An-Najah National University

Faculty of Graduate Studies

EFFECTS OF DIFFERENT LEVELS OF PELLETED DATE PALM (ELAEIS QUINEENSIS JACQ.) LEAVES ON THE PERFORMANCE AND SOME BLOOD METABOLITES OF AWASSI FATTENING LAMBS

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This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Animal Production, Faculty of Graduate Studies, An-Najah National University, Nablus - Palestine.

2023

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Dedication

This thesis is lovingly dedicated to my respective parents, brother, sisters, wife and sons who have been constant source of inspiration. And I extended my sincere thanks and gratitude to my father, who first supporter to me in educational and practical career. They have given me the drive and discipline to tackle any task with enthusiasm and determination. without their support and love this project haven’t been achieved.

Acknowledgements

I am extremely grateful to professor Dr. Jamal Abo Omar and all doctors of An-Najah University for providing me the opportunity of working under their guidance. During my study at An-Najah University I had the chance to learn from their varied experience. Deep appreciation to my graduation committee, Drs. Ahmad Za`za and Eyad Badran. I gracefully acknowledgment their able guidance, help, periodic review of my work and valuable suggestions. I would also like to thank Dr. Fathallah Khurim Director of the Veterinary Department, encouraged me to continue my educational career and Eng. Reyad Abo Hashem for his assistance in supporting me to complete my study by providing pelleting machine. Also, thanks for Eng. Wael Halawa and Moein Shtayyeh for their efforts to complete my work.

Declaration

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

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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.

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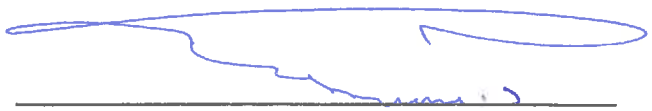
Signature: 

Date: 16.07.2023

List of Contents

List of Tables

List of Figures

List of Appendices

EFFECTS OF DIFFERENT LEVELS OF PELLETED DATE PALM (ELAEIS QUINEENSIS JACQ.) LEAVES ON THE PERFORMANCE AND SOME BLOOD METABOLITES OF AWASSI FATTENING LAMBS

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Abstract

The main objectives of this study were to measure the effect of feeding different levels of pelleted date palm leaves (PDPL) on the performance, digestibility and some blood metabolites of fattening Awassi lambs. A total of 24 Awassi lambs soon after weaning (2-4 month of age) were used in a 70-day fattening trial. Lambs were divided into 3 experimental groups and control group.

Lambs in the control group were fed a traditional corn-soybean meal fattening ration. This ration composed of 18% crude protein concentrate plus wheat straw. In the other 3 experimental groups, the pelleted date palm leaves (PDPL) were incorporated at three different levels (25%, 50 %and 75%) as part of wheat straw. Lambs were fed separately and monitored for body weight and feed intake at weekly basis. Feed conversion ratios were also monitored. At the termination of the fattening trial three lambs from each group were slaughtered for testing the carcass cuts and the visceral organ mass. The blood parameters were tested at termination of the feeding trial from 3 lambs of each treatment. Results of study showed that feeding pelleted DPL at different levels had no effect on lambs' performance. Similarly, DPL had no effects on the feed conversion ratios, and blood metabolites. Visceral organs and carcass cuts were not affected by pelleted DPL.

Digestibility of nutrients were affected by pelleting. In general digestibility of crude protein (CP) decreased with pelleting level. Same trend was observed with fat digestibility. However, crude fiber digestibility increased with pelleting level. Digestibility of DM was decreased with a highly level of pelleted DPL. Feeding DPL had no harm effect on lambs; however, cost of fattening was reduced which can be considered as an advantage of incorporating its ingredient in fattening rations.

Keywords: Blood Parameters; Carcass Cuts; Digestibility; Feed Conversion Ratio; Feed Intake; Pelleted Date Palm Leaves.

Chapter One

Introduction and Literature Review

Livestock sector is a major part of the Palestinian agriculture sector, and plays a very important role in general income. This sector is an important one in assessment of local food security. Livestock numbers are increasing rabidly due to the increasing demand on animals' products.

Globally production and consumption of meat products was increased from 233 million ton in 2000 to 300 million ton by 2020 and milk from 568-700 million ton at the same period FAO, (2001). According to PCBS, (2012) growth rate of Palestinian population was estimated to be 2.9% and this increasing in population was resulted in more demand on livestock products Omar, (2012). Livestock sector is facing many obstacles that resulted in huge decline in livestock population. Among these problems is the scarcity of feed and the increasing cost of ingredients. The restriction of grazing lands made the problem worse. The problem of the limited feed resources and the feed quality resulted in low productivity then reduced the profitability of livestock projects.

It was estimated that the number of sheep is approximately at 730,894 heads. The majority 91.7% in west bank and the rest in Gaza Strip PCBS, (2013) however, goats' numbers 215335 heads 95.2% in west bank PCBS, (2013).

Due to decrease in animal feedstuff in Palestine and presence of many problems during import of grains and shortage in production of concentrate for livestock. We should find a substitution for feedstuff partially to cover decrease in this section. There are many types from agricultural by-products we can use it to produce or make its apart from feedstuff ration and decrease from agricultural wastes in new suitable and safe form.

In the last year, many studies about improve and enhance of nutritive value of fibers content within date palm leaves by mechanical or biological ways Siebenhandl-Ehn, (2011). Also, nutritive value of date palm leaves can be improved through additives or ensiling it with molasses or urea and used for ruminant's feedstuff to compare its needs Islam, (2000). Kawas, (2005) reported a successfully used of palm fronds as a part from sheep ration without any serious effects.

During several months of the year, ruminant depends on low quality feeds with low palatability. Cost feed makes up to 75% of total livestock projects Abu Omar, (2019).

In order to decrease cost of feeds, nonconventional feed ingredients should be considered as part of the ruminant rations Omer, (2019). Huge amounts of agro industrial wastes are available in local communities which have a potential for use in animals' feeds. However, these wastes need to be evaluated in terms of nutritive values and digestibility to decrease cost of feeds. Date palm leaves (DPL) is an example on the available wastes that need evaluation and upgraded to be used as part of ruminant's rations. DPL are available in large quantities as agro wastes and ability to use it in feed as raw material or after treatment to become benefit for animals. Palm leaves are of low nutritive value that resulted in limited advantages. Several research showed that nutritive value of DPL could be significantly improved by certain physical, chemical or biological treatment. Utilizing DPL could be of significant importance in reducing feed cost in ewes' operations and in fattening trials and then increase farms profitability. Abu Hassan, (1991) Ruminants have a special character through its physiological nature of digestive system for digestion fibers and other products have high fiber content, so that using of DPL in ration as raw form or change in its form by many ways doesn't affect on animal performance and visceral organs.

There are many researches associated with feeding DPL to livestock in different forms, however DPL contain many elements its benefit for lambs such as: organic matter range 80-92.3% El-Waziry, (2016), Crude protein in DPL variable from 1.65-6.4% Khalifa, (2019). The crude fiber content in DPL range 24.1- 42.14% El-Tahan, (2013). Range of ether extract in DPL 0.77-3.5% El-Tahan, (2013). Percentage nitrogen free extract (NFE) according for many works 47.68-64.9% El-Tahan, (2013). Value of ash in DPL variable range 8.25% and 12.90% Mahrous, (2021), 10.03% El-Waziry, (2016), 10.50% Elkhanjari, (1992), 10.90% Arhab, (2006).

Various experiments provide an indication about hay as a sole source for nutrients but in other experiments the concentrate in different levels may reach up to 95% from ration is main source for animal's feed. But according to review of Minson, (1963) using of roughage as apart from animal ration or in 50% or more will give a difference in physical nature of fattening ration. So that any improvement in value of fattening ration through

pelleting process may lead to increase in feed intake, enhance of dry matter digestibility and this led to increase value of net energy.

In another experiment for chicks fed with pelleted form increased in body weight more than others fed with un-pelleted and less feed intake than groups fed with un pelleted feed.

Feed production process consist through various route such as grinding, saving and mixing it to become suitable and fit animal's needs, from these types of feedstuffs is a pellet formation, its consider as capsule of feed that contain many types from grains, vitamins and other additives that’s important for animal feed. This process provides more chances to obligate animal to fed or prehension vital feed and elements. According for Abdollahi, (2013) process of pelleting feed take time less than one minute and results in temperature reach to 75C and about of moisture levels 3-4%. These features provide a pellet capsule its consistency. There is not enough research about relationship among feed processing and nutritive vales, chemical and physical alteration in feedstuff processing may effect on animal performance, feed intake, digestibility and on gastrointestinal tract. Svihus, (2011). Manufacturing of animal feed consider as change in normal or natural type and shape of grains with roughage of animal ration through many processes as heat, pressure, water and time to produce new form from feedstuff and compact animal's feed. And this will increase production capacity and affect on nutritive values, physical nature and hygienic quality of processed feed. Skoch, (1981).

In study of Montgomery, (1965) there were insignificant differences in average daily gain (ADG) of Holstein heifers when they fed animals with pelleted ration varying in energy concentration and ADG were 0.64, 0.66, 0.61 and 0.60 with increasing of corn. Also, when they fed lambs with same ration reported same results and showed similarity in dry matter consumption. So that, both experiments provide indication about ruminants that adjust voluntary feed intake with relation to physiological demand of energy.

Burt, (1944) reported fed with pelleted form in white leghorn were heavier at 12 weeks of age than mash fed chicks. Also, there’s increase in feed efficiency with pelleted ration than other rations. And in experiment of Gjorgjievski, (2022) showed increased in growth response to pelleted form as increase of fiber levels within ration from 8 to 18%. Lanson, (1955) reported increasing in bodyweight in broiler chicks fed with pelleted form than

others. Also increasing in feed efficiency and body weight showed by Hussar, (1962) during feeding of pelleted rations that containing of high levels from barley. These researchers believes that improved performance in broiler chicks that fed with pelleted form was not due to increase in feed intake. Stewart, (1951) reported using of pelleted type of feed in broilers didn't affect on growth rate and feed efficiency.

Pelleting of feed ingredients prior to feeding have several advantages compared to other forms of preparations. Both palatability and digestibility are improved by pelleting. Another advantage is reducing the feed spoilage and losses in feeders.

The objectives of this study were to investigate the effects of different levels of pelleted date palm leaves (DPL) on general performance, digestibility, carcass cuts, visceral organ mass and blood parameters of fattening lambs.

1.1 Literature Review

The area of Palestine approximately 27.000 km^2. Palatine has a Mediterranean climate with hot dry summer and cold rainy winter. The total of cultivated area of Palestine is 2,15,800 donums. There are four agro-ecological zones, central highlands, eastern slopes, semi costal and Jordan valley.

Agriculture sector an important part from economic of many Palestinian farmers especially livestock sector it's an essential part for developing agriculture sector and lead to developing most countries and food security. Livestock farming is declining due to restriction of grazing area. Due to increase in feedstuff cost and its raw materials, animals fed on poor quality feed and this led to low palatability and reduce intake main elements then a reduction in productivity. So that agri-waste production plays an important role in animal feeding Za`za, (2008).

The fattening trail are the important activities within livestock sector. According to last statistics, income from fattening trails was estimated up to 50% form total income from livestock. Amount of concentrated feed that consumed by livestock sector is about 767.000 ton/ year. In order to reduce feed costs that make up to 75% livestock expenses, it urgent to feed nonconventional feed ingredient in livestock rations. Many research was conducted through feeding such nonconventional ingredients in different types of rations

were proved to be of great advantages (Omar, (2012); Shtyya, (2022); Bradford, (2012); Grasser, (1995).

