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Comparison and Evaluation of Awassi Lambs` Fattening Systems in Palestine

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Submitted In Partial Fulfillment Of The Requirements For The Degree Of Master In Environmental Science, Faculty Of Graduate Studies At An-Najah National University At Nablus, Palestine.

April 2001

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DEDICATION

This project is dedicated to my parents, sister and brothers, wife and my kids. The completion of this work was not possible without their patience and encouragement.

Acknowledgment

My deepest thanks and appreciation to my advisor Dr. J. M. Abo Omar, who since the first minute I started my study, has provided me with full support and help, and did his atmost to develop my knowledge. I would also like to present my gratitude to my co-advisor Dr. Rateb Aref for his help and patience, to Professor Dr. Adnan Shquier for his help. And to Dr. Hassan Abu Qaoud for his assistance in the statistical analysis of this work .

I am greatly appreciative to Atef Azmouti and all my friends for their assistance, and encouragement .

I would like to thank my parents and brothers. Last but not least, special thanks to my wife and kids, To whom I owe much for their support and encouragement through out this study.

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ABSTRACT

Comparison and Evaluation of Awassi Lambs Fattening Systems in Palestine

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This research was conducted to investigate the differences between the two fattening systems operating in Palestine. Both systems are based on specific locations in the country with variable outcomes.

A total of sixteen Awassi lambs were used in the experiment. Lambs were divided into two groups of eight lambs each. Lambs in the first group were fed a concentrate ration similar to those fed in commercial fattening operations. Lambs in the second group were fed a barley-based diet (70% barley plus 30% legume roughage).

Lambs were fed their rations for 68 days where feed intake and refused were recorded. Lambs were weighed on weekly basis. At day 42 of beginning of the feeding trial a digestion trial was made on two animals of each group. An eight days total collection of feed, feces and

urine was performed. At the time of terminating the trial, two lambs from each group were slaughtered and eviscerated. Weights of carcass, visceral organs, gastrointestinal tract components and contents were recorded. Also, carcasses were dissected for lean, fat and bone tissues and all weights were recorded.

The performance of lambs fed the commercial fattening rations was much better ($p<0.05$) than lambs fed the barley based rations. This was observed from the performance parameters such as the total gain, average daily gain (278 vs. 144 g) and the efficiency of feed conversion. Lambs fed the commercial fattening rations had average feed efficiency of 5.5 kg while that of lambs fed the barley- based rations was 8.3 kg. The cost of gain was significantly ($p<0.05$) higher in lambs fed the barley-based diets.

The digestion trials showed that the dry matter and nutrient digestibility were higher for the commercial fattening rations compared to barley- based rations.

The ration type has an effect on visceral organs and gastrointestinal tract components. Lambs fed the barley-based rations had heavier visceral organs and gastrointestinal tract components, especially the small intestine. Similarly, the gut contents of these lambs were heavier compared to the gut contents of lambs fed the commercial fattening rations.

Lambs fed the commercial fattening rations had more lean and fat nearly in most of the carcass cuts. However, carcass cuts of lambs fed the barley-based rations had more bone, especially in the cuts of neck and leg.

1. Introduction:

Animal production sector plays an important role in the local Palestinian Agricultural sector, in which it contributes 36% (Ministry of Agricultre (MoA), 1999). The importance of the sector stem from the components of the sector, which is the sheep and goats, dairy cattle and poultry sector. The fattening operations are among the important activities within animal production sector. The income from such operations is estimated to be 61% of the total income (Palestinian Central Bureau of Statistics (PCBS), 1999). However, fattening operation systems vary widely in Palestine. The variations are attribute to several reasons; among these are the sizes of investments, location of the fattening farm and the experience of farmers. Anyhow, two types of fattening operations are practiced locally.

The first type is the intensive type, where animals are kept in specialized farms and fed with standard fattening rations.

The second type of fattening operations is the extensive type, which is practiced, mainly in the eastern slopes of the West Bank. Fattening animals in this system are mainly fed with roughage either from range or market. The profitability from each system differs widely.

Adoption of the extensive fattening system has negative impact on local ranges. Lambs fed under this system are considered as potential destroyer of the range especially in the eastern slopes, which can lead to environmental degredation. The intensive system, of livestock raising, might be less harm to the local environment.

The objectives of this project were: to investigate the outcome of the two systems in regard to general performance, daily gain, conversion efficiency, the visceral organ mass and the gastrointestinal tract content and feed wastes during the feeding trial.

2. Literature review:

2.1 Fattening projects in Palestine:

Recent data showed that about 250 thousand heads of lambs were fattened during the year 2000(MoA, 2000). Such fattening projects are important in the animal production sector as makes about 63% of the animal production value (MoA, 2000). Locally, there are two types of lamb fattening systems, the commercial (intensive) and the extensive systems. In the first, commercial fattening manufactured feeds are used in these operations while a barley-based diet is used in the extensive system (Abo Omar, 1992). The extensive fattening system is mainly adopted in eastern slopes of the West Bank (Barghuti and Abo Omar, 2000).

The majority of lambs under fattening operations in either system are of Awassi breed.

2.2 Barley as a feed stuff:

Cereal grains such as barley are common feed ingredients in local fattening operations. It makes a major part of manufactured feeds. Barley is incorporated in formulated feeds at rate of about 25% (Abo Omar, 1996). However, it is used as a sole grain feed ingredient in the extensive fattening system. The amount of barley used in local fattening operations is estimated to be 100 thousand tons/ year (MoA, 2000).

Use of barley in feeding ruminants for the extensive fattening operations used to give satisfactory results. The estimated average daily gain of such feeding program is about 120-200 g (MoA, 1999), while in the intensive fattening system is estimated to be more than 240 g/day (MoA, 1999).

The outcome of such fattening operations is variable especially when the extensive fattening system is considered.

Today barley is the most widely cultivated cereal grain used in animal feed.

Extremes in climatic conditions have been observed to alter the nutritional composition of barley, but with careful management all barley can be used as livestock feed.

Because barley contains a large proportion of starch it is used primarily as an energy source. Compared to most other grains barley has more protein and important vitamins and minerals. By-products generated during the brewing and distilling processes offer high quality and are widely used as feed ingredients. The barley plant can be made into whole-plant or head-chop ensilage. The straw and chaff left after grain harvesting can be used as roughage (fiber) sources for ruminants.

2.3 Nutritive Value of Barley:

Starch is the major constituent of the barley kernel and its percentage is inversely related to protein content. Expressed on a dry matter basis barley has 7.5-18% protein and a total digestible nutrient (TDN) value of 80-84%. Variety differences, soil fertility and climatic conditions have all been found to influence the protein content. High levels of soil nitrogen provide for increased protein content. Livestock feed manufacturers can still use barley with an unacceptably high protein content for malting. When balancing diets for ruminants the nutritional composition of all feedstuffs used should be carefully considered. A cost advantage may be provided when barley is included as an ingredient.

2.3.1 Energy:

Boyles, et al., (1999) evaluated the net energy gain (NEg) values of barley diets fed to cattle. In summer feeding trials the average NEg content of barley was found to be 1.39 Mcal/kg of dry matter. NRC (NRC, 1984) NEg values for barley grain and Pacific Coast barley grain are 1.40 and 1.45 Mcal/kg of dry matter, respectively. All feeds have lower NEg values in winter weather, and barley is no exception.

