry et al., 2013, Chehma and Longo, 2001, Pascual et al., 2000). The nitrogen free extract (NFE) values of DPL estimated by different workers were 47.68% to 64.90% (El-Tahan et al., 2013, Pascual et al., 2000). The total

ash percent of DPL was also found to be variable, ranging between 8.25% and 12.90% (Chehma and Longo, 2001, 10.03% (El-Waziry et al., 2013), 10.50% (El-Hag et al.,1992), 10.90% (Arhab et al., 2006.) 11.60%.

The aim of this study was to determine whether almond hull (AH) and date palm leaves (DPL) in different forms could be fed as a replacement for wheat hay in a fattening lambs' diet to support performance, digestibility, carcass cuts and blood parameters.

Chapter Two

Literature Review

Palestine is located between 29° and 33° north latitude and 35° and 39°longitude, with a total area of 6245 km² (area of west Bank include east Jerusalem and Gaza strip). Palestine has Mediterranean climate with cold rainy Winter and hot dry summer. the precipitation is ranges from 150mm in the south east to 700mm in the north western part of the west bank. in west bank there is four agro- ecological zones, semi costal, central highlands, eastern slopes, and Jordan valley.

In Palestine the total area of cultivated land is 2.15.800 dunums, the rain –fed area is 1.9 million dunum recent statistics showed the cultivated or arable land represents 42.5%, while the area of open land with or without significant vegetation cover represents 29.3 %. Grazing area represents 12.5%, the area of Palestine built- up

Land represents 6.65, and the at area of built –up land in the occupation that occupied sites including the expansion and annexation wall represents 4.1% during the year 2006.

Land and water are fundamental agriculture resources. Roughly, 62.9% of Palestinians arable land is located in C region designated areas with just 18.3% in A area. although grazing lands comprise 2.02 million dunums. Israel settlement activity and Separation Wall construction has reduced grazing areas to 700.000 dounm. the western section of the Separation area is 900.000 dunums of agricultural land.

The fattening operation are among the important activities within animal sector. Recent statistics shows that about 400 thousands head of lambs were fattening in 2000, the income from fattening operation was estimated to be more than 50% of total income resulted from the animal sector. The total amount of concentrate feeds consumed by local livestock is about 767 thousands ton.

Many obstacles are facing the livestock, the most important one is the limited feed resources, it is well documented that feed costs make more than 70 %, to overcome this situation, attempts were made to use unconventional feed ingredients in feeding sheep, so

large amount of agro – industrial wastes are available and can partially reduce dependence on concentration.

The high cost of feed is one of the major obstacles facing the livestock in the world, as well as in Palestine. Large number of sheep farmers sold their animals as a result of increasing of feed cost. Furthermore, low milk production per unit decrease the income of farmers due to the high cost of feed which effect farmer's profitability. the livestock sector plays a significant economic role in most developing countries and is essential for the food security of their rural population. Livestock farming is increasing bring limited by restriction of grazing lands. During the long dry season animals are on poor quality feeds characterized by low palatability, low intake and low nitrogen concentration. However, crops residues (straw) play a key role in animals feeding manly in the region.

Feeding by products of the crop and food processing industries to livestock is a practice as old as the domestication of animals by human. It has two important advantages (Grasser et al.1995), these being to diminish dependence of livestock on grain that can be consumed by human (which was almost certainly the primary original reason), and to eliminate the need for costly waste management programs (which has become very important in recent years, as the world human population has increased and the amount of crop and food by – products has increased, particularly in developed countries.

It is important to reduce of high feed cost and increase animal production. the solution to this problem may be achieved by unconventional feeding system such as using silage in animal ration from by -products as date palm trees and almonds, many case studies were conducted in west bank to study the effect of using silage as a part of sheep ration on milk production and fattening, but unfortunately there are no resisted data to assess silage effect on fattening or milk production

In this study under took fattening data which were collected from using by products made for this reason, This availability of such data will help the farmers proceed with by products and disseminate this technology all over West Bank, also feasibility study to estimate the profitability of feeding by products.

There are several studies concerning the problem of high costs of agricultural inputs and the cost of animal feeds in particular. However, research on how to solve this problem is

limited. It is urgent to investigate local agro industrial wastes in regard availability and nutritive value as proposed in this study. The outcome of this research is expected to provide important information on which raw wastes can be incorporated in animals, rations and the saving that can be achieved.

Almond hull (AH) and date palm leave (DPL) are raw waste can be used animal feeding to reduce the cost and to improve nutrient value through using chemical treatment, or silage and crushed.

Almond tree (*prunus dulcis*), native to southwestern Asia and its edible seed. A member of the family Rosaceae (order Rosales), Prunus dulcis is an economically important crop tree grown primarily in Mediterranean climates between 28° and 48° N and between 20° and 40° S, with California producing nearly 80 percent of the world's supply. , in 2019 , worldwide almond production was 1.37 million ton California was the first producer with 1.06 million ton (77)% followed by Australia (103700) ton , Spain (78089) ton , turkey (20000) ton , and Italy (18000) ton.

Almond processing yields several by-products that can be used in animal feeding, Culled and discarded almond, Almond hulls represent about 52% of the total fresh weight of the fruit, Almond hulls represent about 52% of the total fresh weight of the fruit, Almond shells represent 33% of the total fresh weight of the almond fruit, Almond skins account for 4–8% of the fruit and Almond oil cake or almond oil meal. There are two varieties, sweet almond *(P. dulcis variety dulcis)* and bitter almond. *(P. dulcis variety amara).* In recent years most of farmers depend on almond in ruminant feeding due to the high cost of feeding especially in the bedwens areas in Jordan valley and Jericho due to the lack of pastures areas.

Almond tree is cultivation is concentrated in different regions of Palestine, especially in Aqaba town, and Tubas district; The number of trees planted there is 54,000 trees planted on 2,300 dunams, making it the first in the Palestinian areas, Territory in terms of annual production due to its favorable climate for almond growth, the nature of its soil, and the availability of technical and administrative expertise to follow up on almond requirements.

Almond hull (AH) Utilizing by-product feeds for livestock production has been a practice to reduce feed costs and improve livestock farms income (Abo Omar et al, 2012; DePeters et al., 2000). Almond hulls are a readily available by-product feedstuff in Middle East countries. The California Department of Food and Agriculture requires that almond hulls shall not contain more than 13% moisture, nor more than 15% CF and 9% ash (DePeters et al., 2000).

Feed prices have increased drastically over the past couple of decades. This forces producers to evaluate alternative feeds for incorporation into ruminant diets as a method to reduce feed costs (St-Pierre and Knapp, 2008). Many of the by-product feeds evaluated are as replacements for concentrates in ruminant diets (Abo Omar et al. 2012; Bamipidis and Robinson, 2005; Bradford & Mullins, 2012; Grasser et al., 1995). evaluated the effectiveness and economic benefits of locally available feed resources on lamb growth and carcass traits. It was concluded that the use of locally available feed resources have the potential to reduce and / or stabilize feed costs during times of high grain prices. There is limited data on the use of almond hulls as a potential roughage replacement in sheep diets. The objective of this study was to determine the effects of feeding different levels of almond hulls on finishing lamb growth performance and carcass characteristics.

The feed industry often refers to AH that are the harvesting process, making them an easy feed for dairies to store (Reed and Brown, 1988). A survey conducted in California in 2012 found that of the 104 total mix ration (TMR) sampled 39 contained AH, with an average of 1.45 kg/d per cow being fed (Castillo et al., 2012). The California Department of Agriculture estimated that there were 1.75 million dairy cows in California in 2017. Even if every cow consumed AH, there would still be a sizable surplus of AH on the market. Given this estimated surplus along with the high amounts of fermentable carbohydrates in AH and the affordability of AH as a by-product feed for lactating dairy cows, feeding higher amounts of AH to lactating cows would contribute to the sustainability of both the dairy and almond industries in California. Little recent research has focused on feeding AH to dairy cows. Aguilar et al. (1984) found that AH could be fed to lactating dairy cows at up to 25% of the total mix ration (TMR) with no negative effects on milk production or feed intake. In contrast, (Williams et al.,2018) found that feeding AH to lactating dairy cows at 17.6% of their diet resulted in a decrease in CP and

NDF intake along with a decrease in the yields of milk and milk protein. For both of these previous studies AH were used as a replacement for alfalfa hay, with urea being supplemented in the Aguilar et al. (1984) study. As previously stated, AH are low in CP but high in fermentable carbohydrates. The highly fermentable sugars, such as sucrose and glucose in AH could make them a better replacement for concentrates instead of forages in a lactating cow diet.