The availability of forages and cereal crops is highly seasonal. The importance of roughage as a feed resource is decreasing at the expense of cereals and agro-industrial by-products. Using of wastes of agricultural crops in production of feedstuff for lambs in Palestine should evaluate to meet lambs need from crude protein (CP), crude fiber (CF), dry matter (DM), acid detergent fiber (ADF), and neutral detergent fiber (NDF) (Broekhoven , (2015); Omar,(2002); Abo Omar, (2002); Koul, (2022).

There are two main advantages for using of agricultural by-products in manufacturing of lamb feedstuff, these being to decrease dependence of animals on grains that consumed for human food, the second advantage is reduce cost of waste management programs especially during the last years due to rapid increasing in population growth and industrial revolution Grasser, (1995).

Agriculture waste product and crop residue play a vital role in feedstuff production but it's should treat to reduce harmful effects Iaea, (2012).

Date palm *(Elaeis quineensis* Jacq.) is an important crop in Palestine. The economic lifespan of the palm ranges between 20 and 30 years by which time the palms are 12 to 15 m tall with a basal trunk diameter of 0.6 m and an apical diameter of 0.4 m Shiade, (2023). Date palm wastes have been used historically in livestock feedstuffs by farmers in traditional ways Boufennara, (2016) and it used as a source of animal feeding El Hag, (1995) There are many contents in date such as carbohydrates (70-80%), sugars so that its high in energy content. On the other hand, date is rich in fiber and can be used in ruminant rations at level up to 75% Hossain, (2014).

Date by-products is rich in carbohydrates, fibers and minerals with low fats and protein Boufennara, (2016). This increases ability to use it in supplementary feed for animals Najar, (2010). Aside of using palm date wastes, also palm leaves can be used in animals ration especially in ruminants due to extent fermentation in rumen. Karamshahi, (2014). DPL are available in large quantities and have an important potential as forage feed. DPL are of low nutritive value that resulted in limited advantages. The nutritive analysis showed that it contains 54.12% Dry matter, 89.86% Organic

matter, 8.51% Crude protein, 28.48% Crude fiber, 59.11% NDF, 42.87 % ADF, 24.69 Cellulose, 16.24 Hemicellulose and 14.21% lignin Wong, (2012).

Digestibility and palatability of palm leaves is limited due to its high content lignin and fibers Wong, (2012). However, applying some application to these leaves could improve its properties. Examples on these applications are physical, chemical and biological applications. The low-quality DPL could be improved through enhancing digestibility and palatability of fibrous feed in different methods such as change in form of feed (pelleted form) and using of feed additives Fariani, (2018) and Omar, (2011). However, more investigation needed to find the proper upgrading method and if suitable to combine the alkali treatment with other combinations as urea and pelleting.

Using of palm leaves as a feed could be increased, if leaves preserved in a proper way as ensiling. A good quality DPL silage could be prepared without using any additives Ishida, (1997). Quality of palm leaves improved under anaerobic condition without feed additives Rasool, (2000).

Increasing of animal production and reduce of feedstuff cost very important.
The solution for this achieved by using of an unconventional feeding program such as using of date palm wastes in raw form or incorporating with concentrate and replace amount from wheat straw within feeding trail system. Pellets is a better choice for change form of agricultural waste and make it more palatable and enhance lambs' performance. Although pelleting decrease digestibility of dry matter in ration, there appear no any change or alteration in the net energy value. Increasing in feed conversion efficiency and meat production observed with pelleted ration due to increase feed intake. The other improvement achieved by pelleting depends on the quality on un pelleted ration. Also, there are changes in milk production due pellet ration and the percentage of milk-fat are depressed where finely-grounded hay has been used Minson, (1963). The main effect of grinding and pelleting roughage is to increase palatability and acceptability of animal and increase feed intake, to reduce their digestibility and to improve their net energy value (Minson, (1963); Utley, (1973); Greenhalgh, (2010). The magnitude of these effects varies from one feed to another Minson, (1963) consider that pelleting roughage in animals' feedstuff rich in nutritive value (enhance good production for animal) comparing

with diet of low nutritive values Greenhalgh,(2010) noticed that conclusion applied with variation in nutritive values due to quality of roughage alone or to different ratio between roughage and concentrate. Also, he suggested that pelleting increased intake in sheep greater than in cattle. This opinion was based on comparison among experiments, but Buchman, (1964) had shown the response to pelleting in sheep greater than it in cattle and in young cattle greater than it in dairy cows. feeding lambs with pelleted ration would reduce feed wastes and increase efficiency of labor and improve profitability Bo Li, (2021). Chicks' growth and feed efficiency is improved when we using of pelleted form. This is investigated by (Heywang, (1944); Smyth, (1955) ; John, (1957). But there's a little information about this investigation why the pelleting form induce these responses. By of Haskell, (1961) reported the pelleting ration provide a beneficial effect on chick performance through different ways as the physical nature of pellets feedstuff enhance intake large quantity from feed and this cause increase nutrients intake. And in another way increase of feed efficiency in pelleted form compared with other feed forms. But in another study as Arscott, (1957) were unable to determine effects of pelleting process but showed an increase in growth rate and feed efficiency. Also, in other study an increase in metabolic energy of pelleted ration Jensen Leo, (1962).

To improve rumen fermentation of cattle Tan, (2012) made an experiment on beef cattle and founded an increase in feed intake with increasing level of rice straw with mulberry leaves and ruminal PH and temperature not significantly affected by pelleted ration. Also, ruminal bacteria and cellulolytic bacteria increased with pelleted ration. same trend improves dry matter intake and ruminal NH3.

Many factors affect on feed quality and feed intake during industrial process, so that this study about using of pelleting type in broiler feed. Reported feeding of chicks with diet include high quality pellets give an excellent results as better performance compared with diets contain low quality pellets or diets with natural types of feed. But during production of pelleting feed there are two sites for physiochemical reactions e.g., gelatinization of starch and denaturation of proteins and this will effect on pellet binding Loari, (2011).

Based to study of Muramatsu, (2015) pelleting feedstuff in birds give greater weight gain, feed intake and improve feed conversion ratio. This performance can only obtain, if the pellets remain intact and saved with healthy conditions until it ingested by birds. Also,

there are many factors effect on physical quality of pelleting as particle size, temperature, composition of feed, moisture and time. Sometimes these factors no taken in consideration during pelleting process, this will affect on intact of pellet. However, quantitative and qualitative factors effect on manufacturing process and some researches indicate feed formulation, heat processing and fat inclusion levels are the main factors effect on pelleting process. To increase physical quality of pellets should take in consideration fat inclusion restriction, liquid fat and expansion process. Date palm wastes used as replacer for dietary starch in tilapia feeding and this give an improvement in feed conversion, growth rate and efficiency of protein ratio. Also, in other study about feeding of African catfish with treated waste show an increase in body weight, protein efficiency and this mean high in growth rate due to improve of protein productive value. And this led to improve of carcass traits and blood parameters in fish. With presence of digestive enzymes in date palm seeds this explain of improvement of nutrient utilization. Results of study in Kuwait during used of date palm leaves in corporation with barley straw in feeding cows, give insignificant differences in milk yield, milk composition, weight gain of cows that fed with any type from date palm leaves or barley straw. Therefore, we can use of date palm leaves as alternative roughage in feeding cows to barley straw especially during sudden increase in cost of hay. Other study in Kuwait Al-Sabah, (2015) using of date palm leaves to produce silage by chemical and microbial treatment give a good result about milk yield and weight gain due to enhance nutritive value of roughage and become more palatable and acceptable to animals. In Oman sheep study Mahgoub, (2007) using of two types from roughage grass hay and date palm leaves treated with urea, experimental sheep fed with date palm leaves appear in good health but sheep fed with urea treated date palm leaves lower in feed intake. However, feed intake and weight gain are the same in all groups. So that we can use of date palm leaves as source of roughage for sheep feeding. During this experiment in Omani sheep, the researcher evaluated the nutritive value of date palm leaves and its effect on ruminal fermentation and results show date palm leaves highest in acid detergent fiber, lignin, neutral detergent fiber and crude protein contents. However, date palm leaves highest in dry matter and organic matter ruminal digestibility or degradability. Date palm leaves rich in fiber and its benefit for low producing animals. Addition of protein take place during processing of feedstuff to compensate balance of ruminant diets. However, feeding of date palm wastes and date pits give high in energy content and higher fiber during use date palm leaves and low in

protein. In Iran EL-Mously, (2023) there are a huge amount from agricultural wastes and the solve for these amounts, using it in manufacturing of feedstuff for animal nutrition. But date palm leaves in natural shape very low in its ruminal digestibility. Therefore, treatment of date palm leaves to enhance ruminal digestibility and become effective type of feedstuff. Ruminal bacteria responsible for fermentation of and utilization ingested material. Agricultural wastes as date palm waste appear as a source for deficiency of feedstuff components. In the experimental lambs of Rabee, (2021) that fed different treatments from waste products in feed ration, one group showed lower in growth rate and higher in dry matter compared with other groups. According for results of this study there are insignificant differences among groups in volatile fatty acids, ruminal PH, ruminal ammonia and acetic/propionic ratio. Also, there is a difference in ruminal enzymatic activity. These differences due to different types of diets and number of ruminal microbes between sheep groups. Therefore, we can use of date palm fronds in feedstuff mixture.

Feeding of lambs and other animals with pelleted form of feed very useful due to decreasing of sizeable losses of nutrient during harvesting, saving and feeding. Also, cost of labor is an important part from production cost. So that pelleting feed will reduce number of labors for handling and transport parts of feed for lambs, because it considers a compact capsule or small parts from many types of roughage that very important for animal health. Agricultural by-products best choice to induce production of animal's feedstuff especially during sudden increase in feedstuff cost and rapidly decrease in livestock sector and availability of much agricultural wastes in Palestine.

1.2 Body Weight Gain

Rapid increase in body weight within short time is the main aim of fattening operations, especially under conditions of high cost of feed. However, many other factors that can affect body gain. Infections with Pox virus, sudden change in temperature and the housing environment.

Pelleting ration give a significant increase in average daily gains in two rations from timothy meal as roughage and no significant increase was shown in pelleting ration with alfalfa meal as roughage and there is a significant increase in feed consumption with pelleting meal from timothy compared with alfalfa roughage. Feedstuff required for gain

in lambs was lower in all rations of pellets form. The main advantage occurred on the lowest quality ration Cate, (1955). In another study all lambs not significantly affected by pelleted ration in different types from content such as group from these lambs' taken alfalfa and grass in pellets containing (60-65%) roughage and in the second experiment various levels from alfalfa hay (65-100%) in pelleted ration, although maximum gain occurred when (75-90%) roughage was included in fattening ration Church, (1961).

Whole grains reduce feed conversion efficiency and body weight gain, but with pelleting form reported increase in body weight gain and feed conversion ratio. Addition of extra energy sources for animal feed give improvement in weight gain and feed conversion ratio. Maximum utilization of grains occurs with highly grinded grains and pelleting type induce feed intake and improve broiler performance Douglas, (1990). Small particles of grains that fed for sheep induce feed intake, digestibility, utilization feed, animal growth and animal health. But in ruminant animals small or soft particles of diet decrease digestibility, buffering, rumination and fermentation. But effect of grain size on ruminal microbes remains untested. Feed efficiency and average daily gain present greatly in animals fed pelleted form than those fed with un-pelleted. Pelleted diets had a greater number of bacterial responsible for digestibility process and this enhance fermentation process and increase body weight gain Ishaq, (2019).