NRC (1984) estimates the net energy lactation (NEl) values for barley to be 1.94 and 1.99 Mcal/kg of dry matter for barley and Pacific coast barley grain, respectively.

Seasonal variation has no major effect on the net energy maintenance (NEm) content of barley (Boyles,et al., 1999). They estimated the NEm content of barley to be 1.82 or 1.91 Mcal/kg of dry matter depending upon the analytical method used. These values were similar to those reported by NRC (1984) for barley grain and Pacific Coast barley grain, which were 2.06 and 2.12 Mcal/kg of dry matter, respectively.

The majority of energy in cattle and sheep finishing diets is supplied by starch. It is therefore important to identify the site where starch is digested and to quantify the extent to which it is utilized. Diets

prepared using grain sorghum had total tract digestion values, which were lower than those obtained when corn, barley or wheat was used. The values were 72%, 83%, 84% and 88% respectively. Results from steer feeding trials showed that total tract digestibility of dry processed barley or corn was greater than dry processed grain sorghum; 79% and 81% vs. 76% (Boyles,et al., 1999).

Total tract starch digestion was observed to be greater for steers fed barley or corn when compared to that fed grain sorghum; 99.2% and 99.1% vs. 97.2%. Maximum total tract digestion of starch and other organic matter is related to the rumen degradability of those components .

Although digestion of starch in the small intestine is more efficient than digestion in the rumen, the capacity of the small intestine is limited. Grain sorghum can be expected to have a greater amount of starch entering the small intestine. The percent post-ruminal starch digestion for grain sorghum is lower than for barley and corn, but total grams digested post-ruminally per day is greater .

Investigations have been done on slowing the digestion rate of barley by treating it with formaldehyde. Such treatments may reduce some of the bloat-acidosis problems sometimes associated with feeding high levels of barley.

Steam processing may alter the site of digestion for grain sorghum and corn but does not appear to significantly affect the site of barley digestion. Rumen organic matter digestibility is greater for dry rolled or steam flaked barley versus dry rolled corn and grain sorghum; 61.7% vs. 48.5 and 42.6% (Boyles,et al., 1999). However, total tract organic matter digestibility were slightly different; 78.8%, 83.8% and 80.7%, respectively.

2.3.2 Protein:

Compared to corn, barley has more protein and fiber with slightly less metabolizable energy and total digestible nutrients. Generally, increased protein and fiber contents result in decreased energy content. Protein content of most barley grain ranges from 7.5 to 17% on a dry matter basis with 75% of that protein being digestible. However, protein levels in excess of approximately 13.6% dry matter may not substantially increase the value of barley to livestock feeders (Boyles,et al., 1999) if the costs of other feed ingredients are held constant.

The major feed ingredients used in cattle finishing diets are also the primary sources of dietary crude protein.

2.3.3 Fiber:

The NRC (1984) lists crude fiber contents of 5.7 to 7.1% for barley. Fiber levels in barley are normally greater than those of grain sorghum or corn. Some authors have indicated that this extra fiber may be of benefit in feeding lower amounts of roughage. However, the faster fermentation rate of barley may somewhat reduce its use as an effective fiber source.

Nutritionists should utilize barley beneficial aspects as a high-energy source and relatively high protein grain but not depend on it as a totally effective fiber source.

2.3. 4 Vitamins:

Barley, lacks sufficient carotene. One can meet the requirements by feeding supplemental vitamin A or injecting it. The vitamins, which should be considered in cattle production, are vitamin A, perhaps vitamin D in confinement situations with no sunlight, vitamin E, thiamin, and niacin.

2.3.5 Minerals:

Barley, corn and grain sorghum are low in calcium content. However, barley contains more phosphorus than corn or Milo (NRC, 1984). The primary need for supplemental macrominerals will be calcium. Potassium levels should also be evaluated. Barley is low in several trace minerals, but requirements can usually be met by providing trace mineral salt. Trace mineral deficiency is principally a geographical problem and consultation with soils experts and nutritionists in specific areas is necessary to determine if supplementation is necessary and what type of supplementation is needed. Fortifying diets with vitamin E, choline, zinc and sulfur did not improve the performance of cattle finished on high-energy rations based on dry rolled barley and a standard supplement (Boyles,et al., 1999). However, cattle requirements for these nutrients have changed since this study was done due to livestock genetic selection for growth.

2.4 Variety Effects:

Plumper barley is generally higher in starch and lower in fiber and two-row varieties usually produce larger kernels than six-row types. Other than plumpness, there are no major differences in physical or chemical properties between two-row and six-row barley.

Boyles,et al., (1999) fed two cultivars (Steptoe and Boyer) to yearling steers. Test weights of the Steptoe and Boyer barleys were similar. Statistical analysis of interaction between the physical form of the barley and roughage level indicated improved rate of gain when steam rolled barley was compared to whole barley when 5 or 15% roughage was included. However, there was no improvement observed when 25% roughage was included. The two varieties provided similar results when steam rolled. Boyer had a 10 to 12% advantage over Steptoe with regard to rate of gain and feed efficiency when both were fed as whole grains. When whole grain Boyer barley was fed in conjunction with 25% roughage it produced a slightly greater average daily gain than did steam rolled Boyer barley fed at the same roughage level.

Based on the preceding information, there appears to be some variety difference. However, differences in performance may also be due to test weight variation. Therefore, test weight should always be considered when purchasing barley from various sources. Information supplied from one area to another may not be applicable because geographic variation is more pronounced in barley than in corn.

2.5 Processing Barley:

Grain processing has become synonymous with modern cattle feeding operations. Feed can be the single most costly item in cattle production, representing 70 to 80% of the total cost of gain. Most processing methods have been developed to improve starch and protein availability.

2.5.1 Feeding Barley Whole:

Consumption of feed containing whole barley grain by cattle will be greater than consumption of feed containing ground or rolled barley, but gain will be at a slower rate and thus less efficient (Boyles,et al.,1999). It appears unlikely that the proportion of forage in the diet would influence the relative efficiency of utilization of whole or rolled barley.

Variation in performance of cattle fed whole barley is primarily due to differences among animals as regards their ability to masticate and digest whole grain. It was suggested that whole grain oats were better utilized because more whole oats than whole barley could be transported to the mouth during regurgitation due to the lower specific gravity of oats and thus their positioning within the rumen. Boyles,et al., (1999) suggested that small ruminants had a smaller reticule-omasal orifice, which restricted the flow of whole grain. Larger ruminants do not appear to have this problem.

2.5.2 Grinding and Rolling:

Grinding and rolling are processes used to reduce the size of whole grains. The physical forces employed include impact to create fractures; abrasion/attrition to scrape off material; shear to slice apart; and pressure

to crush (deform) structure. Particle size reduction is important to the feed industry for the following reasons.

First, particle size reduction increases surface area, which leads to improved utilization of grains through increased exposure of endosperm material to digestive enzymes. It is estimated that only about 60% of the starch in whole (unprocessed) grains are digested.

Second, particle size reduction provides improved mixing characteristics of dissimilar feed ingredients.

