An-Najah National University
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A new Source of Fresh Green Feed (Hydroponic Barley) For Awass Sheep

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صدق الله العظيم

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Dedication

To my Parents, Brothers and Sister

With Love and Respect

Acknowledgments

I would like to express my sincere great thanks to my supervisor, Dr. Jamal Abu Omar for supervision, encouragement, guidance and help throughout this study.

Thanks to all my friends, especially Safa & Imtethal Samaneh, Dalal Jaber and Khetam Salameh for their support and encouragement.

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Abstract

This research was conducted to investigate the performance of lactating Awassi ewes when fed the hydroponic barley (HB). HB is fresh forage cultivated without soil or nutrients as fertilizers in part of the experiment and cultivated with raw olive cake as a media in the other. Barley seeds utilized in the research were cultivated in special trays for germination. At one part barley seeds were placed in these trays alone while in the other parts half of the barley seeds were placed on a thin layer of olive cake as a media for germination. For the performance study a total of 20 lactating Awassi ewes were used. The research was based on five feeding groups. In the first ewes were fed a barley basal ration. In the second and third groups, HB was incorporated in rations at levels of 15 and 25%. In the fourth and fifth groups HBOC was fed to ewes at levels of 15 and 25%. The experimental forage was used to replace concentrated feed and part of barley that used in the ration of the control ewes. Milk production and milk components were monitored in this research. Body weight change, health problems, fertility and twin percent were also investigated.

Results of the research showed that HB alone and with OC (HBOC) had various effects on most of the tested parameters. The HB and HBOC mass produced were 10 and 12 kg/ tray. Milk yield and milk total solids

were the highest (P<0.05) in ewes fed 25% of HB and HBOC. Milk protein and fat had increased (P<0.05) as a result of feeding the high level of HB and the two levels of HBOC. The body weight change was increased (P<0.05) in ewes fed the two levels of HB and the low level of HBOC. Both conception rate and twin percentages were improved in ewes fed the forage. No health problems were observed in ewes. These results indicated the importance of this forage as fresh forage in ewes' rations.

Chapter One

Introduction

1. General introduction

Despite its small size, the Occupied Palestinian Territories enjoy a diversity of climatic conditions and plants. Due to numerous restrictions by Israeli authorities, pasture areas have been reduced in size and the movement of shepherds controlled.

The importance of natural pastures for economic development is found primarily in their provision of feed and forage for livestock. Levels of animal production and livestock improvement are closely related to the condition of the country's pastures.

1.1 Background

Before 1967, natural grazing areas constituted 40% of the total area of the West Bank and Gaza. Most of this land was situated on the eastern slopes and highlands where the average annual rainfall ranges between 100-400mm. Presently less than 15% of the pre-1967 grazing areas are still accessible, constituting a marginal 3% of the total land area of the West Bank and Gaza (ARIJ,1999).

Most of the natural pastures in the southern and eastern parts of the West Bank were open to farmers before 1967. These areas were covered with herbs and shrubs, which provided feed for livestock for at least six months out of the year (Ayed, 2000). Since the Israeli occupation in 1967, military restrictions have gradually reduced the total number of dunums available for grazing. Broad areas of pastures have been closed or are in use by the military government, confiscated for settlement location, or designated as natural reserves where wild Animals make their habitat.

Based on an estimate reached using Geographical Information Systems, approximately 400-500 thousand dunums can be classified as natural pastures, of which nearly 90% are presently closed to farmers (ARIJ, 1999).

The livestock sector is an important branch of the Palestinian national economy. It contributes about (7.4%) of total agricultural income **(**Abu Laban, 1988). It contributes with about 38.6% of the total agricultural production. It involves livestock meat (55.7%) and milk (28%). The livestock meat production is concentrated in Hebron, Bethlehem and Gaza Strip. The livestock meat production is about 12.1 thousand tons/year while the annual needs of Palestinians are 35,000 tons/year; therefore, the deficit is about 22.9 thousand tons/year **(**Abu Lanan, 1988).

The grazing on the private rangeland, as if it is public, is a testimony of the failure of the land use. The environmental conditions of these lands deteriorated because of overgrazing and absence of improvement.

Rangelands in Palestine have been degraded since long for several reasons. The capacity of this rangeland area is not fully utilized due to the following main constraints:

1. The Israeli control on the land leads to the fact that most areas that can be considered as grazing areas are either confiscated or military closed.