Through study of Mahgoub, (2007), increasing profitability from animal production by enhance of nutritive value of animal feed through changing of agricultural by products to become more benefits and easily available for animal feeds. However, palm leaves rich in fiber content and low in vitamins and other minerals. And its need to treatment and supplemented with proteins and other minerals to increase and improve its nutrient values for livestock sector.

In study on Najdi lambs reported no significant differences in daily gain in weight of lambs fed with different diets from low quality of date palm leaves also the average daily gain of lambs significantly different ($P < 0.05$). control group of lambs consumed more amount from feed than other groups that fed with date supplemented diets. And this will affect on feed conversion ratio Al-Dabeeb, (2005). Processing of animal feed by pelleting were evaluated in feed of 12 eight-month-old Guernsey heifers when feed processed

ration compared with control group that fed with un-pelleted form (50% raw soybeans and 50% yellow corn) Haenlein, (1962).

According to study of Church, (1961) reported lambs fed with pelleted ration increased in body weight faster and more feed conversion ration than lambs that fed with un-pelleted ration. He showed lambs fed with pelleted forage ate more than lambs fed chopped or long forage. And due too high in feed intake this led to increase in weight gain. This feature is more obvious in lambs fed with pelleted form ration. Liveweight gain in un-pelleted group is low compared with pelleted groups and control group. There are many experiments measure of liveweight gain not feed intake and all of these experiments showed increasing in body weight gain in animals fed with pelleted form than that fed with un pelleted types. In experiment of Meyer, (1959) reported advantages by pelleted form of ration. And showed adding of water to hay led to increase consumption and body weight gain to near results that obtained by pelleted hay. This increasing due to pelleted form may related to put of fine and dusty feed in pellets and this make feed more palatable. Pelleting form of feed that made from copra meal reported increase feed intake and body weight gain and this enhance productivity of poultry section and provide other sources than as by products to produce new form of pelleted feed Sundu, (2009).

The results of our study give an average weight gain about (2-2.5kg)/week in each group. It's an excellent percent for using different levels of pelleted date palm leaves. Pelleted form very suitable for developed of ruminated animals, because its take longer time within rumen and well degraded, fermented and absorbed of VFAs occur readily. Also, luminal passage for this type from feedstuff is slow and this provide a good character for its digestibility and absorption easily than soft type of feed. In addition, presence of DPL in feedstuff provides enough time for fermentation and absorption of vital and useful elements without any side effects.

1.3 Feed Conversion Ratio

The feed conversion ratio in calves fed with pelleted barley-based diet in fattening trial was not significantly affected Kellaway, (1973) there are no significant differences in weight gain in lambs fed with different two ration from low roughage 29% alfalfa hay and high roughage (59%alfalfa hay) pelleted or un-pelleted with or without stilbesterol. Lambs fed with pelleted low roughage had an improvement by 12% in feed efficiency and pelleting high roughage ration increase weight gain and feed consumption, but not feed efficiency Church, (1961). Jordan, (2010) reported significant increasing in feed consumption and weight gain in lambs that fed with complete pelleted rations that contained (50-100%) roughage. however, feed conversion efficiency was improved by pelleting ration in only one trial. Also, gain rate and feed consumption were not improved by pelleting of ground ear corn. Conversely, lambs fed only pelleted alfalfa hay gained significantly faster than lambs that fed with only chopped hay.

Reports of Roy, (2010), showed better of feed conversion efficiency and daily weight gain in ration from pelleted legume followed by grass-based pellet ration. The feed conversion ratio in diet contains pelleted legume is low followed by grass pelleted diet but ration contain pelleted legume is maximum effect on growth performance of Black Bengal goats.

There are significant differences ($P \leq 0.05$) in feed conversion ratio during replacing of clover hay with date palm leaves in feeding of rabbit by comparing groups of experiment with control group. And this provides an indication for rabbit that fed with different levels from date palm leaves increasing in its body weight more than rabbits that fed with normal ration (control group). This increasing may be due to higher palatability and utilizability of date palm leaves within diets. Also, there's increase in average daily gain of rabbits received of date palm leaves with in diets Abdel-Azeem, (2007).

There is significant difference in feed conversion ratio between group of broilers that fed with different forms from feed as pellets, mash and crumble. the highest feed conversion ratio in group fed with mash and this indicate low in feed conversion efficiency. But the feed conversion ratio is low in groups fed with pelleted and crumble type. However, these groups are high in feed conversion efficiency. The same results were obtained by Jahan, (2006), and that feed efficiency is better in group fed pellets than its fed mash.

Howlider, (1992) showed increased of feed conversion ratio in pellets form by 5.9% and in experiment of Jahan, (2006) significantly improve in feed conversion ingroup fed with crumble-pellet type. Also, Reece, (1985) founded improved of feed conversion ratio un crumbling form by 1.5%. feeding lambs with pelleted form of feed provided a double growth promoting value of hay. Lambs fed pellets showed an average daily weight gain 0.42 lb and feed conversion ratio at 1:8.52 compared with 0.12 lb and 1:18.46 for lambs fed with chopped hay. There are insignificant differences among groups of animals. And lambs fed individually with pelleted form gained significantly better than those fed with chopped hay. This gives an insignificant difference among groups of lambs that fed on chopped hay and lambs fed with pelleted feed. Merwe, (1962). Through study of Zatari, (1990) noticed improving in body weight gain at 7-week of age chicken by pelleting of sunflower grains. Pelleting effect more pronounced in diets containing 10-20%of sunflower compared with pelleted of control group. This increase in body weight gains due to increase in feed intake due pellets. Also, efficiency of feed improved with pelleting type compared with normal sunflower diets. And insignificant effect on feed efficiency result from using of sunflower within diets. However, metabolizable energy due to nitrogen and utilization of nutrients were improved through pelleting type. But metabolizable energy reduced with sunflower diets.

Stanley, (2012) reported influence of pelleting type on cecal and jejunal microbes and this cause decrease in feed intake and reduce feed conversion ratio and all of these affected on growth performance of birds. Larger numbers from lactobacilli with in jejunal microbes. However, insignificant differences of feed conversion ratio among birds of study. This effect of pelleting due to long-time of digestibility and retention of feed with in intestine.

Zimonja, (2008) used of oat hulls and pelleted form of feed and founded, oat hulls made pellet more elastic and provided it higher resistance for breakdown. Diets contained oat lowered energy consumption compared with wheat. But no any effect for fiber inclusion on energy consumption. He showed significant increase of intestinal viscosity of broiler birds fed with pelleted feed. Viscosity of intestine appeared doubled increase with wheat source feed and greater with oat containing diets. During feeding of birds with wheat containing diets he noticed decrease of feed intake and weight gain, but feed conversion ratio wasn't affected. And with pelleted feed containing of oat reported decrease of feed

intake and weight gain but there is an increased of feed conversion ratio. Also, metabolizable energy and digestibility of dry matter with wheat diets was improved regardless of intestinal viscosity and other types of feed.

Many researchers as Winowiski, (1995) and Phesatcha, (2021) reported during evaluation of different type of feed in dairy cows' sector in comparing with pelleting type. They noticed dairy cows fed with pelleted form consumed feed more rapidly than other types of feed. Also, in study with rabbits they founded using of fine or soft type of feed cause many problems in rabbit due to direct contact of rabbit's nostril with feed during feed intake and fie feed is dusty and this cause a stress factor with respiratory system of rabbit and led to respiratory problems. This explains why pelleting type is best choice in rabbits and other animals Winowiski, (1995). Through of McCroskey, (1961) showed significant increase in feed intake and weight gain with steers that fed pelleting rations. Also, improved in feed efficiency with pelleted feed. Carcass cuts, chemical and physical nature of carcass not affected with pellet type. And insignificant effect on digestibility with pelleting feed but it's reduced with fiber content feed.

1.4 Nutrients Digestibility

The high fiber content of DPL resulted in higher digestibility of its nutrients (Khalifa, (2019); Aziz, (2020); Supian,(2021); Gad, (2010) and Aziz,(2019). Replacing 33.3% from clover hay by DPLs increased digestibility of CP and CF ($P \leq 0.05$) compared with control group in rabbit. Also, using of DPLs as substitution at 100% lead to increases ether extract (EE) digestibility ($P \leq 0.05$) than other groups. However, there is no significant differences in digestibility of OM, DM and NFE El-Bordeny,(2011).

In another experiment sowed increasing in value of digestibility ($P \leq 0.05$) of crude protein and crude fiber in comparison among experimental groups and control group during replacing of clover hay by 12% date palm leaves. Also, digestibility of ether extracts higher in groups fed with 36% from date palm leaves than other groups. Lowest value of ether extracts for control group in comparison with groups that fed with different levels from date palm leaves its show highest value in groups received 36% followed 24 and 12% from date palm leaves respectively. But insignificant differences in digestibility that observed in organic matter, dry matter and nitrogen free extract. Groups fed with 12%of date palm leaves provide increased in total digestible nutrients than other groups. And

this may be due to increase in digestibility of CP, CF, and ether extract among groups. Mahrous, (2021).

Insignificant difference in organic matter and dry matter in steers fed with different types from pelleted feedstuff. Ipharraguerre, (2002) founded insignificant differences in dry matter and organic matter during replace of corn starch with different source for fat to reach 5%of fat in each diet. Similar results in experiment of Hussein, (1995) reported no effects on dry matter during use of canola fats at level 5% in diets containing different levels from forage in steers' feed. Also, there's no differences in dry matter and organic matter in ration provided for steers that contain low quality of hay with canola seeds. These seeds have no effect on ruminal digestibility.

Due to pelleted form of feed in ration this cause increase feed intake and this provide rapid rate from digestion in rumen.

This speed of digestion provides faster passage of feed within digestive tract. Smallest hay parts more radially absorbed within gut. So that pelleting reduces size of ration and make feed more palatable. Digestion process become more rapid and easier in pelleted and chopped roughage because the limits of lignification digestion in the same degree for both types of feed. So that grinding and pelleting of feed doesn't affect on feeding values. In this study nitrogen result from digestion of alfalfa doesn't proceed in the same manner within digestive tract. Feeding of sheep with constant amount of feed with12 hour apart, time of feeding didn't affect on lignin/nitrogen ratio. We can calculate total nitrogen content through out of tract. Nitrogen result from both type of feed (pelleted and chopped) 50% was lost and absorbed as ammonia. Annison, (1956) reported no evidence absorption for amino acids from rumen. By Gray, (1956) that just 40 percent from nitrogen of alfalfa reaches abomasum but 100 percent from nitrogen of wheat hay reached to abomasum. Also, Balch, (2007) noticed loss of nitrogen in large quantity from tureen.

Large quantity of nitrogen present within small intestine. Ratio of lignin /nitrogen was calculated 10.7 and 14.6 gm of nitrogen moved to abomasum but 21.4 and 22.6gm of nitrogen through small intestine of pelleted and shopped hay of animal feed respectively. However, 5.3 and 5.4 gm of nitrogen present in animal feces. This increasing within small intestine may be due to enzymes and other secretion in the gut. And this mixing from nitrogen (microbial, food nitrogen and endogenous) will affect on overall amount of

nitrogen and amino acids of animal body. Meyer, (1959) founded amount of nitrogen in the digestive system of animal equal to amount of ingested proteins.