Third, particle size reduction of ingredients prior to pelting produces improved pelting efficiency through increased pellet durability and reduced energy consumption.

Fourth, particle size reduction provides improved acceptability and handling of fibrous feedstuffs.

In the livestock feed industry the most common type of equipment used to reduce the particle size of grains is the hammermill. Size reduction is accomplished by using gravity or mechanical flow to position grain kernels within the primary contact zone of spinning hammers. Roller mills rely on the forces of pressure (crushing) and abrasion to reduce particle size. They do not have any effect on fibrous material. Gravity flow is used to pass grain kernels between rotating rolls. The degree of size reduction depends on several factors. First is the relation of kernel size (diameter) and the distance between the rolls (nip). Kernel

diameter must be slightly greater than nip distance, so uniformity of the kernels is important. Second, the rolls may turn at different speeds (differential). This in conjunction with various types of surfacing cuts (corrugation) helps pull kernels into the nip. The corrugations for coarse rolling are three to six grooves per inch. Third, pairs of rolls may be placed on top of one another, so that as pieces exit the nip of the first set of rolls they fall into a narrower nip of the set below.

This practice allows for greater control over the degree of size reduction and provides greater flexibility to the system. Two and three high roll stands are common in the feed industry.

Each device has advantages and disadvantages. Roller mills provide a more uniform distribution of size and produce fewer fine particles, but they do not work on fibrous material. Hammermills offer the greatest control over degree of size reduction because screens having different sized openings can be used. Roller mills are less costly to purchase, operate and maintain. Foreign material (ferrous metal and stones) will cause damage to both. The danger of fire or explosion is perhaps greater for the hammermill because it generates more dust and fine material.

Increased surface area is the final result, and the cost of attaining that increase is the ruler by which success is judged. Digestibility of all constituents except cellulose was found to be increased by rolling

(Boyles,et al., 1999). Dry rolling is faster and requires less energy than grinding. It was found that it was profitable to mill barley when the unit value of the feed exceeded by 2.16 times the unit cost of milling. Boyles (1999) observed that whole barley was not competitive with ground barley until the cost of processing increased to $37 per ton.

Currently the local cost of rolling or grinding barley is between $2 and $3 per ton (Personal communication).

A conscientious manager will obtain the same results from either ground or rolled barley (Boyles,et al., 1999). The production of fines is less likely with rolled barley than ground. A more uniform particle size is obtained from rolled barley. Breaking the kernel into two to three grits is acceptable.

Boyles, (1999) found that when particle size of hay was 0.38 cm gains were best when rolled barley was fed. However, when the particle size of the hay was 3.8-cm gains were best using ground barley.

More fines than normal can be generated when barley of relatively low moisture content is ground through the size of screen commonly used in the feed industry. This can be avoided by operating grinders at a slower than normal speed, which prevents the kernels from shattering into fine particles.

Barley that contains more than 25% fine particles may cause digestive disturbances. Adding higher moisture feeds such as silage, molasses (5%) or fat (3%) to the rations will help hold the fines in suspension. Adding approximately 8 percent water prior to feeding may reduce the problem with fines if high moisture feeds are not available.

1 to 6 F increases the temperature of the grain during grinding or rolling. The greatest temperature increase is observed in the grinding process, which can cause shrink (loss of weight by driving off moisture). The amount of shrink can be controlled through proper system design. Loss of more than 0.5% would be considered unacceptable in most feed manufacturing operations.

2.5.3 Pelleting:

Pelleted barley diets have not demonstrated improved performance in ruminants (Boyles,et al., 1999). Feeder lambs produced gain in less time and were more efficient when fed whole barley rather than rolled or pelleted barley. The destruction of the barley hull during pelleting may coincide with increased acidosis and bloat problems.

2.6 The Effect of Barley on Forage Digestion:

Grain supplementation will be most appropriate when protein content of the forage is already high or when protein supplements alone will not raise the energy content of the total diet to the necessary level (Boyles,et al., 1999). It was indicated that 20 to 30% added grain normally causes little or no depression in intake and digestibility of roughage, but a higher proportion can depress intake to such an extent that it is no longer a supplementation but rather a substitution.

Both corn and barley have negative effects on digestibility of fiber contained in forages.

Digestion of total organic matter was greater for supplemented diets, but digestion of total (NDF) was greater without grain supplementation, and corn depressed (NDF) digestion more than barley. Dry matter intake was increased more by barley than by corn, probably because barley improved the nitrogen or protein status of the animal to a greater extent.

When cows were given a 70% hammer-milled barley diet (DM basis), rumen pH declined to a minimum value of 5.4 six hours after feeding (Abo Omar, 1989). Rumen ammonia-nitrogen concentrations were also lower for the barley diet compared to lupin, pea and fava beans.

Barley did not depress hay digestibility when it was given with hay diets containing bicarbonate (66% $NaHCO_3$: 24% $KHCO_3$) as 3.5% of barley dry matter (Boyles,et al., 1999).

Negative associative effects could be avoided if rumen pH is maintained above the level inhibitory to cellulolysis. It was suggested that this could partially be achieved by offering roughage in long form (increased saliva: increased buffering) to maintain a rumen pH of 6.7.

It was reported by that performance of ewes on winter range was improved without the reduction in forage dry matter intake with a soybean meal-barley pellet compared to no supplement. A supplement of peanut meal had no advantage over barley when an ample supply of herbage of high crude protein was available. In general, it appears that protein supplementation of forage diets low in crude protein (< 6%) usually increases intake. Effects of protein supplementation on diets containing 6 to 8% crude proteins are variable. Incorporating a protein supplement with barley may assist with maintaining the digestibility of forage-based diets.

2.7 Visceral organ mass:

It was reported by different researchers that fiber levels have certain influence on gastrointestinal tract and its accessory organs. Abo Omar et al (1994); Abo Omar (1995) and Johnson (1985) reported variable effects of fiber on these parameters in lambs, and Rabayaa (2000) in broilers.

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

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

It was reported that various levels of mucosal surface changes included distorted and damaged cells when 15% fiber from four different sources were fed to rats. 50% alfalfa diets when fed to pigs caused heavier colon, rectum, kidney and total tract weights and tended to increase cecum, small intestine, pancreas and liver weights when compared to pigs fed regular corn-soy diet (Pekas et al., 1983).

2.8 Carcass cuts:

Type of diet and level of fiber have certain effects on carcass cuts. Abo Omar and Gavoret (1995) reported that different levels of olive cake (from 10-40%) had no significant effect on Awassi lambs cuts. Similar effects were observed in broilers fed olive pulp at levels up to 10% (Rabayaa, 2000).

3. Materials and Methods:

3.1. The fattening trial:

Sixteen Awassi male lambs were obtained from a commercial market soon after weaning. Soon after reaching the experimental site, lambs were treated against both internal and external parasites and were vaccinated against enterotoxemia.

Animals were assigned into weight categories and randomly divided into two groups of eight lambs each. Lambs were allowed to adapt for the new environment and diet for one week, and lambs in the first group were fed a commercial fattening ration (table 1). The second group of lambs was fed a fattening ration similar to that practiced in the fattening extensive system, the ration is made of vetch roughage and barly (table 2).