2. The land ownership problems (land tenure) and fragmentation of property for lands available to Palestinians.

3. Overgrazing, which lead to the destruction of many rangeland plantations.

4. The absence of national organized management for grazing and rangeland areas.

5. The accelerated land degradation and soil erosion in the mountainous area of the West Bank of which the grazing land composes the majority.

6. The lack of awareness to the importance of the rangeland in the national economy.

7. The shortage of applied researches and advisory work for farmers and land users.

8. The lack of socioeconomic studies which are strongly related to rangeland and livestock and the modes of living for rural and Bedouin communities.

9. The absence of institutional bodies organizing those who are heavily involved in livestock raising and land owners to exchange benefits.

The most affected group in the Palestinian society by the dilemma of rangeland poor productivity are the Bedouins and farmers who are heavily dependent on livestock as a source of living. Those are marginalized sector among Palestinians and constitute a considerable percentage of the poor people in this society.

Recently, as shown by the records of the Palestinian Ministry of Agriculture (PMOA) (2001) great losses were recorded in the sheep and goats sectors due to lack of green forage. The last few years were characterized by low precipitation as it was below the average. Under such situation animals suffered from vitamins deficiency, especially of vitamin A. as a result, large number of cases of abortion and stillborn were observed, this was complicated with the high costs of both concentrated

feeds and roughages. To overcome this vital problem many attempts were made, such as utilization of agricultural and industrial by-products (Abu Omar and Ggavoret, 1995; Abu Omar, 2001; Abu Omar, 2002;Abu Omar, 2000; Azmouti, 2002; Rabayaa, 2000). In other countries, new procedures were attempted to provide the green forage. These procedures were focusing on simple techniques as planting seeds without soil while providing the plant requirements**.** This System assures a consistent supply of highly nutritious fresh green feed for all livestock, especially the dairy and meat production livestock on a year round basis for obtaining optimum benefits for the animals (Global Atlas, 2004).

1.2 Olive cake

Olive cake is on of the most by-products of local framing in Palestine. About 36,000 tons of the raw materials are available each year (Abu Omar and Gaveral, 1995; Abu Omar, 2000; Rabayaa, 2000). This amount is of a great importance as a potential feed component when used in sheep feeding. As known the feeding costs in Palestine farms make up to 70% of total production costs in sheep projects (Abu Omar, 2001). Therefore it is highly recommended to incorporate raw materials and farm by products in ration formulation as possible.

Crude olive cake is made of the skiff of the pit reduced to pieces of the mashed pulp; in addition to 25% of water and oil extracted cake has much lower water and oil content. Crude olive cake is poor in protein, but rich in cellulose as well as being relatively rich in fat (Harb, 1986). The removal of oil decreases the fat content (Abu Omar, 2001).

Table 1. Chemical composition of dry olive cake (4).

Item	Percentage
Moisture	11.5
Crude protein	5.2
Fat	5.2
Fiber	32.5
Lignin	23.0
NDF	75.8
Ash	2.3
NDF: Natural	Detergent fiber according to the van Soest
Fiber = AD Lignin	According to the van Soest method

Any how, fat content in olive cake depend on type of oil pressure and degree of pressing the cake.

1.3 Hydroponic barley (HB)

Hydroponic is often defined as the cultivation plants in water; the definition of hydroponic has been broadened to read the cultivation of plants without soil.

Hydroponic production is a half- century old method of cultivating plants using a soil less medium. The true hydroponic method of growing plants in a water and nutrient solution is rarely used as it is more difficult to use than more frequently used method growing in sand, gravel or vermiculite medium in beds or containers. The idea is to achieve maximum and uniform growth of plants by carefully controlling the amount of water and nutrients (Global Atlas, 2004).

1.3.1 The advantages of this method

The advantages of this method include:

1- Does not require soil.

2- Can use light weight materials that may suit rooftop growing.

3- Higher yields because of more rapid maturation of plants and more plants per unit area (no competitions for nutrients).

4- Soil nutrients are not diminished so crop rotation is unnecessary.

5- Weeds are minimal as sterile media are used.

6- Closed system means that pesticides and fertilizers are not washed into water table or streams.