During study on lactating dairy cattle with pelleted feed noticed significant increase feed intake and digestibility of crude protein and neutral detergent fibers. Also, improved of ruminal propionate and ammonia nitrogen concentrations. But ruminal acetate, ratio of acetate: propionate, methane production and numbers of protozoa were decreased ($p<0.05$). pelleted feed and crude protein enhanced nitrogen absorption and utilization and induce microbial nitrogen synthesis. And reported increased of milk production. Pelleted feed with concentrated mixture includes 16% crude protein at dose of 150 g/cow/day could increase end-products of ruminal fermentation, methane production and microbial protein synthesis, this led to increase of milk production in lactating dairy cows. Phesatcha, (2021).

Malik, (2023) founded increased of dry matter intake and body weight gain with pelleted total mix ration. Feeding goats with pelleted mixed ration spent less time than those fed with mash diet. Pelleted mixed ration for goats induce feeding rate to be higher than feeding rate of goat fed with mash diet. Also, size of diet in goats fed with pelleted mix ration larger than those fed with mash diets. But time of rumination with pelleted mix ration lower than it with mash ration. With mash ration, laying time(min/d) and laying frequency were lower than pelleted mix ration. Nutrient digestibility was higher in goats fed with mash ration than those fed with pelleted mix ration. However, balance of nitrogen wasn't affected by any type of diet. Weight of carcass was higher in goats fed with pelleted mixed ration than those fed with mash diet.

In another study, feeding of pelleted by-products with high fat diet decreased ruminal propionate concentrations without any effect on total volatile fatty acids or acetate concentrations. Crude protein digestibility and ruminal ammonia nitrogen were higher than those of control or other groups. Digestible energy reduced during feeding of pelleted wastes with high fat diet, but increased with rich-starch diet or control group. Minimal effect for pelleted type on crude protein. Excretion of nitrogen wasn't affected by any treatment. For pelleted type no harmful effect on ruminal fermentation or apparent digestibility Zenobi, (2015).

Through study of Nasset, (1955) consider number of amino acids of intestinal contents not affected by changing of non-protein to protein containing meal and supplementation of amino acids to poor quality protein may be produced by intestine. Also, addition of nitrogenous compound to feed will change nutritional value of animal's feed Meyer, (1959).

Study about broiler and effect of feed types show similarity in weight gain with different groups but with nitrogen digestibility appear lower with diets contain pelleted form feed and there is pelleting feed decrease starch digestibility compared with control diets. According for digestibility of fat it reduced with pellet type. Same trend noticed with calcium digestibility. There is no effect for P digestibility by pelleting feed. Pelleting feed reduce metabolizable energy compared with others. A greater feed intake and nutrient absorption with pelting treatment without effect on digestibility. So that pelleted feed induces feed consumption and improve broiler performance than other types from feed Abdollahi,(2014). Experiment of Massuquetto,(2020) pelleted feed enhances performance of broiler chickens due to increase feed intake to compensate decreasing of energy compared with other diets that enhance feed intake without changing of energy. With pelleted form feed cost will reduce and quality of carcass improved.

1.5 Blood Metabolites

Feeding lambs with pelleted total mix ration increased concentration of high-density lipoprotein cholesterol ($P < 0.05$) and decrease of low-density lipoprotein cholesterol in plasma ($P < 0.05$) and it was beneficial to health of lambs through modulating cholesterol metabolisms. Also, pelleted total mix ration change of ruminal fermentation and increase the ratio of acetate to propionate in ruminal fluid ($P<0.001$) Uys, (2022).

Mahajan, (2022) reported significant increase ($P<0.01$) in blood glucose and concentration of total blood protein with significant increase in triglycerides in lambs fed with pellets. In study of Hassan, (2016) showed soluble carbohydrates and other digestible nutrients in lambs' diet and this led to increase in blood glucose levels also there's increase in serum proteins and albumin and this effect on hepatic cells. P-value are significantly higher between groups of study. Abdel-Aziz, (2015), recorded in lambs and goats the biological treatment for ration will increase blood proteins (total proteins), blood glucose, urea and AST. Ration supplemented with treated rice straw biologically or

chemically and fed for lambs recorded higher values of blood proteins (albumin and total proteins), urea and AST. Also, they show there is no changes in serum globulin due to biological treatments.

El-Bordeny, (2010) show there is no any effect for adding of fibrolytic enzymes to buffalo diets on blood parameters. Also, Kholif, (2016) found in results of his study on lactating buffalo no changes in blood proteins (albumin, globulin and total proteins), urea and cholesterol. Also, AST and ALT not affected by treatments. However, blood parameters, AST, ALT, urea concentration and alkaline phosphatase not affected during addition of fibrolytic enzymes to dairy cow rations EL-Bordeny, (2021).

An experiment of Malik, (2020) growth performance affected with daily intake of dry matter and this affected by type and physical nature of feed. Goats fed with total pelleted mix ration had greater of dry matter intake compared with other types of rations. He noticed goats fed with 15% of wheat straw regardless type or physical nature of feed were higher in total dry matter intake and daily dry matter intake. In his experiment initial body weight was similar in all groups of treatments and average daily gain, total gain of body weight and final body weight were higher in groups fed with total pelleted mix ration than other groups. There is a significant difference in daily dry matter intake and average daily gain among groups of experiment. Feed: grain ratio was grater in group fed with 25% of wheat straw as compared with group fed with 15%of wheat straw. Also, consistency of feces was influenced by straw level its appear higher fecal score in group of 15%wheat straw than that fed with 25% wheat straw. Ruminal PH was present higher in total concentrate mix ration compared with total pelleted mix ration. so that, body gain and structural measures weren't affected with physical nature of feed and straw level of diet. Digestibility of nutrients, dry matter, crude protein, neutral detergent fiber, acid detergent fiber, organic matter and ether extract were the same in all treatments of experiment. Also, nitrogen intake, fecal nitrogen, nitrogen balance, urinary nitrogen and retained nitrogen were not affected by type and level of feed in the experiment. Liver enzymes ALP, ALT, AST and bilirubin present similar in all treatments in experiment regardless to physical nature and straw level within diet. However, glucose, blood urea nitrogen and cholesterol were insignificantly different among groups. Also, white blood cells, red blood cells, hemoglobin, lymphocytes, monocytes and hematocrit presented in same range values.

Mohamed, (2022) found there is no significant differences in means of serum glucose in all tested diets of groups in lactating goats. However, a non-significant decrease in serum urea concentration in animals fed with biologically treated rice straw and animals fed with untreated rice straw Gado, (2006). According to El-Shahat, (2010) using of biological treatment in diets fed to rabbits resulted no any deleterious effect on renal functions**.** In addition**,** Mohamed, (2022) found in his study insignificant differences in serum creatinine in lactating goats fed with ration supplemented with cellulolytic enzymes.

Feeding of beef cattle with pelleted feed containing Sulphur and fresh cassava root affect on thiocyanate concentration at different time periods ($p < 0.01$). cattle fed with pelleted containing Sulphur at 30g/kg and fresh cassava root at 20g/kg will increase mean of blood thiocyanate to highest level. And no effect found with pelleted Sulphur and fresh cassava root on volatile fatty acids ($p > 0.05$). However, feeding of pelleted Sulphur at 30g/kg increased volatile fatty acids at zero and four h after feeding but concentration of propionate enhanced at four h after feeding ($p < 0.05$). Moreover, insignificant changes founded at any parameter between treatments and among effect of pelleted Sulphur and fresh cassava root supplementation ($p > 0.05$). Using of fresh cassava root and pelleted Sulphur in mix ration at 20g/kg and 30g/kg respectively induce digestibility of nutrients, disappearance of cyanide and microbial numbers without any harmful effect on ruminal fermentation process Prachumchai, (2021).

With experiment of Castillo, (2006) reported animals fed with pelleted feed more stable acid-base balance than other group that fed with un-pelleted feed. But there is a risk to occur grain acid overload, due to lower of bicarbonate and base excess with higher levels of L-lactate. feeding of birds with variously processed feedstuffs affected on blood sodium, chloride concentration and white blood cells. Also, affected on partial pressure of blood carbon dioxide and level of total blood carbon dioxide in veins. And using of different types from feedstuffs affected on acid-base homeostasis and immune system in cecal tonsils Liermann, (2019).

Salama, (2018) reported insignificant increase ($P < 0.05$) in concentration of total serum protein, globulin and albumin in rabbits that fed with different levels from date palm leaves comparing with control group. According to Gatel, (1994) showed a positive relationship between plasma protein and dietary protein concentration. Also, he is

reported low levels of plasma proteins may be due to decrease in absorption of protein or increase of protein losses. Craig, (1991) reported an albumin was affected more easily than globulin by nutritional factors, e.g., restricted in protein intake due to their different functions, site of origin and its metabolism. Ashour, (2014) considered concentration of albumin as a reflection for ability of animal to synthesize and store of protein. And this means the change in albumin level give an indication for liver function. Globulin is synthesis by lymphatic tissue but albumin synthesis in liver Davidson, (1996).

Abdel-Azeem, (2007), reported normal values of total protein in rabbit between 4.9 and 7.2 g/100ml and normal values of blood albumin ranged 3.3 and 5.1g/100ml but normal values of globulin are between 1.85 and3.6 g/100ml. In other study about effect of pelleted mix ration with temperature on blood metabolites, there were no any interaction between temperature and total pelleted ration on blood metabolites, except for concentration of plasma proteins was higher compared with control. And urea N concentration, glucose and alkaline phosphatase were higher in lambs fed with sorghum compared with those fed by pelleted mix ration Li , (2021).

1.6 Carcass Traits

Studies about effect of using date palm leaves are limited. Beshara, (2018) reported that, weight of slaughter, carcass weight and weight of empty body were not affected by biological treatments in rabbits. El-Bordeny, (2011) recorded insignificant effect (P> 0.05) in carcass traits due to fed in rations containing date palm leaves. In another study there's no significant differences in feed conversion ratio and carcass trait in merino lambs fed with complete pelleted diets but showed a higher level from intramuscular fat and saturated fatty acids Andrés, (2019). Omani sheep seem in good health with lack illness signs that feeding with by product from concentrate and roughage of Prosopi pods but it's given a problem in goats Mahgoub, (2007) also all blood values appear normal in this study with no indicator for disease.

Using of arrow leaf and chicory clover or lucerne give heavy weight in lambs faster than lambs fed with other forage types. This due to differentiate minerals and crude protein content in forages with an exception in lambs fed with brassica Gerlane , (2016).

There are insignificant differences between all groups from Assaf lambs during feeding it with different levels from crushed date palm leaves and the results appear similar as (50.43, 50.05, and 49.66%) involve control group (50%). We showed the food that given for lambs in fattening trail was nutritious and useful for animals. During study of muscle mass, thickness of bone and lipids in all lambs within fattening trial we found similarity in distribution comparing with control group. This provides a good picture about feed that was eaten was beneficial and give well form about distribution of fat and red muscle in the body. So that we can use of date palm leaves or its wastes in feeding of lambs as alternative form for corn and barley has no adverse effect on lambs' health and give a good result through distribution of fats in lamb's muscles. Also, there is a study about relationship between date palm leaves and some growth hormones and this help to increase growth rate in animals by increasing levels of amino acids in blood stream (Kewan, (2012); Sami, (2016).