The nutritional composition of AH was reported in several previous research Almond hulls can be used as an energy source in ruminants (Alibes et al., 1983). , which can be used both as a forage (due to the content of fiber and as concentrate (due to its energy content) As they contain little protein, they cannot be fed alone and must be part of a diet containing better protein sources. The NDF content ranged from 16% (Jaffari et al 2011) and 62% (Elahi et al 2017). The levels of ADF ranged from 13.7% (Norallahi et al 2006) to 30.4 %. However, the crude protein levels were 3.7% (Yalchi and Kargar 2010) and 10.3% (Elahi et al 2017). The ash content ranged from 5.3% (Yalchi and Kargar 2010) and 9.9% (Elahi 2017). There was a narrow change in ether extract contents among research as the level ranged from 1.6 % (Yalchi and Kargar, 2010) and 3.6% (DePerters et al, 2000).

Date palm leave is another by product can be used in animal feeding diet to reduce the cost, through improving the nutrient value through different treatment as (silage or chemical treatment or crushed).

Palm trees *(Phoenix dactilyfera L.)* grown in many regions of Arab countries such as Egypt, Iraq, Saudi Arabia, Kuwait, and Palestine. The main product is dates, which used for human consumption since thousand years ago.

Date palm can be cultivated in all five continents of the world, largely between 39° northernmost and 20° southernmost latitudes. However, the main region of production is the Middle East and North Africa, where 89% of dates are produced. In recent years, there has been a surge in the number of date palms planted in this region (FAO, 2010).

Date palm leaves can be used in industry; Leaves are further used as roofing to give shade or for newly planted offshoots. Where mud is used in house construction whole date leaves may be laid across the ceiling beams (made of the trunk) in a thick bedding upon

which a layer of mud is poured to form the first floor or roof cover. Whole palm leaves further have a special meaning at Christian and Jewish religious festivals and the introduction of the date palm into South America has been attributed to the missionaries who carried along date seeds from the old world in order to secure a supply of palm leaves for religious celebrations.

Date palm leaves can be utilized in livestock rations. El-Din and Tag EL-Din (1996) used it in sheep rations and in Friesian cows' rations (Bahman et al.1997), in goats rations (Pascual et al. 2000) and in rabbits rations (Abdel-Azeem and El-Bordeny (2007). Date palm leave can fed dried and easily stored. Also, this locally available roughage may be an acceptable alternative to barley straw in diets for feeding lambs.

In the previous feeding trials palm leaves were used to replace major roughage traditionally used in livestock regular rations in order to reduce feed costs.

The palm leaves were shredded by mechanical shredder. The shredded leaves are easily handled and stored and could be an alternative to wheat or barley hay.

Previous research showed that organic matter content of date palm leaves (DPL)to have a range from 80 to 92.3% (El-Waziry et al., 2013, Pascual et al., 2000).

The DPL had a variable crude protein content ranging from 1.65 to 6.40% (Pascual et al., 2000, Ziaei et al., 2009, Chehma and Longo, 2001, El-Waziry et al., 2013, Genin et al., 2004).

The crude fiber content of DPL was found to be variable, ranging from 24.10% to 42.14% (El-Tahan et al., 2013, Pascual et al., 2000, Chehma and Longo, 2001, El- Bordeny et al., 2011, El-Waziry et al., 2013). Values of ether extract (EE) in DPL were also found to be variable, ranging from 0.77 % to 3.5% (El-Tahan et al., 2013, El-Waziry et al., 2013, Chehma and Longo, 2001, Pascual et al., 2000).

The nitrogen free extract (NFE) values of DPL estimated by different workers were 47.68% to 64.90% (El-Tahan et al., 2013, Pascual et al., 2000).

The total ash percent of DPL was also found to be variable, ranging between 8.25% and 12.90 %, 2011, Chehma and Longo, 2001, 10.03% (El-Waziry et al., 2013), 10.50% (El-Hag and Elkhanjari, 1992), 10.90%., 2006, and 11.60% (Genin et al., 2004).

2.1 Body weight gain:

Results presented in showed the average body weight (BW) and average daily gain (ADG) of lambs fed diets based on wheat straw and treatments groups. The differences in average daily gain was not significant in lambs fed on date palm leaves with or without supplemented direct fed microbial. The average daily gain was numerically higher in lambs fed on date palm leaves with or without supplement direct-fed microbial than those fed the control diets. On the opposite to our results, Beauchemin et al. (1995) indicated that the improvement in live weight with enzymes might be due to increase digestibility, which yields more energy and/or nutrient availability to rumen microbes. On another study, Gado et al. (2009) indicated that enzymes had marked positive effects on increasing the total microbial population in the rumen and increased microbial protein synthesis in sheep.

The results were reported by El Shahat et al (2010) showed that different biological treatments had no effect on growing rabbits. Kholif *et al.* (2012) reported that exogenous enzymes supplementation had no effect on body weight (BW) in Buffaloes. Moreover, Abd El-Rahman *et al.* (2014) found that the average daily weight gain were insignificant for group fed biological treated group compared to fed untreated rice straw in growing calve.

2.2 Feed conversion ratio:

Results in our study are in agreement with that of Gado et al. (2011). They found that the addition exogenous fibrolytic enzymes to ruminant diets increased live weight gain and feed conversion ratio.

Feed conversion ratios expressed as g DMI /g gain for all tested diets showed that were insignificantly improved as compared with control group. Also, DM intake per unit of gain was improved by using date palm leaves untreated, or treated with direct-fed microbial by 12.84, 18.08 and 24.72 %, respectively, as compared with control group.

Aboul-Fotouh *et al. (*2017) reported that feed conversion, recorded no significant differences between the tested rations of lactating goats by using AH and DPL. It was reported that biological treatments of PL and AH resulted in positive improvement in FCR ((Beauchemin *et al.,* 1995; Gado *et al.,* 2011; Deraz, 1996); El-Marakby, 2003; Allam *et al.* 2006; El-Banna *et al.* 2010a).

In the other hand, Petera *et al.* (2015) results of daily feed conversion for lactating goats clearly showed that feed conversion of control ration was significantly decreased.

2.3 Nutrients digestibility:

Abd EL Galil (2000), reported that biological treatments increased digestibility of nutrients especially CF because biological treatments degraded crude fiber. The improvement in CP, CF and fiber fractions digestibility coefficients of over a wide range of low quality (Gorden, 1985; El- Ashry *et al.,* 1997; Fouad *et al.*, 1998; Kholif *et al.,* 2005 and Gado *et al.,* 2006 and 2007; Abo Omar et al, 2012).

Abd El-Razik *et al*. (2012) found that all digestibility coefficients as percentages of nutrients showed higher ($P<0.05$) values with rations contained berssem hay and chemical and biological treated rice straw as compared with untreated groups. The improvement in DM digestibility coefficients percentages were 10.18, 7.77 and 7.83%, respectively for Berssem hay, chemical or biological treated rice straw when compared with the control group. The corresponding values of OM percentages were 17.46, 20.34 and 19.28%, respectively. The improvement in CP digestibility coefficients percentages were 46.88, 38.64 and 41.50%, respectively. Also, the corresponding values of CF percentages were 18.33, 24.46 and 33.02%, respectively. The corresponding values of EE percentages were 8.97, 22.40 and 6.25%, respectively. The improvement in NFE digestibility coefficients percentages were El-Banna *et al.* (2010) showed that the digestibility coefficients of CF, EE, CP, NDF, ADF, hemicellulose and cellulose of biologically treated roughages were 14.44, 14.30 and 10.14%, respectively compared with the control group for lambs.

El-Banna et al. (2010a) showed that the digestibility coefficients of CF, EE, CP, NDF, ADF, hemicellulose and cellulose of biologically treated roughages were significantly increased. While, the digestibility coefficients of OM, DM, NFE and ADL were decreased in comparison with the untreated roughage of sheep. In contrary, the treatments

caused an increased content of CP, EE, ash and ADL than those of untreated Sugarcane bagasse (SCB).

In addition, Khattab et al. (2011) fed Baladi goats on diets containing exogenous enzymes of ZAD® (anaerobic bacteria enzyme) and ZADO®. They found that enzymatic treatments improved ($P<0.05$) nutrients digestibility, rumen fermentation parameters, milk composition and fat content without affecting blood chemistry. On other study, Valdes et al. (2015) showed that feeding lambs on concentrates and maize silage with addition of exogenous enzymes and Salix babylonica extract improved DM and OM digestibility and live weight with a positive impact on the use of nitrogen and microbial protein synthesis.