Animals were fed adlibitum in-groups and had free access to water and salt blocks. Lambs were weighed on aweekly basis along with feeding trial, which lasted for 68 days.

The daily feed intake, and refused was recorded and feed samples were collected for later analysis. Animals were observed for

abnormalities, health problems and comments about all these were recorded.

The weight gain, cost of gain and feed efficiencies were recorded.

3.2. The digestion trial:

Forty-two days after starting of the feeding trial, two lambs were taken randomly from each group and placed in metabolic crates. Prior to this, lambs were sheared and prepared for the collection period. Animals were adapted to crates for four days.

The daily feed intake was recorded during the entire collection period. Water was available to lambs free choice. Samples of both feeds and feces for each lamb were collected and sampled for later analysis.

Fresh and oven dried weight of feces, from each animal, were ground to 1 mm, and representative samples were taken for later analysis. The excreted urine by each animal during 24 hours was collected using a plastic jar (2 liters) containing 20 ml of diluted sulfuric acid (v: v) and 500 ml of tap water. The collected urine was transferred to a 5-liter container and diluted with tap water to the mark. A sample of 100 ml was taken from the diluted urine and kept in a 2-liter bottle in a refrigerator. The samples (100 ml, each) of diluted urine during 7 days were

composited in the 2 liter bottle. A triplicate sample of 2 ml of urine sample was analyzed for nitrogen content.

3.3. Visceral organ mass study:

At time of termination of the feeding trial, two lambs from each group were taken randomly for slaughter. Lambs were slaughtered in the morning before consuming their morning meals. Lambs were slaughtered during the same day by a routine procedure practiced at municipal slaughterhouse. Animals were bled, skinned and eviscerated. The rectum and esophagus were tied off to prevent loss of gastrointestinal tract contents before viscera were removed from the carcass. The liver and gall bladder were removed from the body at the plane immediately adjacent to the base. Lungs, without trachea, were removed and weighed, and the total weight for kidneys was recorded.

The lower gut and abomasums were tied off at the pylorus, the omasal abomasal junction and the ileo-cecal junction. The viscera were then placed into a plastic lined offal tray and become ready for dissection.

After the total GIT weights were taken, the tract was tied and sectioned into esophagus, reticule- rumen, omasum, abomasums, small

intestine, cecum and large intestine. The spleen and pancreas were generally removed first and weighed.

The external fat was removed from each organ of the foregut (rumen, omasum, and abomasum) and the cecum. The full fat-free organ weight was recorded. The rumen was emptied. Scraped as clean as possible without washing and then weighed.

The contents were homogenized and a one-liter sample was taken for dry matter analysis. The rumen was washed and weighed. The wet weight of the washed tissue and dry weight of each segment (organ) was determined.

The omasum and abomasums were opened, emptied of their contents and washed. Their contents and their washed tissues were sampled for dry matter analysis. The weight of contents was calculated as the difference between the full and washed weights.

The large and small intestine was separated from the alimentary tract leaving some fat. The contents were removed, weighed and sampled. The fat was removed from the intestines leaving only the tissue, which was weighed.

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

As soon as the tissues and digesta were taken, they were placed into a walk-in freezer at – 20 C and stored until analysis. The tissue samples from each organ were stored in an 11X20 cm whirl-Pak bags.

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

3.4. Carcass cuts:

The carcasses of the slaughtered animals were allowed to chill for 12 hours at 5 C before cold carcass weights were recorded. They were then split down the backbone and the right side of each cold carcass was fabricated according to the American National Livestock and Meat Board Standard into leg, shoulder, loin, rack and neck .

Each wholesale cut was trimmed of all external fat (subcutaneous fat), boned out and intermascular fat was removed. The total of trimmed and intermuscular fat was recorded. The lean of each cut was used as the estimate of dissectible lean and the bone of each cut boned out as the estimate of bones. The three components were weighed separately to determine relative proportions within cuts. Also,

percentages of dissected lean, fat and bone in the cold half carcass was calculated from the proportional combination of the weights recorded for each cut.

3.5. Chemical analysis:

Samples of the feed ingredients used in the experiment were used to determine the following: Moisture content (appendix 1), ash content (appendix 2), crude protein content (appendix 3), crude fat content (appendix 4), the crude fiber content (appendix 5), nitrogen free extract content which was determined by difference.

% NFE = %100 – [%ash + %crude protein + % fat + %crude fiber]

and gross energy contents (appendix 6).

Data were analyzed by the T- Independent Test using SPSS package to determine the effect of experimental rations on feed intake, body weight gain, feed conversion, visceral organ mass, gastrointestinal tract components and contents, and carcass cuts.

Table (1) Composition of the commercial fattening ration

Ingredient	**Kg per ton**
Corn	400
Wheat	150
Bran	160
SBM	175
Limestone	27
Barley	75
Vitamins	1
Salt	5
Urea	7
Chemical composition:	**%**
Crude protein	18
Crude fiber	6.1
Crude fat	3.3
Ash	5.2
Calcium	1.2
Phosphorus	0.6
Energy (Mcal/kg)	2240
moisture	12

Table (2) Composition of the barley- based ration

Ingredient	**% of ration**
Barley	70
Hay (Vetch)	30
Chemical composition:	**%**
Crude protein	17.8
Crude fiber	16.2
Crude fat	3.6
Ash	2.98
Calcium	0.47
Phosphorus	0.40
Gross energy (Mcal/kg)	4656
Moisture	13

4. Results and discussion:

4.1 Composition of barley:

Chemical analysis of barley used in this study is shown in table (3).

Table (3) Chemical composition of barley used in the experiment:

Nutrient	%
Crude protein	13.0
Crude fiber	6.1
Crude fat	1.9
Ash	2.5
Calcium	0.06
Phosphorus	0.35
Gross energy (GE), kcal	4300

These results are in agreement with the NRC list (1984). Barley has low calcium content (.06%); the phosphorus content is 0.35%.

4.2 Lambs performance:

Table (4) shows the overall performance of lambs utilizing the two experimental diets. It is obvious that the total gain is significantly higher ($p < 0.05$) in lambs fed the concentrate diet (figure 1). These lambs gained 47% more than the barley fed lambs.

The average daily gain of lambs fed the concentrate diet was 278 g. this value is similar to values reported by other researchers with lambs fed commercial diets (Abo Omar and Gavoret, 1995; Harb, 1986). Similarly, gain in lambs fed barley diets was close to that observed in most of fattening operations adopting the traditional methods of fattening (MoA, 2000). Similar trends were observed in values of feed conversion ratios for both lambs fed concentrate or barley diets.