Kumari, (2012) reported insignificant differences in preslaughter body weight, carcass weight, empty body weight and dressing percentage. Also, edible cuts and nonedible parts appeared insignificant. Bone and meat also presented with no significant differences among groups of experiment. Types of feed and it’s percent from roughage to concentrate didn’t affect on composition of meat. Increasing of concentrate with in diet led to increase fat content of meat. Results of Phillip, (2007) showed increased of carcass fatness as a result for increased concentrate ratio with in diets and there were no changes on bone or meat. Alteration of fatty acid components of carcass fats due to concentrate level with in diets. Feed intake, percent of feed: gain, average daily gain, initial and final body weight didn’t differ significantly among starch sugar by-products groups and control group of experiment. Insignificant difference between groups of steers in carcass traits, but in dressing percentage a greater significant difference among groups that fed with starch sugar by-products. According for fats, unsaturated fatty acids was lower and saturated fatty acids was greater than animals of control group. And ratio of unsaturated fatty acids to saturated fatty acids was lower in groups fed with starch sugar by-products than control animals Choi, (2022).

Liermann, (2019) noticed pelleted feed for poultry cause enlargement in proventricular and increase gizzard weight and length. With normal type of feed showed smaller and heavier gizzards compared with other types of feed except for pelleted feed, this cause

shortage with feed intake due to organs traits. Also, jejunum appear heavier in chickens fed with pelleted feed compared with other groups. By hydrothermally treated feedstuff noticed an effect on ratio of intestinal segment to length of total small intestine (duodenum, jejunum) ($P < 0.01$). Other types of feed (non- compacted) caused lowest of weight to length ratio. By Mohamed, (2022), there were no differences between groups of experiment that fed with total pelleted mix ration and others fed with control, also no any effect for temperature and mixed pelleted ration on dressing percentage. Dressing percentage in lambs fed with sorghum was lower than that fed with pelleted mix ration. And weight of carcass and dressing percentage decreased during increase of temperatures. But there's an effect for ration type on meat color such as longissimus and mid gluteal muscle with a larger value in group fed with pelleted mix ration. There are no effects on carcass weight and dressing percentage during feeding lambs with pelleted form from cereal ergot. Also, no evidence abnormalities health in lambs' liver or carcass fats depots. Stephanie, (2017).

Tufarelli, (2010) reported a greater effect for pelleted feed not only on growth performance and feed utilization but also on meat and carcass characters. Rabbits fed with pelleted type of feed appear with a significant lower part of skin and abdominal lipids compared with other groups fed with un-pelleted form. Reducing feed parts size caused a decrease loss of rabbit carcass. Also, meat color parameters provide an indication for significant difference in meat color according for feeding type. These beneficial effects such as feed utilization, growth performance, and nutrient digestibility refer to pelleted type of feeding.

1.7 Economic Efficiency

Results show the differences between groups for cost of concentrate feed are insignificant. The total feed cost of weight gain in all groups that fed with different levels of DPL insignificantly different with control group. Providing lambs rations of pelleted date palm leaves and concentrate without supplement enzymes lead to decrease cost of feed and improve total cost of gaining compared with control groups. Karkoutli, (2019) using of date palm leaves in different levels and biological treatment will improve economic efficiency than use of wheat straw alone as control group. So that cost of gaining one kg will decrease gradually by increasing DPL. Abd El-Rahman, (2014) recycling and biological treatment of agriculture wastes will increase its nutritional value and become more benefit for feeding animals. We can calculate of feed efficiency for animals fed with treated and untreated rice straw. Abdelhamid, (2009) founded biological

and chemical treatment of rice straw (TRS) and corn stalk (TCS) will reduce feed cost that used to produce one kg of live body weight gain by 15.54 and 16.82% respectively in lambs. And this in agreement with Abdel-Azim,(2011) treatment rice straw and treatment corn stalk reduce feed cost than untreated rations. Abdel-Azeem,(2007) founded increasing levels of palm leaves and reducing level of clover hay in animal ration led to gradual decrease in feed cost.

Economic efficiency due to using of cucumber vines straw as replacer for cloved hay and produced pelleted feed to fed rabbits was negatively affected. Replaced of clover hay by 22.5% from cucumber vines straw, growth performance and economic efficiency may reach up to 30% Maaty, (2014).

El-Bordeny , (2011) found gradual decrease in feed cost during replace of alfalfa hay with palm leaves in 10% and 20%, while 30% insignificant decrease in feed cost due to increase feed intake in this group. During feeding of lambs with 12% from date palm leaves within diet in fattening trials we show significant economical profitability. So that using of date palm leaves without any adverse effect on growth performance and blood metabolites of lamb will lead to good economical profitability Hassan,(2021).

Chapter Two

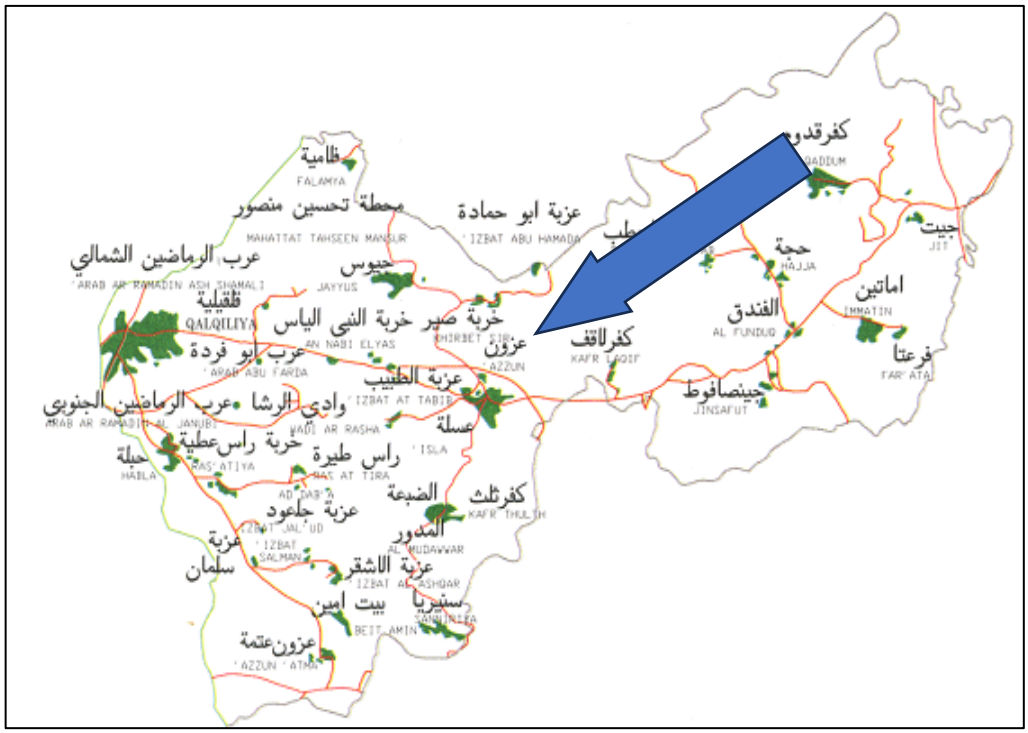
Materials and Methods

2.1 Study Site

The study was done on private farm in Qalqilya at Azzoun town (figure 1). This farm includes more than 150 Assaf sheep for production of milk beside lambs fattening.

Figure 1

Experimental Site



2.2 Animals and Experiment Design

A total 24 Awassi lambs soon after weaning at age (2-4) months were used in the fattening trial for a duration of 70 days. Lambs were stratified for 3 experimental groups plus the control group.

Lambs were ear tagged and weighed before the beginning of the experiment.

Lambs were housed in individual shaded pens (0.75 × 1.5 m) shaded with *ad libitum* access to feed and water. Each lamb was considered a replicate (figure 2). Lambs were vaccinated against pesti des petites ruminant (PPR), pox disease (POX), foot and mouth disease (FMD) and enterotoxaemia especially the clostridium perfringens type C and D.

Lambs treated against external and internal parasites. Mineral blocks were offered for lambs. The control group lambs were fed a regular fattening ration of corn-soybean based diet plus wheat straw. The pelleted (DPL) was fed at levels of 25, 50 and 75% as part of wheat straw (Table 1). Lambs were fed individually and monitored for body weight and feed intake at weekly basis. Period of this study was August to October, 2022. Lambs were fed at (5:00 am) in the morning and (5:00 pm) in the evening.

Every lamb separated alone with easily reach to feed and water source, each group from lambs for every treatment avoided separately from others, every group consist from six lambs and were fed with same treatment (control group: lambs fed with natural diet without any change or date palm leaves in its roughage, group (2) of 75% of date palm leaves were fed with concentrate and taken 75% date palm leaves in its roughage and 25% wheat straw, group (3) of 50% date palm leaves were fed by concentrate and 50% from its roughage contain date palm leaves and 50% wheat straw and group (4) of 25% of date palm leaves were fed with same amount from concentrate in all groups but its contain 25% date palm leaves and 75% wheat straw in its ration.

All lambs fed with same amount from concentrate but the differ among groups in percent of date palm leaves and all lambs with same character.

Feeding lambs with pelleted form of feed. And the pellet capsule contains all components of ration (concentrate, wheat straw and date palm leaves).

All ration were calculated to meet NRC, (1985) recommendations.

Figure 2

Experimental Design

2.3 Experimental Rations

This study includes 4 group Table 1:

Group 1: control group, where lambs fed normal fattening ration 1kg from concentrate 18% crude protein and 0.7 kg of wheat straw.

Group 2: lambs fed with 1 kg of concentrate 18% crude protein and 75% of DPL and 25% of wheat straw.

Group 3: lambs fed with 1 kg of concentrate 18% crude protein and 50% of DPL and 50% of wheat straw.

Group 4: lambs fed with 1 kg from concentrate 18% crude protein and 25% of DPL and 75% of wheat straw.

Representative sample of all feed ration were analyzed in National Agriculture Research Center (NARC) as dry matter basis.

Table 1

Rations and chemical composition used in total mix ration of lambs

Ingredient	G1	G2	G3	G4
Concentrate feed (18% crude protein)	70	70	70	70
Wheat straw	30	7.5	15	22.5
Pelleted DPL	0	22.5	15	7.5
Total	100	100	100	100
Chemical composition %				
Dry matter	87.89	85.16	87.90	87.97
Crude protein	15.80	16.50	16.20	16.01
Ether extract	3.17	3.40	3.35	3.20
Crude fiber	9.03	9.08	8.86	9.01
Acid detergent fiber (ADF)	6.10	7.10	8.47	6.30
Neutral detergent fiber (NDF)	14.71	14.60	17.30	14.81
Ash	6.21	6.50	6.83	6.25
Ca	1.10	1.20	1.11	1.13

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

Figure 3

Experimental ration after pelleting process

2.4 Preparation of DPL

2.4.1 Raw ingredients

The dry date palm leaves (DPL) figure 4A were collected from Azzoun and Qalqilya area and transported to the experimental site. The raw palm leaves were sun dried then chopped as in figure 2.A prior to the pelleting process as in figure 4.A in appendix.

2.4.2 Preparing of feed for lambs

We are mixed all content of feed for fattening trial (concentrate, crushed wheat straw and crushed date palm leaves) in the same time with different percent from date palm leaves according to group needs as 25%,50% and 75% from DPL and 75%,50% and 25% from wheat straw respectively figure 3.A and then use pelleted machine to change form of feedstuff to new pelleted form figure 4.A to become more edible and acceptable for lambs of fattening trial.

2.5 Digestibility measurements

Three lambs from each group were used in the digestion trial. A 7 days adaptation period prior to a six days total collection period. Lambs were monitored for feed daily intake and fecal matter. Feed refusals were also monitored. Samples of feeds and fecal matter were collected for measuring feed digestibility.