2.4 Blood metabolites:

(Kholif et al. (2005) reported that biological treatments increased serum total protein in goats. However, the serum globulin was not affected. El-Bordeny et al. (2015) found a significant ($P<0.05$) increase in serum total protein concentration with supplementation exogenous fibrolytic enzymes to dairy cow's ration. Also, they added albumin and globulin concentrations were not significantly affected.

The present results indicated that values of total protein concentration were within the normal range from 5.79 to 6.72 mg/dl. Merek (1991) recorded that the normal value of total protein ranged from (6-7.5 g/dl) in sheep. Also, the values of albumin concentration in the present study (2.96 to 3.06 g/dl) are laying within the normal range (2.7-3.7g/dl). Moreover, the presented values of blood globulin concentration (2.73 to 3.68g/dl) were within the normal range (3.2 to 5 g/dl) as described by Merek (1991). At the same time, the experimental animals appeared healthy and in normal condition and performance.

Feeding rations containing date palm leaves with or without direct-fed microbial supplementation to lambs did not significantly affect the serum cholesterol concentrations. But it could be noticed that the cholesterol concentrations tended to be higher in rations containing date palm leaves with 2g direct-fed microbial supplementation than other group.

El Shahat et al. (2010) they showed that the cholesterol concentration was not significantly affected by biological treatments supplemented to rabbit rations confirmed these results.

Gado *et al. (*2006) reported that animals, which were fed rations contained biologically treated rice straw, resulted in a non-significant decrease in blood serum urea concentration than the animal fed untreated rice straw. In addition, El-Shahat *et al.* (2010) reported that the biological treatments used have no deleterious effects on the kidney's functions of growing rabbits.

Kholif (2006) found that animals fed on silage had no significant increase in serum glucose concentration. Aboul-Fotouh *et al.* (2017) serum glucose of lactating goats received the tested rations recorded insignificant differences among all groups in the overall means of serum glucose. The higher concentration of glucose reflects the improvement of energy utilization and soluble carbohydrate in the rumen absorbed through ruminal wall to blood which resulted higher glucose available.

2.5 Carcass traits:

References related to effects of feeding DPL or AH, on animal's carcass cuts and visceral organs are limited. Abdel-Azeem and El-Bordeny (2007) found that, no significant effects ($P > 0.05$) were detected in absolute or relative weights for carcass traits which estimated due to feeding diets containing dietary palm leaves. Similar findings were reported by (El-Shahat *et al.* 2010) where the slaughter weight carcass weight, empty body weight and dressing percentage were not significantly affected by the different biological treatments of growing rabbits.

Feeding AH had non effects on hot carcass weights, yield grade and quality grade however; dressing percentages were affected by level of AH in diets (Norollahi et al. 2006).

2.6 Economic Efficiency:

Results shows that there is no significantly differences among groups for the cost of concentrate that mixed every day. The total feed cost for one kg weight gain and feed cost for total gain were significantly ($P<0.05$) lower in groups that fed on rations containing

date palm leaves (DPL) with or without direct fed microbial (DFM) than control groups. Feeding lambs on date palm leaves ration without supplement direct fed microbial (DFM) decreased the cost of ration and improved the cost of total gain a compared with control ration. In another study, EL-Tahan et al. (2013) reported that, feeding rations containing different levels from biological treatments of palm fronds grinded (PFG) improved economic efficiency compared to the control group.

The economic efficiency was improved by biological treatments of palm fronds compared to control (EL-Tahan *et al.* 2013). Also, the cost of kg gain decreased gradually with increasing palm fronds. Total feed cost was increased for treated rice straw compared with untreated rice straw. The net revenue was higher for treated rice straw compared with untreated. This increasing of net revenue was due to increasing the average daily gain for group fed treated rice straw than the group fed untreated. The economic feed efficiency for animals fed treated rice straw was higher (13.68 %) than those fed untreated rice straw (11.76 %).

The chemical and biological treatments of rice straw and corn stalks decreased the cost of feeds used to produce one kg live body weight gain by 15.54 and 16.82% for rations including corn stalks, respectively of lambs (Deraz, 1996; Ibrahim, 2001). Safa Abdel-Azim *et al.* (2011) reported similar results that least feed cost/Kg body weight gain and economic efficiency were in favor to treated ingredients compared to untreated. Replacing alfalfa hay with 10 and 20% of palm leaves resulted a gradual decrease in total feed cost, while 30% not significant decrease the feed cost as a result to increase feed intake in this group. This may be attributed to the not significant difference which was observed in feed consumption in parallel to the gradual increase in palm leaves percentage, which led to decrease cost of kg feed.

Chapter Three

Materials and Methods

3.1 Study Site:

The study was conducted at a private farm at AL – Nassareyeh town east of Nablus. This farm is of the semi extensive raising system with more than 200 sheep, on the other hand he is interested in lamb fattening depending on intensive system.

Figure 1:

Experimental area

3.2 Animals and experiment design.

A total 28 of weaning Cross breed lambs at age 60days were used in study that were distributed into 7 groups of 4 lambs in each. Each lamb in the group was considered as replicate. Lambs were treated against internal parasites and external parasites and injected with enterotoxaemia vaccine, also were vaccinated against Clostridium perfringens types C and D. All lamb in each group has number by using ear tagging for recording data during the study period 87 days, wool sharing for all cross bred lambs done due to get rid of external parasites and to adapt with the external condition of temperature.

Data used in this study were collected over the period from May to July 2021. Feed was offered to lambs in the morning (6:00 am) and evening (6:00 pm) and recorded at daily basis. A 7-d adaptation period was considered prior to the experimental period. Mineral blocks and water were adlibitum. Rations were formulated to meet the (NRC, 1985) recommendations (Table 1).

Figure 2

Management and Experimental design

Lambs were randomly selected according to weight and age and 4 lambs in each group were fed according to requirement using NRC table.

3.3 Experimental groups:

The study includes 7 groups as the following (Table 1):

G1: control group, where lambs fed a traditional fattening ration (1 kg concentrate plus 0.60 kg wheat hay).

G2: Fed on 85% concentrate and 7.5% wheat straw and 7.5% almond hulls silage

G3: Fed on 85% concentrate and 7.5% wheat straw and 7.5 % alkali treated almond hulls.

G4: Fed on 85% concentrate and 7.5% wheat straw and 7.5 % almond hulls.

G5: Fed on 85% concentrate and 7.5% wheat straw and 7.5 % palm leaves silage

G6: Fed on 85% concentrate and 7.5% wheat straw and 7.5 % alkali treated palm leaves.

G7: Fed on 85% concentrate and 7.5% wheat straw and 7.5 % crushed palm leaves.

Table 1

Ingredients and chemical composition of the rations fed to the fattening cross bred lambs.

Ingredients %	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**	**G7**
Concentrated feed 18% CP	85	85	85	85	85	85	85
Wheat hay	15	7.5.	7.5	7.5	7.5	7.5	7.5
Almond hull silage	0	7.5	0	0	0	0	0
Alkali treated almond hulls	0	0	7.5	0	0	0	0
Almond hulls	0	0	0	7.5	0	0	0
Palm leaves silage	0	0	0	0	7.5	0	0
Alkali treated palm leaves	0	0	0	0	0	7.5	0
Palm leaves	0	0	0	0	0	0	7.5
Total	100	100	100	100	100	100	100
Chemical composition%							
Dry matter	87.98	82.34	86.89	87.01	84.16	87.55	87.88
Crude protein	15.68	16.48	16.53	16.10	16.60	16.67	16.10
Ether extract	3.18	3.23	3.24	3.18	3.39	33.37	3.33
Crude fiber	9.07	8.20	7.87	8.97	8.68	8.93	8.84
ADF	6.20	7.20	6.81	8.20	7.03	7.29	8.49
NDF	14.67	15.22	15.28	15.72	14.54	15.26	17.42
Ash	6.15	6.58	6.57	6.81	6.43	6.58	6.81
Ca	1.11	1.21	1.15	1.13	1.17	1.15	1.10
P- value	0.51	0.57	0.54	0.55	0.56	0.53	0.51

G1: control group; **G2:**7.5% AH silage; **G3:** 7.5% alkali treated AH**; G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

Chemical composition and representative sample of all feed ration were analyzed in National Agriculture Research Center (NARC).