7- Hydroponically grown fodder has high moisture content

8- Hydroponically grown fodder is dust free, which reduces risk, and helps prevent and cure respiratory disease.

9- In greenhouse only 2 to 3 liter of water are required to produce 1 kg. of green grass whereas conventional methods require an average of 80 liter water to produce the same quantity.

10- The growing procedure is simple to operate: irrigation, cooling, and lighting systems are controlled by one central electronic monitoring system and maintained at a very low cost.

11- Produces succulent green feed of constant quality and quantity every day of the year. The green feed produced is palatable, nutritious and free from contamination.

12- Green feed is nutritious & rich in energy comparable to commercial feed. Thus, requirements for concentrated feed products are reduced.

Fresh green barley grass produced is of such high quality that it is suitable even for all livestock (World Wide Sale, 2004). The fresh green feed is grown from any cereal grain seed, but the use of barley seed has

been found on a worldwide basis to be more practical because of its price and availability. Crude protein in the fresh green feed is maintained at 16% to 17%. A vitro digestibility of over than 85% was observed (Global Atals, 2004). It is high in vitamin E and beta carotene, which improves fertility in animals.

The development of the mechanically produced fresh green feed production system comes at a time when the world is facing serious deficiencies in food production caused by a number of factors. Most important of all is the annual increase in population and corresponding decrease of available arable lands and deficiency water resources.

The liquid protein and grass Juice factors contained in the fresh green feed coupled together with the dry matter is fed as a supplement just as any other plant product containing a high percentage of juices. The digestion of cellulose contained is most other high DM feeds is a accomplished, not by the secretions from the glands of animals, but by bacteria that inhabit the elementary canal and breaks down the complex carbohydrates into readily assailable products (Steven, 1996).

The enlarged and elaborated portions of canal of such animals enable the passage of the ingested material to be delayed optimum conditions of temperature, moisture and acidity for the action of the bacteria to accomplish the digestive process. The fresh green feed because of its palatability and digestibility coupled with high crude protein (amino acids) accelerate the digestive process of the other less digestive feeds and reduces the stress factor on the animal (Steven,1996). In addition, the important carotene in the liquid state of this feed have the right form of

conveyance of the energy that is otherwise lost in the digestive system through excrement.

All the vitamins are soluble free, thus able to be assimilate directly. Vitamin E found completely in an assailable state a freely circulates throughout the young plant, while in dry grain it is present in the cuticle covering and is eliminated without a benefit in the animal's excrement (Green field, 2004). Only when seed is sprout does the animal gain the importance of vitamin E that stimulates fertility. The production fresh green feed can be important element of overall ration, which has been proven to increase milk yields improve livestock health, reduce heat stress and increase birth rates (World Wide, 2004).

It is high in vitamin E and Beta-carotene that improves health and fertility in animals. The system produces feed by organic growth and it is taken very little space as compared to traditional methods of agriculture.

Table 2. Composition of HB

Analysis performed	Unit	Result
Protein	%	16.5
Ether extract	%	3.4
Moisture	%	84
Ash	%	3.6
Potassium	mg/Kg	180
Sodium	mg/Kg	36
Phosphorous	mg/Kg	150
Zinc	mg/Kg	4.634

3.2. Environmental impact

The Produce fresh green feeds uses very little water and do not cause soil depletion caused by excessive crop production and soil erosion. Also produce feed without any chemicals, pesticides or massive from of

fertilizers making the system 100% environmentally free (Global Atlas, 2004).

Fresh green feed is fed fresh to the animals it was not be faced with issues presented by dry alfalfa such as storage heat damage, dust and spoilage. The key for the animal nutrition's is predictability. The feed ration will be easier to control and calculate because the produced green fresh feed will be of consistent quality and quantity **(**Global Atlas,2004**).**

3.3. No wastage

In dry climates animals will resist eating feed. Moreover, they resist eating the other dry components of the feed ration such as concentrates. This results in a drop in productivity during hot summer months that may even lead to a total cessation of lactation. The cow's reluctance to consume dry feed, when under heat stress resulted in wastage. The fresh green feed enjoys an 85% digestibility factors and animals eat 100% of what is put free of them **(**Global Atlas, 2004**).** In Addition, cows will be encouraged to eat the other components of the feed ration. The combination of higher digestibility along with the increase consumption of complementary offset issues relating to dry matter intake.