Digestibility was calculated according to the following formula:
Digestibility=feed intake-feed excreted /feed intake *100%

2.6 Blood samples and blood analysis

At the end of the fattening trial, blood samples were collected from jugular vein of three lambs of each treatment. Serum was separated through centrifuge at 3000rpm for 15 min and stored for later analysis.

Stored serum was analyzed for total protein (TP) Armstrong, (1964), albumin Basil. Doumas, (1971), creatinine Hafez, (2013), urea nitrogen On Nutrition, (1992), glucose and total cholesterol (TC) Mahrous, (2021).

Reitman,(1957) method we can determine calorimetrically alanine aminotransferase (ALT) and aspartate aminotransferase (AST). Globulin concentration was determined by total protein minus albumin.

Total protein=globulin +albumin

Figure 4

blood sample collection

2.7 Chemical analysis

Feed and fecal samples were analyzed for dry matter, ash, crude protein and ether extract following The Association of the Official Analytical Chemists AOAC William, (2000), samples were analyzed for dry matter (DM) through air forced oven at 100c for 24-hour method 967.03, ash in ashing furance at 550c for 6-hour method 942, crude protein by Kjeldahl procedure and ether extract (Soxtec procedure, Soxtec system HT 1043 Extraction Unit, TECATOR, Box 70, Hoganas, Sweeden). Also, samples were analyzed for acid detergent fiber (ADF: ANKOM2000 fiber analyzer, ANKOM Technology Corporation, Fairport, NY, USA) and neutral detergent fiber (NDF: with stable-amylase and sodium sulfite). Values for ADF and NDF are present in ash based to Van Soest, (1991).

Samples of feed and feces were analyzed in National Agriculture research center (NARC).

2.8 visceral organs and carcass cuts

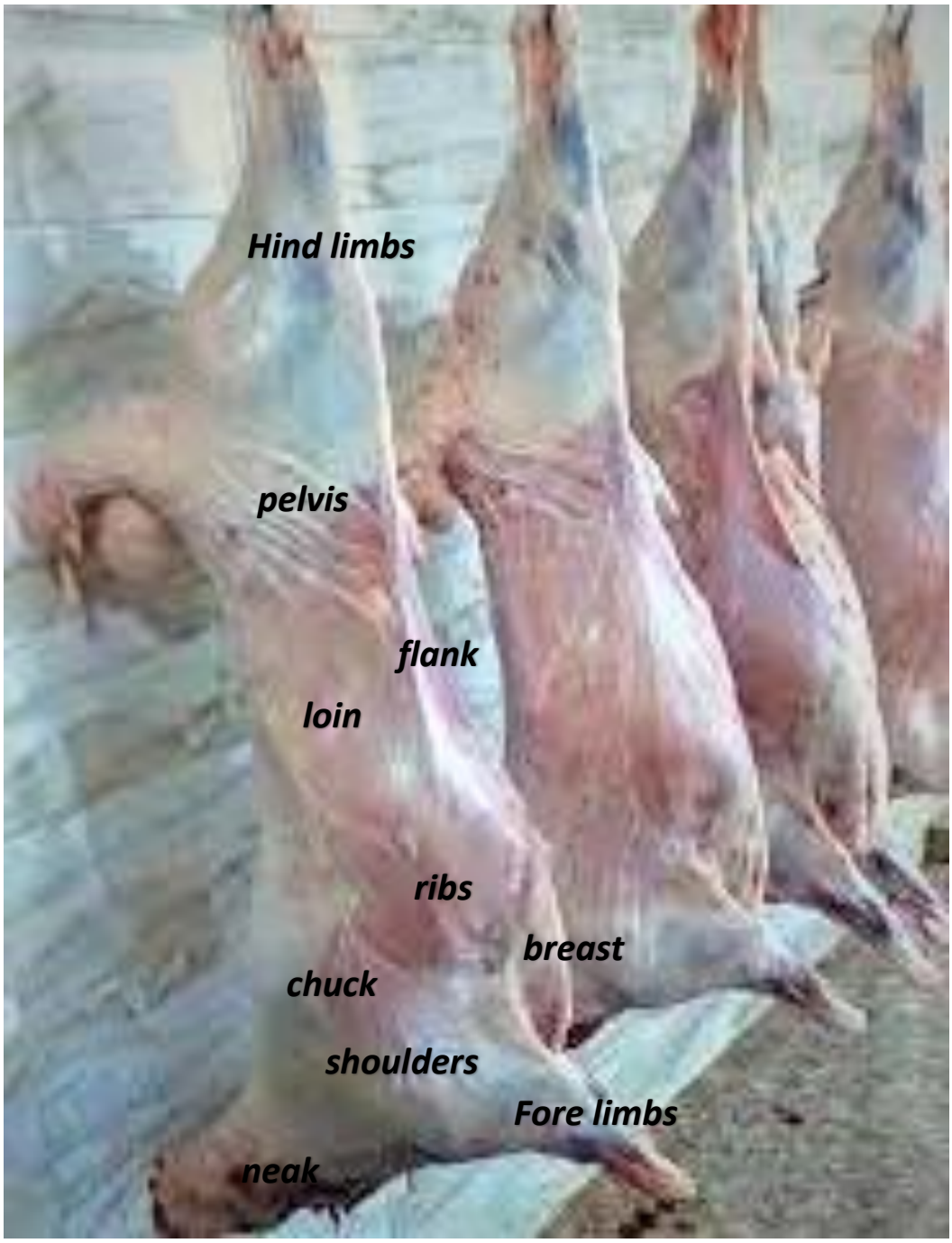
At the end of experiment, 3 lambs from each treatment were slaughtered. Before slaughter, lambs were fasted for 18 hours. Lambs live and hot carcass weights were recorded for each lamb. Lambs were eviscerated and visceral organ mass was recorded. The considered visceral organs were liver, spleen, heart, kidney and lungs.

Carcasses were divided longitudinally in two sides, left and right side and then divided to four parts right four quarter, right hind quarter, left fore quarter and left hind quarter were weighted and each part from these quarter weighted alone such as breast, chuck, neck, fore limb, hind limb, loin, shoulders and pelvis figure 5. Weight of digestive tract expressed as difference between full and empty weight of digestive tract.

Every part from carcass weighted and divided from whole weight and then multiply with 100 to determine its percent.

Figure 5

Carcass cuts



2.9 Statistical analysis

Weight of lambs at the beginning of experiment, weight at the end of study and weight every 7 days were recorded. Feed conversion ratio, average daily gain, total weight gain and feed cost were calculated. The one-way ANOVA was used to compare between these variables and blood variables through following statistical model:

$Yij = \mu + Gi + Eij.$

where: Yij= 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 4), 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.

Chapter Three

Results and discussion

3.1 chemical composition of date palm leaves

The chemical composition of the ingredients (date palm leaves, concentrate and wheat straw) used in the experiment is shown in table (2).

Chemical compositions were analyzed in National Agriculture Research Center (NARC).

Date palm leaves (DPL) appear to be higher in crude protein (CP) and acid detergent fiber (ADF) than wheat straw but it is similar in ash and dry matter. However, DPL lower in crude fiber and NDF than wheat straw. Khalifa, (2019) recorded that date palm leaves were higher in CP, CF, OM, DM and EE than wheat straw. But wheat straw higher in ash than date palm leaves, and two sources are the same in nitrogen free extract (NFE).

Table 2

Chemical composition of feed that used in pelleted ration, %:

Chemical composition%	Concentrate	Wheat straw	Palm leaves
CP	18.00	4.10	4.50
Fat	3.50	7.20	2.80
CF	6.00	24.40	22.60
Ca	1.30	0.16	0.10
P	0.60	0.04	0.10
DM	87.00	92.90	92.10
ADF	5.50	9.70	28.00
NDF	11.00	52.00	55.00
Ash	6.00	10.00	10.00

CP: crude protein, CF: crude fiber, Ca: calcium, P: phosphor, DM: dry matter, ADF: acid detergent fiber, NDF: neutral detergent fiber,

Crude protein content of date palm leaves was approximately the same that in wheat straw. Also values of crude protein in our study was higher than recorded values in previous studies (Mahrous, (2021); El-Waziry, (2016). The crude fiber in palm leaves was lower than it in wheat straw 22.6 vs 24.4%. El-Bordeny, (2011) showed that the value of CF recorded 38.21% similar to the value of palm leaves that determined by Mahrous, (2021) as 42.14% and El-Waziry, (2016) as 34.9% were higher than that of our study.

The value of ether extract in palm leaves 2.8% was lower than it in wheat straw 7.2%. This was with disagreement with results recorded in previous research as Khalifa, (2019) 2.31%, Dayani, (2012) 2.1%, Khalifa, (2019) 2% and El-Waziry, (2016) 3.5%.

According to ash content in palm leaves, it was similar to that of wheat straw 10%. However, the recorded value of ash in previous researchers were 12.9% Hassan , (2021), 11.6% Dayani, (2012), 8.25% Khalifa, (2019), and 10.03% El-Waziry, (2016)**.**

3.2 Daily gain

The daily gain values are presented in table 3. Level of pelleted DPL had no effect on weight gain. Similar gain was noticed in lambs fed with wheat straw and DPL.

Meyer, (1959) reported an advantageous pelleted for both lambs and steers in fattening trial. This shows an increase in feed intake and weight gain when fed animals with pelleted form compared with long hay. Also, addition of 30% from concentrate to pelleted ration will not significantly increase gain in either steers or lambs, but this increase feed efficiency. Lambs fed with 30% concentrate with pelleted ration give better feed efficiency than others that fed with chopped hay and barley. However, no significant effect in performance of these animals. Steers fed with 60% concentrate pellets consumed less feed, less body gain, and their carcass contained less fat than other steers. Also, pellet fed steers more efficient in converting their feed to gain.

Esplin, (1957) found that feeding groups of lambs with pellets caused less consumption of feed per unit of production compared to consumption of the un-pelleted feed. However, there were no significant difference between lambs fed pelleted and other fed un- pelleted feed.

Beauchemin, (2003) showed that using of enzymes in feed ration enhance digestibility and provide energy or nutrients for ruminal microbes, lead to improve body weight in lambs.