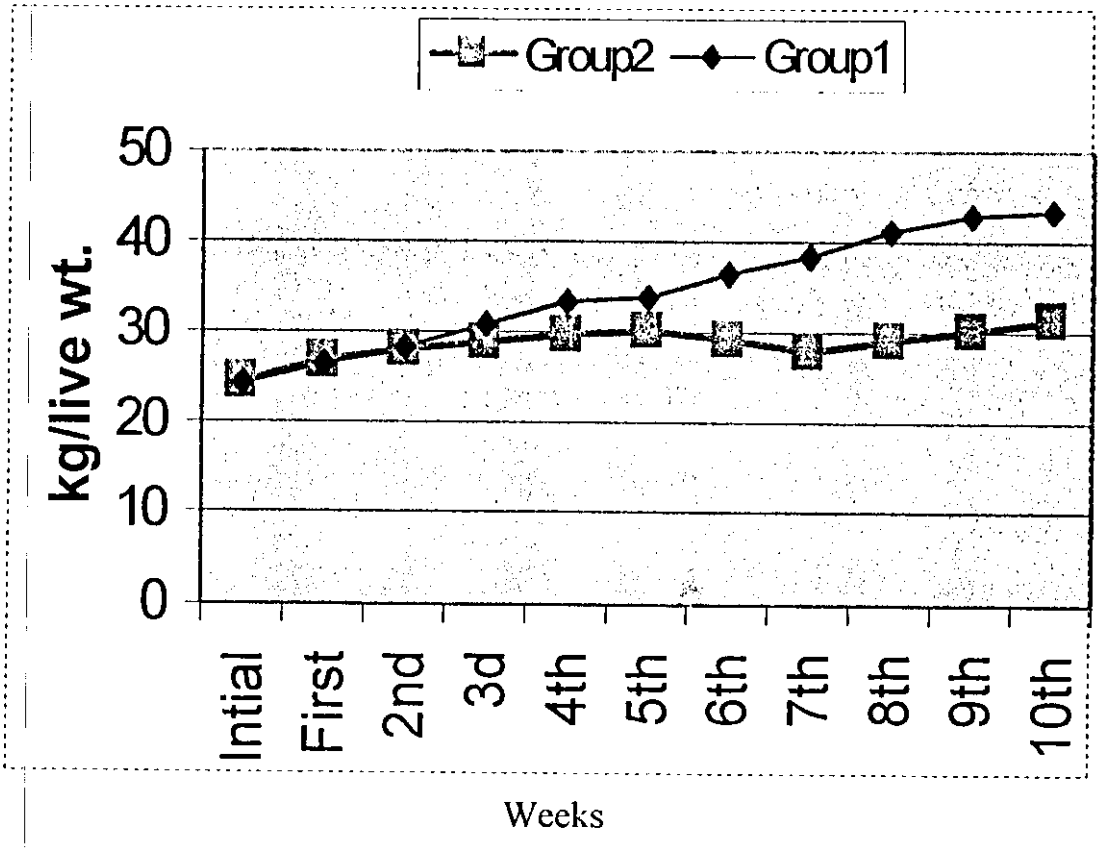
Table (4) Results of fattening trial

Parameter	Concentrate group	Barley group
No. of lambs	8	8
Days of experiment	68	68
Initial weight (kg)	24.3	24.5
Final weight (kg)	43.25	34.4
Total gain (kg)	18.95a	9.8b
Mean daily gain (g)	278a	144b
Daily feed intake (kg)	1.55	1.20
Feed conversion efficiency (kg feed / kg live wt.)	5.56	8.3
Cost of total gain(NIS)	105.36a	89.5b
Cost of diet (NIS/kg)	1.0	1.1
Cost of 1 kg gain(NIS)	5.56b	9.13a

Rows with different letters are significantly different at $p<0.05$ level.

(NIS)= New Israeli Sheqel.

Figure (1) Average lambs weight during the fattening trial:



4.3 Feed intake:

The experiment showed that feed intake for lambs fed the barley based ration was lower than that of lambs fed the commercial concentrate diet (1.55 vs. 1.2 kg). The bulkiness of diets for lambs fed the barley-based diet may explain the depressed intake compared to intake of

lambs in the other group. This intake was similar to intakes observed in many other fattening trials (Abo Omar and Gavoret, 1995 & Harb, 1986).

4.4 Body weight gain:

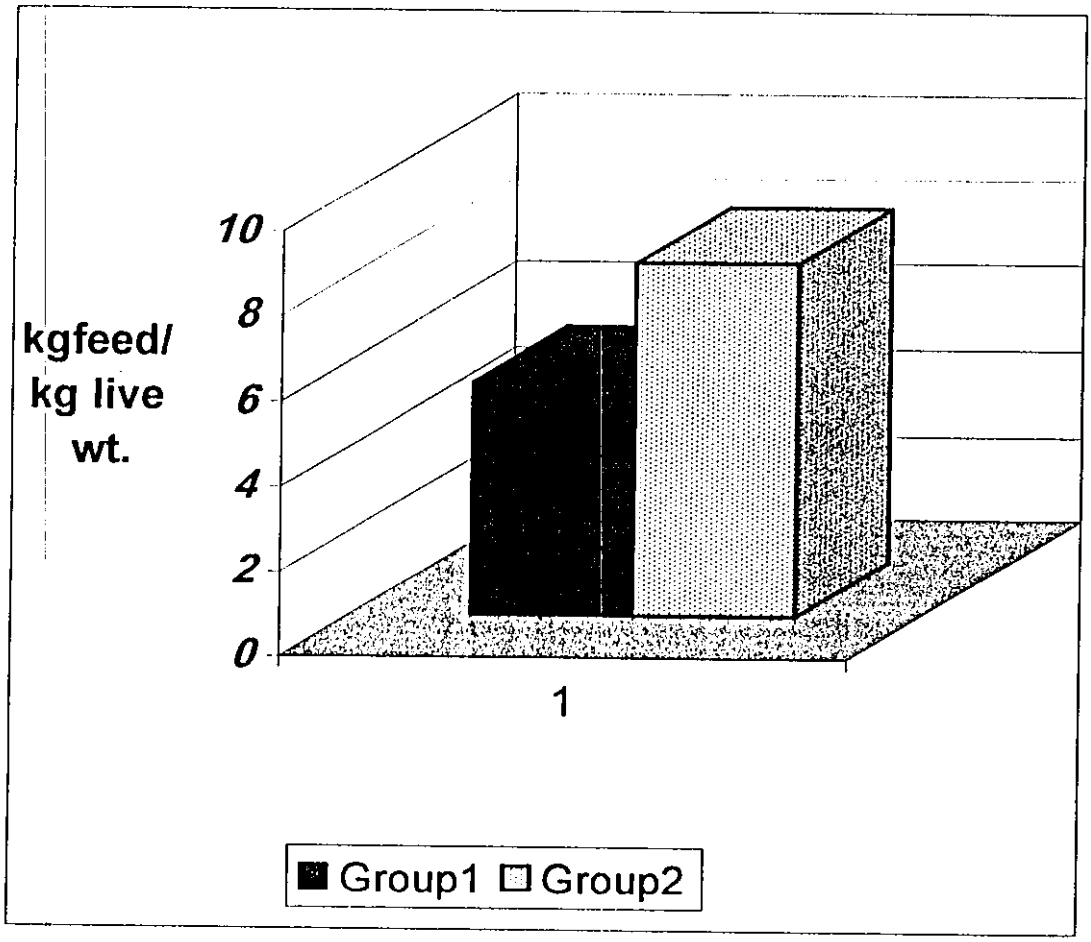
The total gain in lambs fed the commercial fattening diet was about 19 kg during the entire feeding trial. However, gain in lambs fed barley diets was about 10 kg. The average daily gain in the tow experiments were 278 and 144 g, respectively. The lower gain in lambs fed the barley-based diets explains why fattening operations in the extensive fattening systems take longer time for termination. Lambs in this system should be kept under fattening more days to achieve the marketing weight (MoA, 2000).