3.4 Preparation of DPL and AH:

3.4.1 Raw ingredients:

A suitable amount of dry palm leaves (DPL) were collected from palm farms located at town of Jeftlik, in Jericho governorate and transported to the experiment site. Leaved were chopped using a tractor mounted machine to 3-5 cm pieces. Chopped DPL were stored for later use, At the same site AH were collected from nearby areas and crushed using an automatic crusher.

The process for crushing dry date palm leaves (DPL) by Automatic machine chapalino to small species 2-3 cm in al jeftilk village.

Figure 3 (A)

Chapalino machine for chopping almond hull and date palm leaves.

Figure 3 (B)

Crushed Date palm leaves on the right and almond treated by NAOH on the left.

3.4.2 Silage preparing:

Silage preparation to ration is often accompanied by increased feed intake, which may partly be due to increased palatability of the diet due to sugars released by pre-ingestive fiber hydrolysis. However, post-ingestive enzyme effects may increase hydrolytic activity in the rumen to reduce gut fill and enhance feed intake. Direct-fed enzymes can also enhance microbial colonization of feed by increasing numbers of ruminal fibrolytic microbes.

Some research's demonstrated that feeding cattle on diets supplemented with fiber-degrading enzymes can improve feed utilization and animal performance by enhancing fiber degradation.

Silage is fermented feed which is important to improve the nutrient value and increase palatability and digestibility for PL and be available for feeding animals all the year.

Silage is important due to microbial ensilage of crop residues increased daily gains, feed intake, feed conversion, and decreased feed cost per unit gain in growing ruminants.

The process of silage making includes cutting green PL, compacting, storing and fermentation under controlling condition. Preparing DPL silage done by collecting green leaves from nearby farms and chopped them to 2-3 cm, then ensiled them by using plastic

barrels. Adding sugar and chopped corn were added to PL to have effective fermentation under anaerobic condition to have high quality o of silage, the ensiled ingredients were kept for 4 weeks before used in feeding the experimental lambs. when PH for silage around 3.5 to 4 and high content of vitamin C and carotene, lactic acid is 0.7%, olive green color, good smell, humidity not more than 70 %, free of harm and molds that means we have good quality of silage.

On the other hand, making silage of (AH) done in the same way for making PL silage, through adding sugar and corn, but we differ between them in the humidity since the humidity in AH is less than the humidity in PL silage, so water must be added more during making AH silage, using silage of AH and PL can be used after 4 weeks for feeding.

Date palm leave (DPL) and Almond hull (AH) silage, barrels of alamond hull (AH) and date palm leaves (DPL) silage to be used for cross bred lambs feeding .

T **Figure 4**

Two types of different Parells of silage (alamond hull and Date palm leaves) .

he nutritional composition is shown in Table (2).

Figure 4

Two types of different Parells of silage (alamond hull and Date palm leaves) .

3.4.3 Treatment with sodium Hydroxide:

The main purpose for using biological treatments of some by-products are very essential in order to degrade lignocelluloses into lignin, cellulose, hemicellulose and improve crude protein content. Swelling of cell walls facilitates the easy access of rumen microbial enzymes to the cellulose and hemicellulose, and to increase voluntary of roughages. Enzyme treatment methods for improvement of poor-quality forages and roughages have not been used in practice to date, but it may prove to be one of the most promising in the future.

A 5% NaOH solution was prepared by adding one kilogram of NAOH % to 25 liters of water with suitable 25 kilogram of raw DPL and soaked in the solution for 2 hours. The ingredients kept a while to become dry then put them on plastic sheet for later use., with the necessary to turn them daily to be dried and to prevent molds and fungus, the alkali treated materials were fed after 2 weeks of treatment.
The same method for chemical treatment for AH is the same for PL chemical treatment.
The nutritional composition is shown in Table (2).

3.5 Digestibility measurements:

The digestibility of the seventh rations used was determined on 28 lambs, four lambs from each treatment group were selected at random for digestibility trial, each four lambs were kept as group and fed alone, the ration were given adlibitum for all group for seven days.

Samples from rations, refusals and feces were taken daily to measure the digestibility over a week following the fattening trial. Refusals were collected daily at 08:00 h, weighed, sampled and then stored. Total daily fecal output for each animal was also collected, weighed, and homogenized. Then two representative samples, one of 100 g was dried for 24 h at 105 C to measure fecal dry matter and the second of 40 g was kept at -15 C. pooled samples of feces obtained from each animal were used for chemical analysis.

The digestibility of nutrient is often measured as the differences between the amount of nutrient ingested minus the amount of nutrient excreted in the feces expressed as percentage of nutrient ingested * 100%.

*Digestibility = feed intake –feed excreted/feed intake*100%*

3.6 Slaughtering measurements:

3.6.1 Slaughtering procedure:

At the end of the trial, one male cross bred lamb from each group were selected randomly for slaughter after being fasted for 18 h according to routine procedure at local commercial slaughterhouse. Fasted live and hot carcass weights recorded before and immediately after slaughter.

3.6.2 Non –carcass components measurement:

After bleeding killed animals were peeled and eviscerated according to routine dressing procedure, directly after slaughter, non-carcass components (*i.e.*, head and feet, lungs, trachea, heart, 4- compartment of stomach, small intestine and large intestine, liver, kidney, kidney fat, mesenteric fat) were removed and weighed. Carcasses were chilled at 4 C for 24 h and cold carcass weights were recorded. Dressing proportion was calculated by dividing hot carcass weight by fasting live weight.

Figure 5: cuts of the lambs non-carcass components (*i.e.*, head and feet, lungs, trachea, heart, liver, kidney, kidney fat, mesenteric fat carcass . legs).

Figuer 5

Mesurmment of carcass cuts.

3.7 Blood Test:

The main aim purpose for blood test is to measure the effect of PL and AH on the immune system and the toxic level in blood in all lambs.

Blood samples were drawn from the jugular veins of three lambs of each group at 4 h after morning at the end of feeding trial plasma was separated by centrifuged for 20 min at 3000 rpm. and stored at − 20 °C for subsequent analysis. Blood serum was analyzed for total protein (Armstrong and Carr 1964), albumin (Doumas et al. 1971), creatinine (Folin 1994), urea (Siest et al. 1981), and cholesterol (Fassati and Prenciple 1982). Amino aspartate transaminase (AST) and alanine transaminase (ALT) were determined calorimetrically by the methods of Reitman and Frankel (1957), using commercial kits (Biodiagnostic, Dokki, Giza, Egypt). Globulin concentration was calculated by subtracting albumin concentration from the corresponding total protein concentration.

Figure 6

Blood Samples test.

3.8 Chemical analysis:

Following AOAC (1990) procedures, samples were analyzed for DM (100 c in air forced oven for 24 h; method 967.03), ash (550 C in ashing furnace for 6 h; method 942), crude protein (Kjeldahl procedure), ether extract (Soxtec procedure, Soxtec system HT 1043 Extraction Unit, TECATOR, Box 70, Hoganas, Sweeden).

Additionally, samples were analyzed for neutral detergent fiber (aNDF; with stable-amylase and sodium sulfite) and acid detergent fiber (ADF: ANKOM2000 fiber analyzer, ANKOM Technology Corporation, Fairport, NY, USA) according to Van Soest et al. (1991). Values for NDF and ADF are expressed inclusive of residual ash.

3.9 Statistical analysis:

Initial lamb weight, final lamb weight, as well as weight every 10 days were recorded. Average daily gain, feed conversion ratio, total weight gain, and cost of feed were calculated. These variables and blood variables were compared among groups using one-way ANOVA based on the following statistical model:

$$Yij = \mu + Gi + Eij.$$

where: Yij= the observation of the dependent variable analyzed (Initial weight, Average daily, etc) on lamb j in group i. μ = an overall mean, Gi = fixed effect of group i (i = 1 to 7), Eij= residual for lamb j receiving treatment in group i. Each lamb was considered as the basic statistical unit. The data were analyzed using SPSS v21.0 for windows.

Chapter Four

Results and Discussion

4.1 Chemical composition of date palm leaves:

Results in Table (2) showed the chemical composition of the DPL and the original feed ingredients (concentrate and wheat hay). Our discussions will be concentrated on the comparison between (DPL) and wheat straw. The date palm leaves tended to be higher in crude protein and ADF than wheat hay, but similar dry matter and ash. However, date palm leaves had lower NDF and crude fiber. Khalifa (2019) reported that date palm leaves were higher on DM, OM, CP, CF and EE than wheat straw. However, the content date palm leaves from ash was lower than wheat straw, while NFE content is close for the two sources.