Table 3

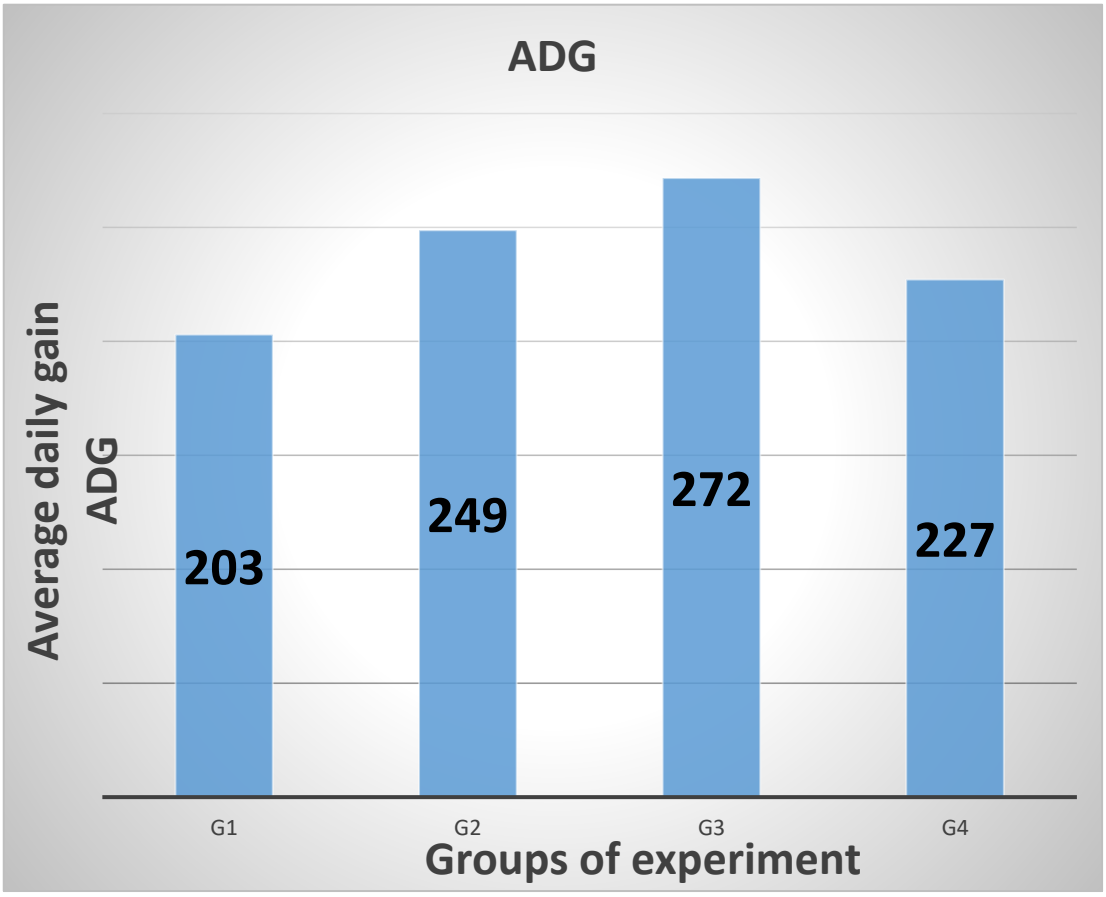
Performance of fattening lambs fed with total mix ration

Item	G1	G2	G3	G4	p-value
Feed intake(kg)	82.15	85.58	79.30	100.35	0.62
Initial weight(kg)	28.90	26.90	25.50	32.20	0.07
Final weight(kg)	41.08	41.83	41.80	45.83	0.09
Total weight gain(kg)	12.18	14.93	16.30	13.63	0.62
ADG(g)	203.00	248.80	271.67	227.16	0.62
FCR (kg/DM intake)	6.73	5.73	4.86	7.36	0.72
Cost/kg ration, Nis	2.23	1.93	2.06	2.19	0.85

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

Figure 6

Average daily gain in lambs fed different levels of total mix ration



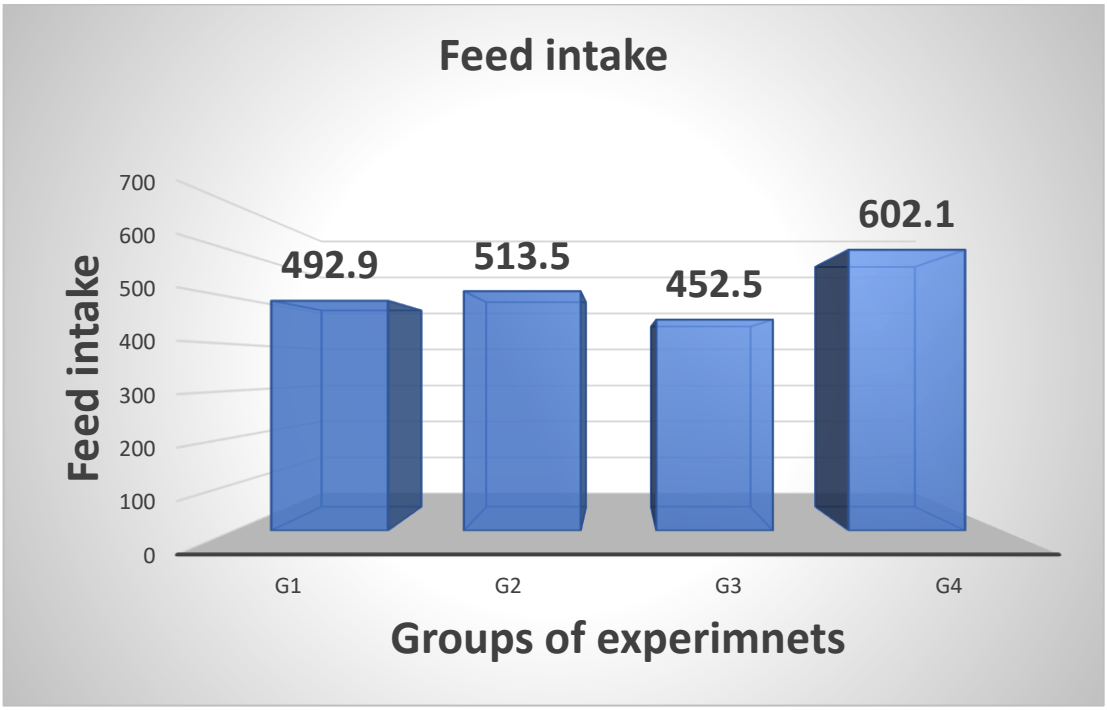
G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

3.3 Feed intake

Feed intake was not affected by feeding DPL. Similar intake was observed in all lambs of different experimental groups.

Figure 7

Amount of pelleted ration that taken by lambs in different groups



G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

Li , (2021) reported that lambs consumed pelleted feed take shorter time than that fed with un pelleted diets, it took 115min/d for feed intake, which was 85min/d shorter. The intake time was 200min/d in lambs fed with un pelleted feed. Distribution time of feed intake was concentrated to a relatively short period of time after feeding with pelleted feed and more evenly distributed over 24h for fed un- pelleted ration Khalifa, (2019) concluded that date palm was a good quality roughage for small ruminants and increased feed intake when fed at level of 15%.

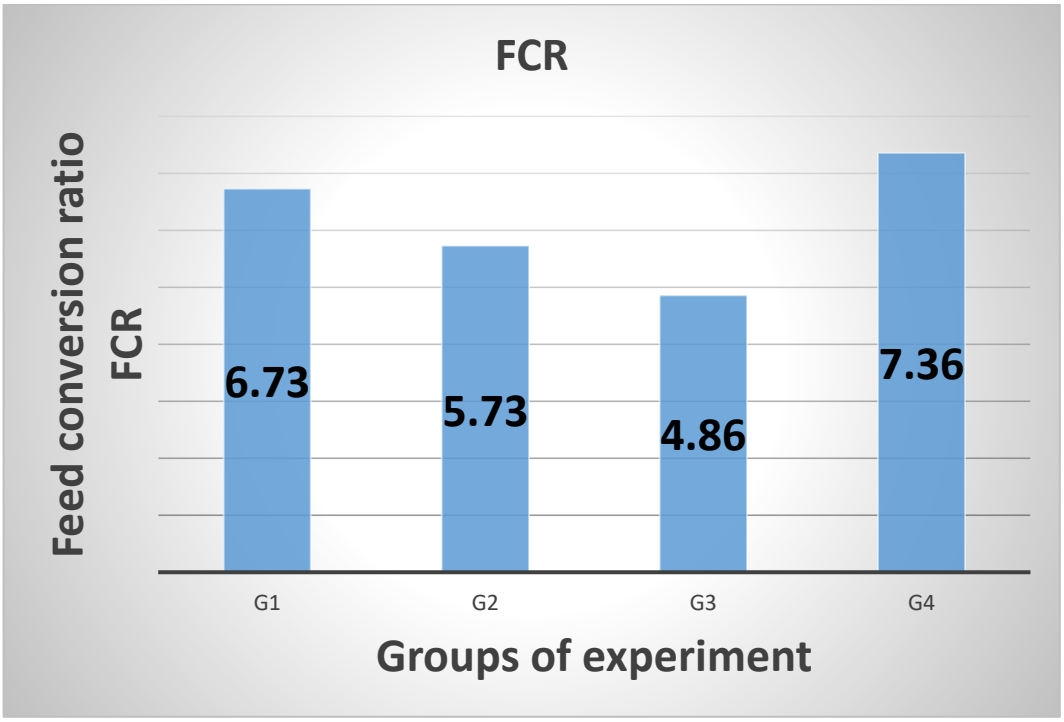
3.4 Feed conversion ratio

Feed conversion ratio was not affected all experimental groups (table3, figure 9). However, lambs were in healthy condition without any health change. Similar results were reported by (Khalifa, (2019); Mahrous, (2021); Aziz , (2020); El-Nahrawy, (2015); Ibrahim,(2010). however, Alananbeh, (2014) showed an improvement in feed conversion ratios.

Feed conversion ratio (kg/DM)

Figure 8

feed conversion ratios of lambs fed different levels of pelleted DPL



G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

3.5 Blood metabolites

The results in our study showed there is no significant differences between blood parameters and liver enzymes (globulin, albumin, total protein, ALT, AST, triglyceride cholesterol, and glucose) among groups fed with different levels of pelleted DPL compared with control group. Values of the blood metabolites are shown in table 5. All blood parameters are within normal range, and there was no significant effect for different levels of pelleted DPL on liver function and blood parameters. Different treatments of roughage had no effects on serum globulins when fed to goats Abdel-Aziz, (2015) and lambs Alam, (2016). However, same treatments caused an increase in the serum total protein, blood glucose and AST. Aldemir, (2019) reported an increase in serum total protein and glucose when adding fibrolytic enzymes to dairy cow ration compared with control group.

Blood samples were analyzed in Azzoun medical lab.

Table 4

The blood parameters in lambs fed with different levels of total mix ration

	Mean							
Group	Glucose mg/dl	Cholesterol	Triglyceride	AST	ALT	T. protein	Albumin	Globulin
G1.0	75.667	93.667	53.667	94.667	18.933	5.370	3.453	1.917
G2.0	68.333	76.667	34.667	78.467	11.567	5.040	2.957	2.083
G3.0	64.333	78.000	38.667	84.500	15.033	5.217	3.380	1.837
G4.0	78.667	74.333	27.667	86.767	13.700	6.010	3.830	2.180
Total	71.750	80.667	38.667	86.100	14.808	5.409	3.405	2.004
P -value	.712	.688	.080	.923	.246	.534	.210	.811

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

AST: aspartate aminotransferase. ALT: alanine aminotransferase. T. protein: total protein.

3.6 Digestibility

This study showed a significant effect of pelleting on the digestibility of CP, fat, fibers and DM Table 6. In general digestibility of CP decreased with pelleting level. Same trend was observed with fat digestibility. However, crude fiber digestibility increased with pelleting level. Digestibility of DM was decreased with highly level of pelleted DPL.

Salama, (2018) Reported that replacing 33.3% of clover hay by DPL caused an increase in digestibility of CP and CF compared with control group in rabbit. Also, using of DPL as substitution at 100% of traditional roughage leaded to an increases of ether extract (EE) digestibility. However, there was no significant effects on the digestibility of OM, DM and NFE. Yalchi, (2011) reported higher digestibility of DM in lambs fed with almond hull than alfalfa hay and this may be due to sugar content of almond hulls.

Table 5

Nutrient digestibility in lambs fed with different level from (DPL):

Group	CP	Fat	Fiber	DM
G1	59.84^{a}	60.94^{a}	58.34^{c}	87.50^{a}
G2	52.40^{c}	53.60^{c}	63.14^{a}	83.30^{c}
G3	43.48^{d}	54.21^{b}	59.50^{b}	87.93^{a}
G4	58.32^{b}	60.24^{a}	59.12^{b}	86.89^{b}
P-value	<0.05	<0.05	<0.05	<0.05

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

All means in the same column with different superscript are significantly different P-value<0.05.