4.5 Feed conversion efficiency:

The efficiencies of feed conversion were 5.5 and 8.3 (kg / kg live BW) for lambs fed the commercial fattening and the barley diets, respectively (figure 2). Lambs fed the commercial fattening diet have 33% higher average conversion efficiency compared to the efficiency in the other group.

This again explains the long duration of fattening trials performed by farmers adopting the extensive system of fattening observed in many locations in Palestine.

Figure (2) Feed conversion efficiency of the two experimental groups



4.6 Cost of gain:

The cost per kg gain is indicated in table 4. The higher cost of gain observed in lambs fed the barley diet was due to two reasons, first the low conversion efficiency of feed, second the more cost/kg of that diet. Roughage prices are higher than that of concentrates in many occasions, especially in summer followed by low rainfall seasons.

4.7 Digestibility of diets:

The digestibility of dry matter and the different feed ingredients are shown in table (5). It is the first attempt to evaluate digestibility parameters in local lambs either consuming the traditional fattening rations or in those consuming rations as in the extensive fattening system.

Table (5) Digestibility parameters for diets fed to fattening lambs:

Parameter	Concentrate ration %	Barley- based ration%
DM	79.5a	73.2b
CP	75.5a	70.5b
CF	62.0a	55.4b
NFE	90.0	87.0
Ash	88.8	86.0
DE	4250a	1270b

Rows with different letters are significantly different at $p<0.05$ level.

The digestibility of DM, CP, CF, and DE were significantly ($p<0.05$) higher in lambs fed the concentrate diet compared to lambs fed the barley based diet. The high fiber content of barley-based diet may explain the low digestibility values observed. Boyles, et al., (1999) showed that barley in diets reduced the overall digestibility of the rations as it has negative effect on the digestibility.

4.8 Visceral organ mass:

4.8.1 The visceral organs:

The visceral organs under investigation were esophagus, trachea, lungs, heart, liver, kidneys, spleen and pancreas. Table (6) shows the mean weight of these organs .

Table (6) visceral organs mean weight in lambs fed the experimental rations (g/kg carcass weight):

Parameter	Concentrate ration	Barley based ration
Weight carcass	21.8a	14.4b
Liver	32.2	39.2
Kidneys	6.0	6.6
Lungs	26.0	37.0
Spleen	8.0	5.5
Heart	8.8	5.5
Pancreas	2.4	4.0
Trachea	2.8	3.8
Esophagus	2.2	2.3

Rows of different letters are significantly different at levels of $p<0.05$

Visceral organs of lambs fed the barley -based diet had higher weights of most of the tested organs. They had 18%, 10%, 29%, 40%, 26% and 4% increase in the average weights of liver, kidneys, lungs, pancreas, trachea and esophagus, respectively. The increase was significant ($p<0.05$) for pancreas. However, average weights of spleen and heart were lower ($p<0.05$) in lambs fed barley- based diets compared to these of lambs fed the commercial fattening diets. These results agree with what has been reported by other researcher (Koukou et al., 1997; Mcleod and Baldwin, 1997; Abo Omar et al., 1994; Abo Omar, 1995; Johnson, 1985) concerning the variable effects of diets on visceral organs.

4.8.2 Gastrointestinal tract:

The type of diet consumed had no clear influence on the digestive tract components (table 7). However, lambs fed the barley -based diets had always higher gastrointestinal component weights, which was significantly higher ($p<0.05$) only for small intestine both wet and dry tissues. Similar results were reported by Abo Omar, et al., (1994) in lambs fed different levels of fiber, by Younoszai et al., (1978) in monogastrics fed different roughage's and by Sainz and Bently (1997) in steers.

Table (7) Effect of type of diet on gastrointestinal tract components (g/ kg carcass weight):

Parameter	Concentrate diet	Barley based diet
Rumen, wet	35.0	36.5
Rumen, dry	6.6	6.8
Omasum, wet	3.0	3.1
Omasum, dry	0.7	0.72
Abomasum, wet	6.0	8.0
Abomasum, dry	1.2	1.7
Small intestine, wet	42.0b	55.0a
Small intestine, dry	7.8b	11.2a
Large intestine, wet	8.5	9.2
Large intestine, dry	1.7	2.0
Cecum, wet	7.5	8.0
Cecum, dry	2.0	2.1
Length, small intestine (cm)	3010	3000

Rows of different litters are significantly different at $p<0.05$ level.

4.8.3 Gastrointestinal tract contents:

Contents of the rumen and most of other gastrointestinal tract segments lambs fed the barley-based diet were significantly heavier ($p<0.05$) compared to the contents of rumen in lambs fed the commercial diet (table 8). These results are in agreement with other research where digestive tract content in all its components is higher for lambs fed more fiber in their diet (Abo Omar, et al., 1994; Abo Omar, 1995; Johnson, 1985).

Table (8) Effect of type of fattening diet on gastrointestinal tract contents(g/kg carcass wt.):

Parameter	Concentrate diet	Barley based diet
Rumen content	111.0b	220.0a
Omasum content	1.85	4.5
Abomasum content	5.9b	19.65a
Small intestine content	11.5b	39.0a
Large intestine content	14.0	12.0
Cecum content	26.0b	40.0a

Rows with different litters are significantly different at $p<0.05$ level.

4.9 Carcass cuts:

The study showed that type of diet had variable influence on different carcass cuts (table 9). Lambs fed the barley-based diet had less lean compared to other lambs fed the commercial fattening rations (figure 3). Similar trends were observed in the distribution of the fat tissue, which was distributed more in carcasses of lambs fed the commercial fattening ration.

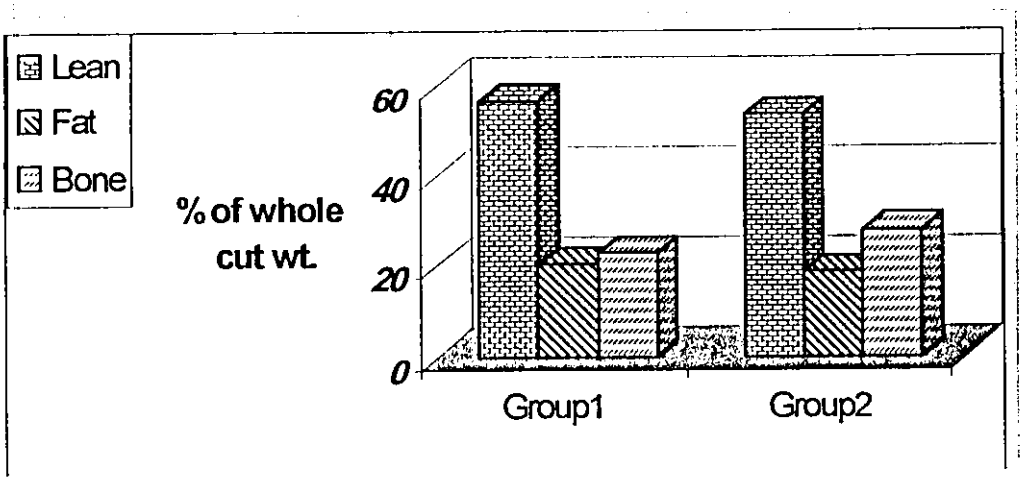
However, lambs fed the barley-based ration had more percentages of bone tissue in all of the cuts investigated, especially in the neck and leg cuts which were significantly higher ($p<0.05$) compared to same cuts of lambs fed the commercial fattening ration.