Table 2

The nutrient chemical composition of feed ingredients used in different rations:

Feed%	Feed nutrient chemical composition %								
	CP	**Fat**	**CF**	**Ca**	**P**	**DM**	**ADF**	**NDF**	**Ash**
Concentrate feed	18.00	3.50	6.00	1.30	0.60	87.00	5.50	11.00	6.00
wheat Hay	4.10	7.20	24.40	0.16	0.04	92.90	9.70	52.00	10.00
AH silage	8.30	1.30	22.10	0.80	0.50	30.50	22.90	48.50	12.20
AH treated with 5% Noah	7.10	1.50	18.30	0.10	0.20	82.80	18.50	49.20	15.30
Ground AH	5.20	1.60	23.60	0.30	0.30	85.10	25.70	41.40	8.30
DPL silage	7.90	3.10	35.80	0.10	0.40	37.40	27.00	52.00	8.80
PL treated with 5 % NAOH	6.80	2.90	30.50	0.10	0.10	90.40	24.00	49.00	11.70
Chopped DPL	4.50	2.80	22.60	0.10	0.10	92.10	28.00	55.00	10.00

Note: All samples were analyzed in National Agriculture Research Center (NARC).

The crude protein content of DPL was about 34% higher than wheat hay. The value of crude protein from this study was higher than values reported from previous research (Kafilzadeh *et al.,* 2009, El-Waziry *et al.,* 2013), the crude fiber content of DPL tended to be lower than wheat hay (22.6 vs. 24.4%).

However, the value determined by El- Bordeny *et al*. (2011) 38.21%. Similar value of DPL CF content was recorded by El-Tahan *et al*. (2013) 42.14% and (El-Waziry *et al.,* 2013) 34.9% were lower than our results. Little improvement of protein level as a result of ensiling and the alkali treatment of DPL.

The value of ether extract in DPL was lower than that found in wheat hay (2.8 vs. 7.2%). These results are in dis agreement with the values recorded by Khalifa (2019) 2.31%, Pascual *et al*. (2000) 2.1%, Chehma and Longo (2001), 2% and El- Wazary et al. (2013), 3.5%. Ash content of DPL was similar to that in wheat hay (10%), however, ash level as reported by previous research was lower by 32.60% compared to wheat hay (Khalifa, 2019). However, the estimated values by different workers were 12.90% (Chehma and Longo, 2001), 11.60% (Genin *et al*., 2004) 8.25% (Medjekal *et al.,* 2011), and 10.03% (El-Waziry *et al.*, 2013).

4.2 Chemical analysis of Almond hulls:

The crude protein content in chopped, ensiled and alkali treated AH was higher than level in wheat hay, 7.4, 7.5, 8 and 4.1%, respectively. The treatment of AH had little advantage in improving levels of crude protein. The crude protein level in raw AH as reported in previous research was in the range of 2.7% (Yalchi and Kargar, 2010) to 10.3% (Elahi *et al*. 2017).

The crude fat content in raw AH was 23.6% compared to 24.4% in wheat hay. Reported values of crude fiber in raw AH were ranged from 10.6 (Calixto and Cannilas, 1982) and 15.1% (Aguilar *et al*. 1984). The difference in results here might be due the variety of almond trees, the environmental conditions and type of soil.

The alkali treatment AH caused 22% decrease in crude fiber, however, ensiling of AH had minor improvement. The ADF and NDF values in AH were higher than that of wheat hay. Our results showed that ADF and NDF in AH were 15.6% and 81.4%, respectively (Table 2). Previous research showed that these values for raw AH ranged from 13.7% (Norallahi et al. 2006) to 30.4% (Elahi et al. 2017) for the ADF and from 16.0% (Jaffari *et al*. 2011) to 62.0% (Elahi *et al*. 2017) for the NDF. Type of treatment had a great impact on reduction of both ADF and NDF of raw AH. However, ash content was increased by the ensiling and alkali treatment.

Table 3

Performances of fattening cross bred lambs fed different forms of DPL and AH, and cost fattening.

ITEM	G1	G2	G3	G4	G5	G6	G7	*P-value*
Feed intake(kg)	112.80	116.70	111.60	112.80	112.80	115.00	114.70	0.770
Initial weight(kg)	18.00	20.40	22.50	16.90	23.70	21.90	22.80	0.128
Final weight(kg)	45.00	46.20	46.25	38.90	45.30	49.20	43.50	0.742
Total weight gain(kg)	27.00	25.80	23.80	22.10	21.70	27.30	20.70	0.626
ADG(g)	310.00	297.00	273.00	253.00	248.00	314.00	238.00	0.626
FCR (kg/ DM intake)	3.77	3.60	4.20	4.70	4.32	3.70	5.07	0.819
Cost of gain (Nis)	62.10	51.30	47.60	44.20	44.20	60.06	39.33	0.630
Cost / lamb, Nis	264.00	231.20	233.40	231.00	236.00	253.00	217.00	0.895
Cost/kg ration, Nis	2.30	1.99	2.00	2.00	2.04	2.20	1.90	0.850

G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

4.3 Feed intake:

The experimental animals appeared healthy and in normal condition and performance, and the immune system were non affected by using different treatment of by products (silage or chemical treatment or crushed).

(Guo et al., 2002) showed that microbial ensilage of crop residues increased daily gains, feed intake and feed conversion and decreased feed cost per unit gain in growing ruminants. It also indicated that lactating cows fed diets based on microbial ensiled straw had increased milk and fat-corrected milk yield and slightly higher milk fat percentages compared with diets based on untreated straw. Another significant effect of microbial ensilage of dry crop residues is probably to hydrate and weaken plant structures so that less energy is expended on rumination. Most exogenous fibrolytic enzyme (EFE) contain mainly xylanases and cellulases of fungal or bacterial origin applied to the ration before consumption with the expectation to improve feed efficiency and animal performance (Beauchemin and Holtshausen, 2010).

EL-Tahan et al. (2013) reported that the total quantity of DM intake was insignificantly increased with increasing palm fronds grinded treated (PFGT) in all experimental rations this may due to good palatability of PFGT.

Daily DM intake of lambs fed rations containing raw DPL and AH or treated forms are presented in Table (3).

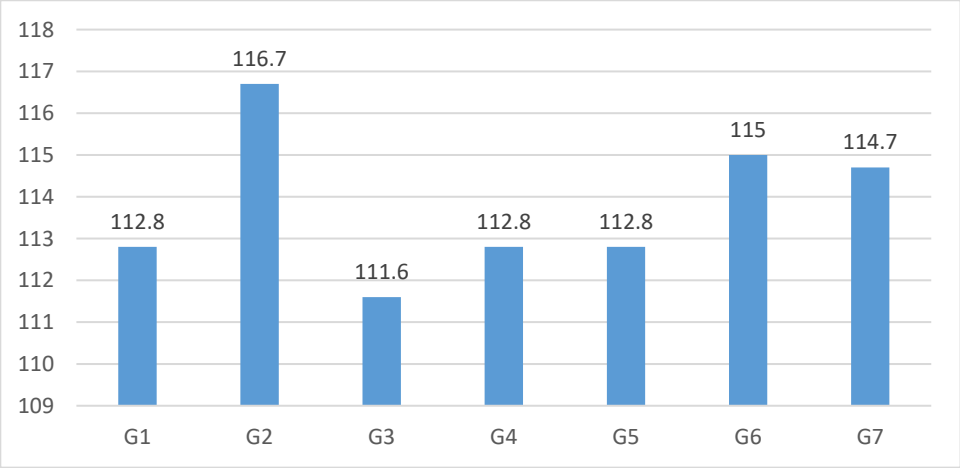
Feed intake was the same in all animal at different experimental groups which means that palatability was not affected by treatments.

A survey conducted in California in 2012 found that of the 104 TMR sampled, 39 contained AH, with an average of 1.45 kg/d per cow being fed (Castillo *et al*., 2012). Little recent research has focused on feeding AH to livestock. Aguilar *et al*. (1984) found that AH could be fed to lactating dairy cows at up to 25% of the TMR with no negative effects on milk production or feed intake. Williams *et al*. (2018) found that feeding AH to lactating dairy cows at 17.6% of their diet resulted in a decrease in CP and NDF intake along with a decrease in the yields of milk and milk protein. Ziaei (2009) reported that DM intake increased with lambs fed diet containing 15% date palm, which it was considerably as a good quality roughage for small ruminants. Different results were reported by EL-Tahan *et al.* (2013) where dry matter intake was not increased with grinded date palm leaves.