3.7 Slaughtering results

Average weights of visceral organs and carcass cuts are shown in table 7 and 8. Feeding pelleted DPL had no effect on the tested parameters P_value >0.05 of carcass cuts and visceral organs among groups of experiment. Our results were in agreement with those reported by previous research Salama, (2018) who reported that insignificant effects were detected in absolute or relative weights for carcass traits which estimated through feeding diets containing palm leaves.

Table 6

Effect of different levels from DPL on carcass cuts, % of live weight

Carcass cuts	G1	G2	G3	G4	P_value
Neck	5.76	5.33	5.38	5.55	0.60
Ribs	14.21	13.33	13.84	14.07	0.72
Chuck	7.69	8.66	8.46	8.14	0.68
Breast	4.61	6.00	6.15	4.81	0.07
Loin	11.53	12.00	12.30	11.85	0.10
Shoulders	8.07	9.33	9.23	8.14	0.68
Legs	15.76	23.33	23.07	15.92	0.08
Fore limbs	8.46	10.00	10.76	8.14	0.80
Pelvis	8.55	10.00	10.76	9.25	0.06

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

Table 7

Effect of different levels from DPL on visceral organs, % live weight

Visceral organs	G1	G2	G3	G4	P_value
Lungs	4.23	3.33	3.84	3.70	0.91
Liver	1.66	4.66	3.84	1.85	0.06
Gall bladder	0.03	0.16	0.10	0.04	0.07
Spleen	0.38	0.66	0.77	0.37	0.06
Heart	0.78	0.66	0.77	0.74	0.56
Kidneys	0.53	1.00	0.77	0.37	0.10
Small intestine	2.69	3.33	3.84	2.96	0.26
Large intestine	3.46	4.66	4.61	3.70	0.82
Rumen	3.84	4.66	4.61	3.33	0.57
Reticulum	0.35	1.00	0.77	0.37	0.07
Omasum	0.38	1.00	0.77	0.37	0.08
Abomasum	0.77	2.00	1.53	1.11	0.83
Omentum	5.00	6.66	6.92	5.55	0.68

G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

3.8 Economic efficiency

Total feed cost can be reduced through using the pelleted DPL. By achieving this, fattening projects profitability will be improved. The improvement in economy of using pelleted DPL can be referred to lack of negative effect of animals and digestibility.

Using of palm leaves in ration give more time for digestibility may be due to high content from fiber, this will give more chance for absorption of feed elements especially VFA, and feed take more long time in digestive tract. this agrees with Mahrous, (2021).

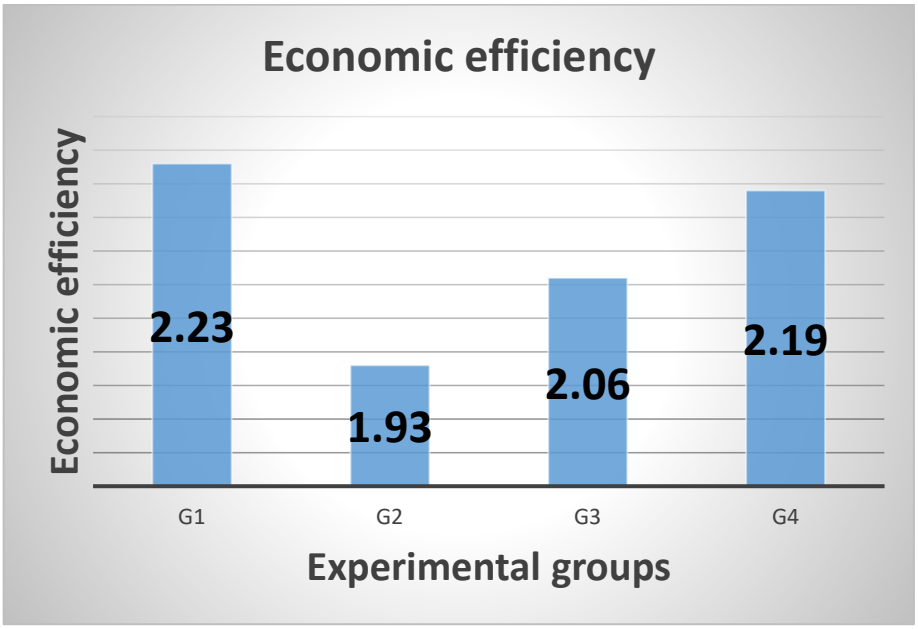
Li , (2021) showed that feeding of pelleting increase production cost, improve animal performance that fed with pelleted TMR. this led to low ratio of live weight gain to feed

and increase profits. This will reduce cost for kg of live weight gain in his study. And this improves growth performance and decrease of time needed until lambs reach slaughter weight. However, feeding lambs with pelleted ration would reduce feed wastes and increase efficiency of labor and improve profitability.

Abd El-Rahman , (2014) reported that the nutritional value and feed costs were improved through roughage recycling and processing. Shtyya, (2022) reported that processing of DPL and almond hulls caused a 11.7% decrease in rations costs. Salama , (2018) reported that the economic efficiency was increased in lambs fed rations containing different forms of biological treated palm fronds grinded (PFG) compared with control group. Also, a gradual decrease in cost of kg gain with increasing of treated palm fronds in rations. Moreover, wheat straw can be replaced with or without direct feed microbial (DFM) as a source of roughage in animal rations. Khalifa, (2019) reported a reduction in feed cost/kg of body weight gain and economic efficiency with treated ration compared with untreated. Using of palm leaves in 10 and 20% as replacer for alfalfa hay will reduce in total feed cost.

Figure 9

Economic efficiency of waste products



G1: control, G2:75%DPL and 25% wheat straw, G3:50%DPL and 50% wheat straw, G4:25%DPL and 75% wheat straw.

According to economic efficiency for using of agricultural waste product, we can use of date palm leaves with wheat straw and concentrate in pelleted form without any side effect on lambs' health and any physiological change within internal organs of lambs.

Chapter Four

Conclusions and Recommendations

4.1 Conclusions

1. Using pelleted DPL up to 75% of wheat straw had no harm effects on lambs' general performance, feed conversion ratio, digestibility, visceral organ mass, carcass cuts and blood metabolites.
2. Lambs' health status was not negatively affected by feeding pelleted DPL.
3. Saving in feed cost could be achieved through feeding pelleted DPL.

4.2 Recommendations

1. It is recommended to incorporate pelleted DPL as part of the traditional roughage according to the tested levels.
2. More investigations are needed for better assessment of the advantages of feeding DPL as a nonconventional feed ingredient.

List of Abbreviations

Abbreviation	Meaning
DPL	Date Palm Leaves
FAO	Food and Agriculture Organization
PCBs	Palestinian Central Bureau of statistics.
NFE	Nitrogen Free Extract
CP	Crude Protein
CF	Crude Fiber
DM	Dry Matter
ADF	Acid Detergent Fiber
NDF	Neutral Detergent Fiber
VFAs	Volatile Fatty Acids
TRS	Treated Rice Straw
TCS	Treated Corn Straw
EE	Ether Extract
OM	Organic Matter
TV	Trichoderma Viride
ADL	Acid Detergent Lignin
DFM	Direct Feed Microbial
AST	Aspartate Amino Transferase
ALT	Alanine Amino Transferase

PPR	Pesti des Petits Ruminant
POX	Pox virus
FMD	Foot and Mouth Disease
NRC	National Research Council
NARC	National Agriculture Research Center
TP	Total Protein
TC	Total Cholesterol
AOAC	Association of Official Agricultural Chemists
ANOVA	Analysis of Variance
SPSS	Statistical Product and Service Solution
ADG	Average Daily Gain
BW	Body Weight
SCB	Sugarcane Bagasse
FCR	Feed Conversion Ration
PFG	Palm Fronds Grinded
TMR	Total mix ration

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Appendices

Appendix A

Figure

Figure 1.A

Dried palm leaves before crushing

Figure 2.A

Crushing of dried date palm leaves in the same site of experiment

Figure 3.A

Mixed ration from crushed wheat straw and date palm leaves with concentrate

Figure 4.A

Pelleted process

جـامعـــة النجاح الوطنية

كليـــة الدراســـات العليـــا

تأثيرات المستويات المختلفة لورق نخيل التمر المحبب على الأداء وبعض نواتج الأيض في دم خراف التسمين العواسي

إعداد

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إشراف

أ.د. جمال أبو عمر

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في إنتاج حيواني، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

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الملخص

تهدف هذه الدراسة بشكل رئيسي إلى قياس تأثير أوراق نخيل التمر المقطعة في تسمين سلالة أغنام العواسي، حيث تم قايس أداء وهضمية الأغنام في مرحلة التسمين بالإضافة إلى تأثير هذه التغذية على بعض نواتج الدم بعد الفحص. شملت العينة في تجربة التسمين والتي استمرت لمدة 70 يومًا على ما مجموعه 24 من أغنام العواسي الذين اختيروا بعد فترة الفطام أي بعمر 2–4 أ قَسِّمت الخراف إلى ثلاثة مجموعات تجريبية بالإضافة إلى مجموعة مراقبة، وتم تغذية الخراف في مجموعة المراقبة بأعلاف تسمين تقليدية تتكون من دقيق الذرة وفول الصويا، وتتألف هذه الحصة من 18٪ بروتين خام مركز بالإضافة إلى قش القمح. في المجموعات التجريبية الثلاث الأخرى، تم دمج أوراق نخيل التمر المقطعة على ثلاثة مستويات مختلفة (25، 50 و75٪) كجزء من قش القمح، وتمت تغذية الخراف بشكل منفصل ومراقبة وزن الخراف وكمية الأكل أسبوعيًا، كما تم أيضًا مراقبة معدلات التحويل الغذائي. في نهاية تجربة التسمين، ذبحت ثلاثة من الخرفان من كل مجموعة لقياس أجزاء الجسم ووزن الأعضاء الداخلية، كما اختبرت نواتج الدم عند انتهاء فترة التغذية من ثلاثة من الخرفان من كل مجموعة. أظهرت نتائج الدراسة أن تغذية الخراف بأوراق نخيل التمر المقطعة بمستويات مختلفة لم تكن لها أي تأثير على أداء الخرفان. بالمثل، لم تكن لأوراق نخيل التمر المقطعة تأثيرات على نسب التحويل الغذائي وفحوصات الدم، كما لم تتأثر أعضاء الجسم الداخلية وأجزاء الجسم بذلك أيضًا. ولكن تأثرت هضمية المواد الغذائية بشكل عام للخراف التي تناولت أوراق التمر المقطعة، فلقد تناقصت هضمية البروتين الخام للخراف التي تناولت أوراق التمر المقطعة، ولوحظت وجود تناقص أيضًا مع هضم

الدهون على عكس هضمية الألياف الخام التي لوحظ ازديادها. أيضًا تناقصت هضمية المواد الجافة عند الخراف التي تم تغذيتها بأوراق نخيل التمر المقطعة بشكل عالٍ، ولم يكن لتغذية أوراق نخيل التمر المقطعة أي تأثير ضار على الخرفان. ومع ذلك، تم تقليل تكلفة التسمين، وهو ما يمكن اعتباره ميزة لدمج هذا المكون في أعلاف التسمين.

الكلمات المفتاحية: أوراق نخيل التمر المقطعة، كمية الأكل، نسبة تحويل الأعلاف، الهضمية، أجزاء الجسم، نواتج الدم.