Table (9) Effect of type of diet on carcass cuts (as percentage of the whole cuts):

Cuts	Concentrate diet	Barley-based diet
Lean	**%**	**%**
Neck	51.0a	43.5b
Rack	56.0	52.0
Shoulder	62.0	62.0
Leg	58.0	56.0
Fat		
Neck	29.0	24.5
Rack	20.0	22.0
Shoulder	16.0	16.0
Leg	16.5	12.25
Bone		
Neck	20.0b	32.0a
Rack	24.0	26.0
Shoulder	22.0	22.0
Leg	25.5b	31.75b

(Distribution of Lean, Fat, Bone, as percentage of whole cuts).

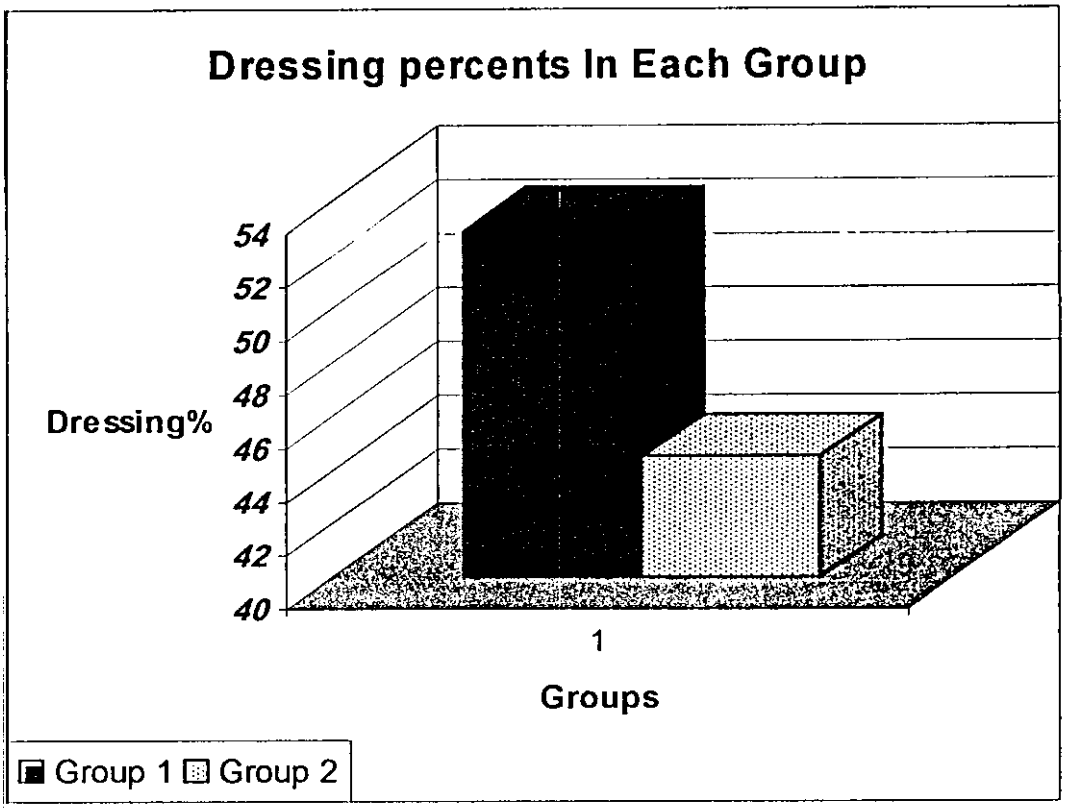
Figure (3) carcass cuts tissues of lambs fed the two experiment diets:



4.10 Dressing percent:

The experiment showed that the dressing percentages were 52.9 and 44.5% for the commercial fattening (concentrate) ration and barley-based ration, respectively (figure 4). Lambs fed the ration had 15.8% increase in their average dressing percent. The lower dressing percent observed for lambs fed the barley based rations can be explained by the larger average weights of visceral organs, the heavier weights of gastrointestinal components and the heavier gastrointestinal tract contents observed in these lambs. The overall lambs body conditions based on type of ration consumed can also explain the lower dressing percent of these lambs.

Figure (4) Dressing percents of lambs fed the two experimental Rations:



4.11 Feed waste:

The study showed that the feed waste was 6% and 14% for the commercial fattening and barley-based rations, respectively. The high amount of waste observed in the barley based ration was due to the type of feeders used for this ration which was used to simulate similar feeders used in the extensive fattening operations. Lots of feed can be saved when use modern feeders as using in the commercial fattening operations.

5. Conclusion and Recommendations:

5.1 Conclusion:

The findings of this study are in agreement with other results concerning lambs fattening. Animals on the two diets had similar performance, as lambs fed similar diets in either of the two fattening systems in Palestine.

Anyhow the following conclusions can be stated:

1. Lambs fed commercial fattening rations had better performance compared to lambs fed barley-based rations, this can be reflected through Lambs gain and feed conversion efficiency.
2. Lambs fed the barley-based ration should stay for longer times under fattening in order to reach a suitable marketing weight.
3. The chemical composition of used barley is nearly the same of varieties reported by NRC.
4. The cost of 1-kg gain is lower for lambs fed the commercial fattening ration.
5. The cost of 1- kg ration is higher for the barley based ration due to the high cost of roughage.
6. Feed intake of lambs fed the barley-based ration is lower than that fed

the commercial fattening ration.

7. The digestibility of dry matter, crude protein and digestible energy is higher in lambs fed the commercial fattening ration.

8. Lambs fed the barley-based rations had heavier visceral organs, gastrointestinal components, especially the small intestine, and heavier gastrointestinal tract contents.

9. Lambs fed the barley-based rations had carcass cuts of less lean and fat but more bone, especially for neck and leg compared to other lambs.

5.2 Recommendations:

1. Lambs will have better performance when fed commercial fattening rations compared to barley- based rations.

2. The study suggests that the fattening system adopted by farmers in the eastern slopes should be changed to better fattening results.

3. More research is recommended to assure the feasibility of both fattening systems.

4. More research is needed to examine the lambs performance when fed processed barley with roughage of different qualities.

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7. APPENDICES

Appendix-1:

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

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

Calculation:

$$\% \text{ Moisture} = \frac{(\text{weight of can + sample before drying}) - (\text{weight of can+sample after drying})}{\text{weight of wet sample}} \times 100\%$$

Appendix-2:

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

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

Calculation:

$$\% \text{ Ash} = \frac{\text{(Weight of ash)}}{\text{Weight of sample (dry matter)}} \times 100\%$$

Appendix- 3:

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

Reagents:

1. Sulfuric acid (concentrated 98%).

2. Boric acid: 4% solution.

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

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

4. Indicator solution: screened methyl red indicator solution:

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

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

5. Digestion mixture: add to each digestion flask .19g of CuSO4.5H2O and 9.7g K2SO4 and mix.

6. Anti foaming granules.

7. Hydrochloric acid solution .01N.

Procedure:

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

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

3. Digestive the mixture until the solution becomes clear.

4. Transfer the digestion tube to connect the distillation unit, allow 50ml of distilled water to add into the digestion tube.