Feeding diets with AH resulted in higher dry matter intake in general. Clutter and Rodiek (1992) concluded that almond hulls seem to be safe and palatable for horses. and can be fed up to 45% replacing oat Lucerne in diets of horses (Cana *et al*. 2007).

Figure 7

Feed intake(kg) between groups



G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

Results shows that group (G2) has the highest vale and (G3) has the lowest value.

4.4 Daily gain:

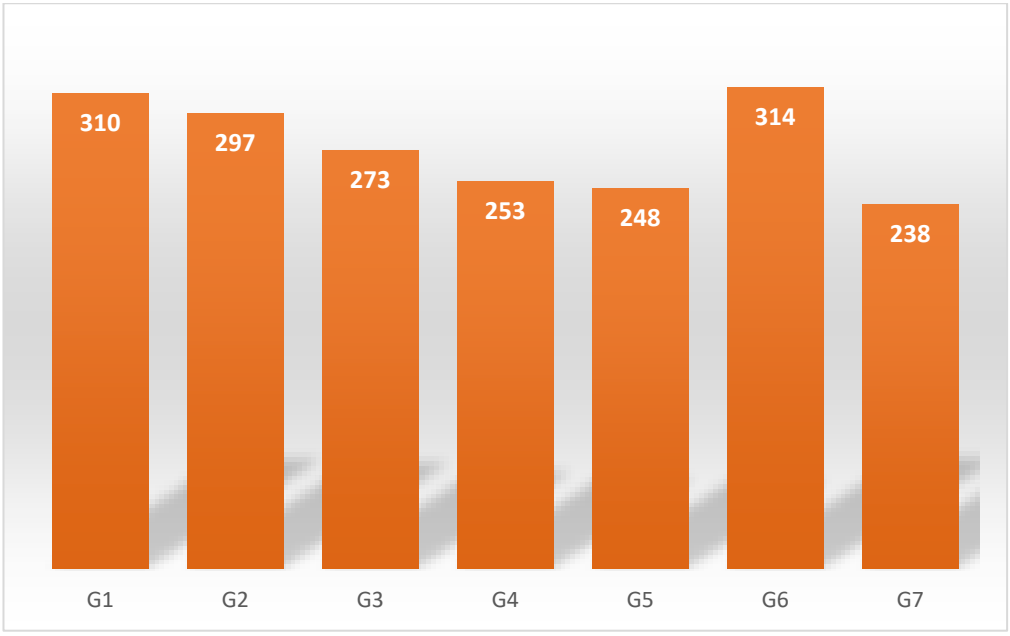
Results presented in Table (3) showed the average body weight (BW) and average daily gain (ADG) of lambs fed rations contained the experimented diets. The average daily was not affected by incorporation of raw date palm leaves. Similar trends were observed when feeding the treated palm leaves. Khalifa (2019) reported similar findings. Beauchemin *et al.* (1995) reported that the enzymatic treated date palm leaves resulted in higher gain in sheep due to the increased digestibility and more bioavailable feed nutrients and the more synthesis of microbial protein (Gado *et al.* 2009).

Gado (1997) reported that increasing the concentration of cellulose enzyme had a positive ($P<0.05$) reflection on average body gain in bagasse treatment in comparison with control treatment in Baladi goats. Also, Allam et al. (2006) showed that growing lambs fed on fungaly treated roughages recorded the highest daily gain compared with control groups. On another hand, El-Banna et al. (2010a) reported that average daily gain of sheep that were fed on SCB treated with brown rot fungi was less than that of sheep fed on the untreated SCB.

El Shahat et al (2010) reported Similar to our results where different biological treatments had non-effect on growing rabbits. Kholif *et al.* (2012) reported that exogenous enzymes supplementation had no effect on body weight (BW) in Buffaloes. Moreover, Abd El-Rahman *et al.* (2014) found that the average daily weight gain were insignificant for group fed biological treated group compared to fed untreated rice straw in growing calve.

Figure 8

Average daily gain weight (ADG), g



G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

The results from Figure (9) showed that the highest daily gain value was in group (G6) and the lowest value daily gain was in group (G5**).**

4.5 Feed conversion ratio:

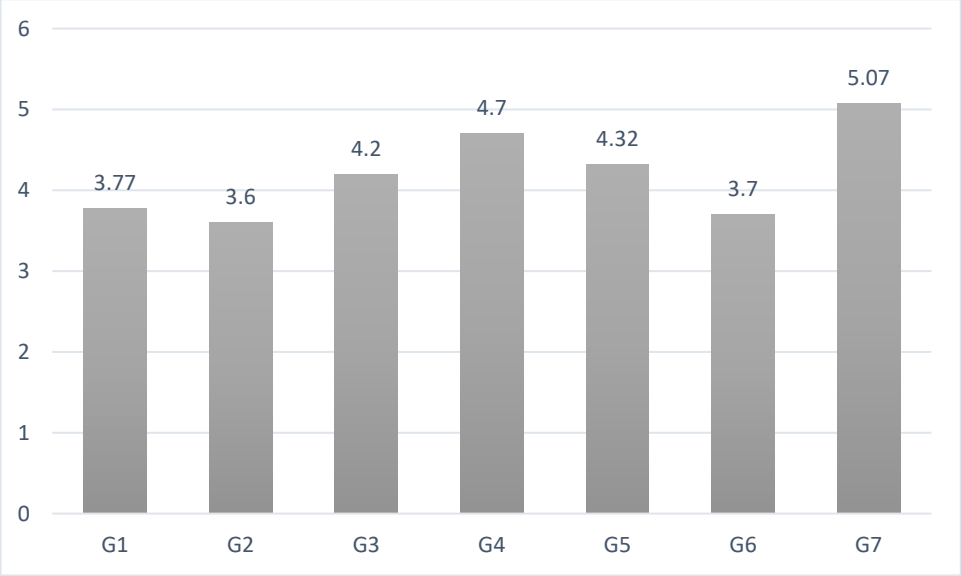
All types of treatments had no effects on FCR (Table 3). The FCR values in this study were similar to values in practical fattening operations. Similar findings were reported by Aboul-Fotouh *et al. (*2017) where feed conversion recorded no significant differences between the tested rations of lactating goats.

It was reported that biological treatments resulted in positive improvement in FCR (Beauchemin *et al.*, 1995; Gado *et al.*, 2011; El-Marakby, 2003; Allam *et al.* 2006; El-Banna *et al.* 2010a) Allam et al. (2006) found that animal groups fed biologically treated roughages were more efficient than those fed the untreated roughages

In the other hand, Petera *et al.* (2015) results of daily feed conversion for lactating goats clearly showed that feed conversion of control ration was significantly decreased.

Figure 9

Feed conversion ratio FCR (kg/ DM intake)



G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

4.6 Digestibility:

NaOH treatment increased rate of digestibility of straw, while high level of concentrates decreases it. in contract NAOH treatment and high levels of concentrate decrease cellulolytic activity but neither type of concentrate nor limitation of intake altered it. NAOH treatment only slightly modified PH because a higher level of VFA in rumen balance NAOH presence. An important negative effect on PH of high level of concentrate was observed, but there was no effect on PH of high levels of concentrate was observed, but there was no effect or type of concentrate or limitation of intake

Feeding DPL and AH at all forms resulted in insignificant (P>0.05) reduction in crude protein and crude fat digestibility (Table 4). The digestibility of crude fiber in the control group (59%) was reduced to 44.6, 47, 53.6, 57.3 and 44 for diets including the ensiled AH, alkali treated AH, ensiled DPL, alkali treated DPL and chopped DPL, respectively. Yalchi, 2011 reported that digestibility of AH was 59.6 to 66.7% ***in vivo*** dry matter digestibility (DMD).

The average digestibility of DM, CP, CF, EE, NFE, organic matter (OM) and total digestible nutrients (TDN) of almond hull were 73.05, 29.6, 40.6, 84.3, 84.4, 68.4, and

29.4 percent, digestible energy (DE) and metabolizable energy (ME) were 1.29 and 1.05 Mcal/kg. With respect to these results, the intake of almond hull was high but through enrichment of almond hull it is possible to improve its nutritive value and digestible energy (Norollahi, et al. 2006).

Generally, roughages subjected to biological treatments increased digestibility of nutrients especially CF because biological treatments degraded crude fiber by cellulose enzymes produced by microorganisms during incubation of roughages.

The improvement in CP, CF and fiber fractions digestibility coefficients of over a wide range of low-quality roughage due to fungus treatments incubation of roughage were observed

Yalchi (2011) determined that almond hulls were higher in sugars than alfalfa hay and had greater DM digestibility in lambs, than alfalfa hay. Vonghia, et al. (1989) evaluated the impact of almond hulls at 15% and 30% of lamb finishing diets.

Inclusion of the AH at 3% decreased ileal digestibility of DM and ideal protein digestibility. However, 6% had no significant effects on the ileal digestibility of DM and protein. It was also reported that ruminants could not utilize the crude protein from almond hulls (Askelson et al., 2014; Rad et al., 2016). Presence of some natural compounds in AH are the reason for reducing the digestibility of protein such as tannins which was estimated at levels from 70 to 120 mg/g (Adamczyk et al., 2011; Kahlaoui et al., 2019).

El-Banna et al. (2010a) showed that the digestibility coefficients of CF, EE, CP, NDF, ADF, hemicellulose and cellulose of sugarcane bagasse (SCB) treated with brown rot fungi were significantly increased. While, the digestibility coefficients of OM, DM, NFE and ADL were decreased in comparison with the untreated SCB of sheep.

Table 4

Dry matter and nutrients digestibility in lambs fed different forms of DPL and AH, %.

Group	CP	Fat	Fiber	DM
G1	60.34^{a}	61.94^{a}	59.24^{a}	87.4^{a}
G2	48.28^{b}	60.68^{a}	44.6^{b}	87.32^{a}
G3	39.18^{c}	55^{c}	47^{c}	87.34^{a}
G4	42.4^{d}	55.44^{c}	53.6^{d}	87.1^{a}
G5	48.4^{e}	52.9^{d}	62.04^{e}	82.3^{b}
G6	48.28^{e}	58.1^{e}	57.3^{f}	88.18^{c}
G7	42.32^{d}	52.26^{d}	44^{g}	81.2^{d}
P-value	<0.001	<0.001	<0.001	<0.001

G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

The means with different superscript P- value <0.001 are significant different, G1 have the highest mean for CP, Fat, DM. Also, as results shows G7 have the lowest mean for all.

4.7 Slaughtering procedure:

Results of our study showed no effects of feeding DPL and AH on the carcass cuts and visceral organs. And there were no significant differences between groups in slaughter weight, This results agree with Dahmen et al. (1985) that a positive relationship between dressing percentage and live body weight

Feeding AH had non-effects on hot carcass weights, yield grade and quality grade however; dressing percentages were affected by level of AH in diets (Norollahi et al. 2006).

Phillips et al. (2015) showed that the dressing percentages were non affected by feeding AH. In another study, Abdel-Azeem and El-Bordeny (2007) found that, no significant effects (P> 0.05) were detected in absolute or relative weights for carcass traits which estimated due to feeding diets containing dietary PTL.

However, upon the basis of the present results one may suggest that the biological treatments may have on important role on the testis of growing lambs. The data of slaughter weight carcass weight, empty body weight and dressing percentage were not significantly affected by the different biological treatments of growing lambs.

Table 5

Effect of feeding different forms of AH and DPL on the carcass cuts and visceral organ mass.

Carcass cuts %	G1	G2	G3	G4	G5	G6	G7
Live weight(kg)	47.00	59.00	51.00	43.00	56.00	63.00	48.00
Skin	11.17	11.19	11.37	11.58	11.27	11.27	11.04
Hands	1.38	1.16	1.28	1.21	1.15	1.08	1.38
Legs	1.81	1.53	1.69	1.88	1.54	1.43	1.80
Head	5.32	4.75	5.59	5.12	4.64	4.92	5.56
Testes	0.96	0.79	0.90	0.93	0.83	0.79	0.96
Spleen	0.23	0.45	0.24	0.22	0.42	0.42	0.25
Kidney	0.61	0.79	0.89	0.57	0.83	0.75	0.61
Small intestine	2.77	2.54	2.71	2.67	2.77	2.54	2.94
Large intestine	2.34	2.03	2.22	2.30	2.30	2.25	2.40
Rumen	1.70	1.39	1.60	1.72	1.48	1.32	1.71
Abomasum	0.85	0.71	0.81	0.88	0.75	0.67	0.86
Reticulum	0.21	0.36	0.37	0.21	0.39	0.35	0.26
Omasum	0.43	0.50	0.44	0.40	0.53	0.49	0.49
Liver	2.40	2.17	2.24	2.56	2053.57	2.22	2.48
Heart	0.64	0.56	0.63	0.58	0.58	0.54	0.68
Lugs	1.49	1.22	1.40	1.49	1.36	1.15	1.59
Fat	5.96	4.41	4.12	2.33	3.21	3.49	3.96
Pancreases	0.02	0.03	0.02	0.02	0.02	0.02	0.03
Dressing percentage%	48.00	49.00	50.00	52.00	50.00	51.00	48.00

G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

4.8 Blood metabolites:

The levels of all blood parameters were within the normal ranges. It could be concluded that treating the available roughage sources with chemical treatment improved the chemical composition, digestibility, feeding value, and rumen fermentation without any adverse effect on the functions of neither liver nor kidney.

Kholif et al. (2005) in goats and Allam et al. (2006) in lambs reported that, biological treatments increased serum total protein, urea, glucose and AST by biological treatment. They also reported that serum globulin was not affected by biological treatment. Adding fibrolytic enzymes to dairy cow's ration caused a significant increase in serum total protein and glucose concentration compared to control group (El-Bordeny et al., 2015).

Type of diet had no effect on all testes blood parameters (Albumin, Total protein, Glucose, Cholesterol, triglysterol, AST-GOT, ALT GPT, Bun, Urea, Globolin) as in our

results . (Kholif 2005), reported that animals which were fed rations contained biologically treated date palm leave and almond hull resulted in a non-significant decrease in blood serum urea concentration than the animal fed untreated date palm leave and almond comparative with the control.

In addition, El-Shahat et al. (2010) reported that the biological treatments used have no deleterious effects on the kidney's functions of growing rabbits. It was reported that serum total protein, urea, glucose and AST by biological treatment were increased by biological treatment, Allam et al. 2006) in goats and lambs, respectively. Lambs fed diets containing treated date palm leaves and almond hull with chemical or biological treatments recorded no differences values of blood total protein, albumin, urea and AST. They also reported that serum globulin was not affected by biological treatment. Serum total protein, albumin, globulin, albumin /globulin ratio, urea nitrogen and cholesterol were not affected by enzymatic treatments (Kholif et al. 2012). Moreover, blood serum AST and ALT values were not affected by treatments of lactating buffalo. El-Marakby (2003) reported that insignificant differences among treatments in plasma serum AST and ALT for lambs fed biologically treated wheat straw compared with control ration. Aboul-Fotouh et al. (2017) reported that insignificant differences among all groups in the overall means of serum AST and ALT of lactating goats received the tested rations.

Kholif (2006) found that animals fed on silage had no significant increase in serum glucose concentration. Aboul-Fotouh et al. (2017) serum glucose of lactating goats received the tested rations recorded insignificant differences among all groups in the overall means of serum glucose. The higher concentration of glucose reflects the improvement of energy utilization and soluble carbohydrate in the rumen absorbed through ruminal wall to blood which resulted higher glucose available.

Table (6) shows the blood parameters in lambs fed different forms of AH and DPL.

Table 6

Average blood test for fatting cross bred lambs.

Group	Albumin	Total protein	Glucose	Cholesterol	Triglysterole	AST-GOT	ALT-GPT	Bun	UREA	GLOBOLIN
G1	3.56	6.42	67.00	58.00	36.30	98.37	14.43	28.30	60.57	2.86
G2	3.45	6.23	63.00	59.00	25.30	107.90	14.93	30.20	58.93	2.79
G3	3.54	6.56	56.30	64.00	27.30	110.83	23.27	29.70	54.07	3.02
G4	3.42	6.12	48.30	63.00	22.70	87.87	25.43	24.00	46.33	2.77
G5	3.42	6.42	57.30	60.00	20.70	93.70	20.47	23.50	48.00	3.00
G6	3.36	6.61	55.70	59.00	23.30	107.23	20.47	23.00	47.83	3.24
G7	3.35	6.05	66.30	59.00	23.00	90.10	17.30	23.00	49.03	2.68
P -*value*	0.510	0.280	0.414	0.949	0.080	0.644	0.776	0.717	0.718	0.40

G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

4.9 The economic efficiency:

Feeding treated or untreated DPL cause saving in feed cost. The cost per kg diets was reduced up to 17%. However, the cost of lamb's gain was reduced by 37% table (3).