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

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

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

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

Calculation :

$$\%\text{Nitrogen} = \frac{\text{Vol. HCl X N. HCl X 14.007X 100 X 100}}{\text{100 X Weight of dry sample}}$$

% Crude proteine = % nitrogen x 6.25

Appendix-4 :

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

1. Weigh 2g sample into the extraction thimble.

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

3. Place thimble at the extraction apparatus.

4. Add 40ml diethylether to the solvent flask.

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

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

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

Calculation:

$$\% \text{ Crude Fat} = \frac{\text{Wt. Of flask after extraction} - \text{Weight of flask before extraction}}{\text{Weight of dry sample}} \times 100$$

Appendix -5:

- Crude Fiber Determination:

Reagents:

1. Sulfuric acid solution 0.255N

2. Sodium hydroxide 0.313N

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

3. Methyl alcohol and diethylether.

Procedure:

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

2. Add 200ml of 0.255N sulfuric acid.

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

4. Filter through filter paper.

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

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

7. Filter through a new filter paper.

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

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

Calculation:

$$\% \text{ Crude Fiber} = \frac{M1 - M0 \times 100}{M2}$$

Where:

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

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

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

Appendix - 6:

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

1. Neutral detergent solution:

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

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

- Dissolve 6.81g disodium hydrogen phosphate in some water.

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

- Check the pH to range 6.9-7.1.

Procedure:

1. Weigh 1g sample and put in a beaker.

2. Add in order, 100ml neutral detergent solution, and 2ml decahydronaphthalene and .5g sodium sulfite.

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

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

5. Wash twice with acetone.

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

Calculation:

$$\text{Neutral Detergent Fiber} = \frac{M1 - M0}{M2} \times 100$$

Where:

M0 = weight of the crucible.

M1 = weight of the crucible and sample after drying.

M2 = weight of the sample.

Appendix –7:

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

dissolve 20g of cetylmethylammonium bromide in 1 liter

Sulfuric acid (1N).

procedure:

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

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

3. Add 2 ml of decahhyronphalene.

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

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

6. Wash the fiber with acetone.

7. Wash the fiber with hexane.

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

9. Ash at 600 C overnight cools and weigh.

Calculation:

$$\text{Acid detergent Fiber} = \frac{M0 - M1}{M2} \times 100$$

Where:

M0 = weight of crucible and fiber

M1 = weight of crucible and ash.

M2 = weight of sample.

Appendix- 8:

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

Gross energy was determined using bomb calorimeter.

Equipment:

1. Oxygen bomb and accessories.

2. Balance with a accuracy of .1g

Reagents:

- Standard sodium carbonate solution.

- Methyl orange indicator.

- Benzoic acid composition tablets.

Procedure:

1. Weigh about 1g sample.

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

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

The oxygen bomb lid.

4. Assemble the bomb.

5. Fill the bomb with oxygen.

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

7. Measure 2000 ml and have it always at the same temperature to

22-23C.

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

9. Put the heaters on.

10. When ready to fire press the firing button.

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

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

13. Rinse the bomb with distilled water, collect the washings then titrate it with sodium carbonate (Na2CO3) with methyl red indicator.

Calculation:

$$GE(cal/g) = \frac{\text{final T-initial T x hydrothermal equavalent of bomb-length of fuse wire burned X cal Na2CO3}}{\text{Weight of dry sample}}$$

٨- الملخص

مقارنة وتقيم لنظم تسمين الخراف العواسي في فلسطين

اعداد

وجدي حسين علي حماد

المشرف

د. جمال أبو عمر

المشرف المشارك

د. راتب عارف

يهدف هذا البحث إلى دراسة الاختلافات بين نظامي التسمين المتبعين في فلسطين ، وكلا النظامين يعمل بهما في مناطق خاصة في الوطن وبنتائج مختلفة .

فقد تم تقسيم الستة عشر رأسا من الخراف الذكور العواسي إلى مجموعتين ، ضمت كل مجموعة ثمانية خراف ، غذيت الخراف في المجموعة الاولى بعليقه الأعلاف المركزة ، بينما غذيت المجموعة الثانية بعليقه الشعير (٧٠ % شعير ، إضافة إلى ٣٠ % قش البيقا)، ولمدة ٦٨ يوما .

وخلال هذه المدة تم وزن وتسجيل الأعلاف المقدمة والمتبقية والمستهلكة لكل مجموعة ، كما تم أخذ وزن الخراف أسبوعيا ، ووضع في سجلات خاصة أعدت لهذا الغرض .

وبعد مرور ٤٢ يوم من بداية التجربة تم فصل خروفين عشوائيا من كل مجموعة ووضع كل منهما في قفص منفرد ، وذلك لحساب معاملات الهضم ولمدة ثمانية أيام ، حيث تم خلال فترة هذه التجربة وزن وتسجيل الأعلاف المستهلكة والروث والبول لكل خروف على حدة ، واخذت عينات من هذه المواد وتم تحليلها لمعرفة معاملات الهضم.

وفي نهاية التجربة تم اختيار خروفين عشوائيا من كل مجموعة ، حيث تم ذبحهما ونزع الأحشاء الداخلية لكل منها ،اضافة الى أعضاء الجهاز الهضمي ومكوناته ومحتوياته ، إضافة إلى تقطيع كل ذبيحة إلى أجزاء اللحم والدهن والعظم ، حيث تم وزن وتسجيل ذلك لكل خروف في نموذج خاص اعد لهذا الغرض .

وقد تبين أن الخراف التي غذيت بالأعلاف المركزة (المجموعة الأولى) افضل من الخراف التي غذيت بالشعير (المجموعة الثانية) ، وهذا تبين من خلال الدلائل التالية :

- الكسب الكلي (الزيادة في الوزن الكلي) للمجموعة الأولى أعلى من المجموعة الثانية .
- معدل الزيادة الوزنية اليومية (٢٧٨ غم مقابل ١٤٤ غم) للمجموعة الأولى أعلى منه للمجموعة الثانية.
- الكفاءة التحويلية (٥,٥ كغم مقابل ٨,٣ كغم) للمجموعة الأولى افضل منه للمجموعة الثانية .
- تكلفة الكيلو غرام الواحد من اللحم للمجموعة الأولى اقل منه للمجموعة الثانية وهذا افضل، ويظهر فروقا معنوية .
- المادة الجافة ومعامل هضم الغذاء في المجموعة الأولى أعلى منها في المجموعة الثانية .
- لنوع العليقه تأثير على الأحشاء الداخلية ، وأعضاء الجهاز الهضمي ومكوناته ، حيث كانت اثقل في المجموعة الثانية منها في المجموعة الأولى ، وخاصة الامعاء الدقيقة .
- كانت الذبيحة تحتوي على اللحم الأحمر والدهن بشكل أعلى لخراف المجموعة الأولى منها للمجموعة الثانية ، بينما كان العكس لخصوص العظم وتحديدا عظم الرقبة والفخذ .