The economic efficiency was improved by biological treatments of palm fronds compared to control (EL-Tahan et al. 2013). Abd El-Rahman et al. (2014) the recycling of agriculture wastes is important to raise its nutritional value and reduce feeding cost and can be used in the ruminants Feeding biological treatments. Based upon the difference in both growth rate and feeding cost per animal, Also the cost of kg gain decreased gradually with increasing palm fronds. Total feed cost was increased for treated date palm leave and almond hull compared with untreated date palm leave and almond hull. The net revenue was higher for treated Palm leave and almond hull compared with untreated. This increasing of net revenue was due to increasing the average daily gain for group fed treated date palm leave and almond hull, than the group fed untreated. The economic feed efficiency for animals fed treated date palm leave and almond hull was higher (13.68 %) than those fed untreated date palm leave and almond hull (11.76%).

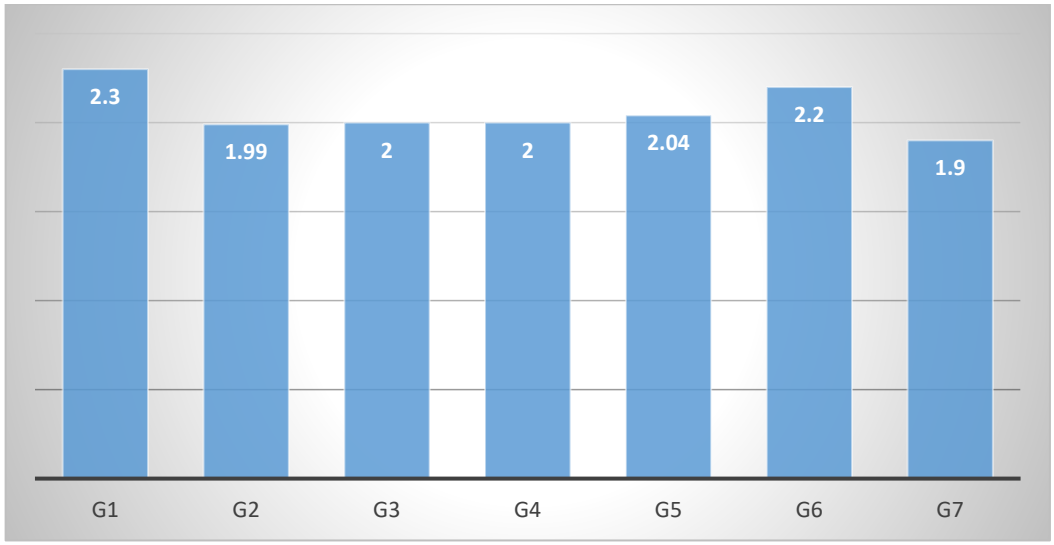
EL-Tahan et al. (2013) reported that, feeding rations containing different levels from biological treatments of palm fronds grinded (PFG) improved economic efficiency compared to the control group. Also, the cost of kg gain decreased gradually with increasing palm fronds grinded treated (PFGT) in rations. In addition, wheat straw can be replaced by date palm leaves with or without direct feed microbial (DFM) supplementation as a source of roughage in sheep ration.

Feeding lambs on date palm leaves and almond hull ration decreased the cost of ration and improved the cost of total gain as compared with control ration.

Safa Abdel-Azim *et al.* (2011) reported similar results that least feed cost/Kg body weight gain and economic efficiency were in favor to treated ingredients compared to untreated. Replacing alfalfa hay with 10 and 20% of palm leaves resulted a gradual decrease in total feed cost, while 30% not significant decrease the feed cost as a result to increase feed intake in this group. This may be attributed to the not significant difference which was observed in feed consumption in parallel to the gradual increase in palm leaves percentage, which led to decrease cost of kg feed (El-Bordeny *et al.* 2011).

Figure 10

The economic efficiency cost of by – products.



G1: control group; **G2:** 7.5% AH silage; **G3:** 7.5% alkali treated AH; **G4:** 7.5% chopped AH; **G5:** 7.5% DPL silage; **G6:** 7.5% alkali treated DPL; **G7:** 7.5% ground DPL.

According to the economic efficiency results shows using by products as crushed DPL and AH and feeds treated with NAOH reduce the cost comparative the control, without any side effect on health.

Conclusions:

1. Feeding both AH or DPL in fattening diets proved to be safe and no motility is recorded during study period.
2. Savings up to 20% in feed costs could be achieved when feeding different forms of both DPL and AH.
3. It can be concluded that feeding these two ingredients will cause no harm effects on feed intake, rumination, nutrition value, economic value, coefficients, carcass characteristic, and growth performance.

Recommendations

1. Special attention should be considered by decision makers and the extension department of the ministry of agriculture to consider feeding such feed ingredients.

2. Using date palm leaves and almond hull in the animal rations and the improvement of nutrition value requires further studies.

List of Abbreviations

Abbreviation	Meaning
NRC	National Research Council
PL	Palm Leave
PCBS	Palestinian central bureau of statics
CAH	Crushed Almond Hull
G	Group
DM	Dry Matter
CP	Crude Protein
ADL	Acid detergent lignin
BW	Body Weight.
FCR	Feed Conversion Ratio
NE	Net Energy
ADF	Acid Detergent fiber
NDF	Neutral Detergent Fiber
NARC	National Agriculture Research Center
TDN	Total Digestible Nutrients
DMI	Dry Matter Intake
CF	Crude Fiber
BW	Body weight
AST-GOT	Aspartate Amino transferees
ALT-GPT	Alanine transaminase
ADG	Average Daily Gain
Ca	Calcium
IBW	Initial Body Weight
FBW	Final Body weight
NIS	New Israel Shekel
P	Phosphorus
DWG	Daily weight gain
TFC	Total feed cost
TC	Total cost
NAOH	Sodium hydroxide
BSA	Blood sample analysis
NV	Nutrition value
EC	Economic side
TMR	Total mix ration
FI	Feed intake
WG	Weight gain
SSPS	Statistical product and service solution
DFM	Direct feed microbial

SCB	Sugarcane bagasse
ZAD	Anaerobic bacteria enzyme
VFA	Volatile fatty a cide
DMI	Dry matter intake
PFGT	Palm fronds grinded treated

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كلية الدراسات العليا

تحسين دخل مربي الماشية من خلال خفض تكاليف الأعلاف: دمج بعض المخلفات الزراعية الرئيس في علائق المواشي

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قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في الإنتاج الحيواني، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

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الملخص

الهدف من هذه الدراسة هو معرفة تأثير تغذية أشكال مختلفة من سعف النخيل (DPL) وقشر اللوز (AH) على أداء تسمين الحملان والجدوى الاقتصادية لهذه الممارسة. تم دمج كلاهما سعف النخيل (DPL) وقشر اللوز (AH) في علائق التسمين كمكونات خام، (مجروشه أو سيلاج أومعالجة قلوية). تم استخدام ثمانية وعشرين خاروف هجينا في هذه الدراسة. قسمت الخراف إلى سبع مجموعات، في كل مجموعة أربعة خراف. كانت المجموعة (G1) عبارة عن مجموعة شاهد , العليقة تحتوي على 85٪ مركز و15٪ قش قمح، اما بالنسبة للمجموعات التجريبية G2 إلى G7، إضافة المخلفات إلى العلائق لتحل محل نصف قش القمح. تم حساب نسبة الهضمية وقياس تحليل الدم ودراسة خصائص الذبيحة في نهاية التجربة 87 يوم.

أظهرت نتائج الدراسة أن استخدام المخلفات الزراعية من (DPL&AH) لم يكن لها أي تأثير على معايير الأداء (تناول العلف، FI، زيادة الوزن، WG، نسبة الكفاءة التحويل للعلف، FCR). لم تتأثر قابلية هضم العناصر الغذائية وخصائص الذبيحة والأعضاء الداخلية ونتائج تحليل الدم بنوع النظام الغذائي المقدم مقارنة بالشاهد. كما تبين ان تغذية المجموعات المختلفة باستخدام DPL وAH ادى إلى خفض تكلفة التغذية بنسبة تصل إلى 20٪. أن تغذية المجموعات على DPL وAH في شكلها

الخام او سيلاج، او معالجتها قلويا) له فائدة كبيرة في الزيادة الوزنية، والكفاءة التحويلية. كما انها تقلل من تكاليف سعر الاعلاف المستخدمة في عملية التسمين. بالإضافة إلى حماية البيئة من التلوث , كما ينبغي التحقيق في أفضل مستويات التغذية والحصول على افضل النتائج .