3.4. No spoilage

Farms usually store dry feeds and a percentage of the stored process is lost due to spoilage, rot, disease, mold, pilfering and rodent. Another economical factor that is not taken in consideration when making an economical valuation of the fresh green feed **(**Global Atlas, 2004**).**

1.2 Objectives

1.2.1 Main objective

The objectives of this study were to cultivate and produce of the hydroponic barley alone and with olive cake under local conditions and study the performance of Awassi ewes consuming this product.

1.2.2 Detailed objectives

The detailed objectives were to investigate the effect of the HBOC on:

- Through the lactation season and pregnancy.
- Milk composition.
- Ewes feed intake and body weight change
- Conception rate and twin's percent.
- The feasibility of feeding these products.

Chapter Two

Materials and Methods

2.1 Cultivation of HB

Barley seeds were obtained from a local supplier and were taken to the experiment site in local farm in Salem village close to Nablus city. Seeds were manually cleaned from any foreign seeds or materials as possible**.**

Plastic trays were used to germinate barley seeds. The trays used had the dimensions of 100cm length X 50cm width X5cm height**,** half of trays were planted only with barley while the other half were planted with barley seeds with raw olive cake as a media for germination (Figure 1). Barley seeds were placed on trays with 2cm thickness and in other preparation with 1 cm thickness.

The trays have a drainage ports to collect water used in soaking barley seeds. The barley seeds were placed in the trays to have a thickness of two centimeters. Soon after that, seeds were soaked with water for few seconds. Used water was permitted to drain for collection in order to be used again. The soaking of barley seeds was repeated twice daily for 14 days. At end of this period the barley seedling reaches the height of 14 cm. It has carpet like appearance with dark green color and thick roots (Figure 2). The amount of barley seeds per tray was 2 kg of pure barley seeds. When used with olive cake as germination media only 1 Kg of barley seeds were utilized.

Figure 1. Hydropnic barley cultivate in plastic trays

Figure 2. Hydroponic barley in greenhouse

2.2 Sheep handling

A total of 20 of about two years old Awassi ewes one month of lactation were used in the experiment. Animals were purchased from a local livestock market. At the experimental farm ewes were vaccinated against enterotoxaemia and were treated for both internal and external parasites. This treatment was repeated after three weeks of feeding the experimental diets. A pregnancy test was made and ewes were sheared at proper time.

Ewes were randomly divided into five experimental groups with 4 ewes in each. Ewes were fed individually where each was considered as a replicate (Figure 3). The pen space allowed for each ewe was 1.5x1m. Ewes were fed the experimental feeds for 120 days. Ewes' body weights were recorded every 30 days.

Figure 3. Ewes fed in the experiment individual

2.3 Feeding trial

The five experimental groups were the control (C), which was fed 70% whole barley grain, 13%wheat bran, 15% concentrate feed and 2% salt (Table 1).). In groups 1 and 2 HB was added to diets at rate of 15 and 25% respectively. These amounts of HB were added to replace part of barley grains and the total amount of the concentrated feed. However, in groups 3 and 4 hydroponic with olive cake (HBOC) was introduced to rations to replace part of barley grains and the concentrated feed (Table 3). Rations were used to meet the NRC (1984) sheep requirements.

Table 3. Composition of the experimental diets

Ingredients % of diet	**Control**	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Barley	70	70	60	65	55
Barley carpet (HB)	0	15	25	0	0
Barley carpet with Olive cake (HBOC)	0	0	0	15	25
Wheat bran	13	13	13	13	13
Conc.	15	0	0	5	5
Salts	2	2	2	2	2

Table 4. Chemical composition of experimental diets.

Item %	Control	Group 1	Group 2	Group3	Group4
CP	12.7	12.6	13.0	12.0	13.00
DM	88.7	23.5	61.5	44.1	66.8
Ca	0.4	1.0	0.5	0.6	0.4
P	0.3	0.4	0.3	0.4	0.3

2.4 Milk collection

The ewes were milked twice per day, in the morning and afternoon. Total milk production was recorded per ewe. Milk samples were collected on monthly basis till the termination of the experiment.

2.5 Chemical analysis

Samples of grain barley, HB, HBOC, concentrated feed and the experimental rations were analyzed for crude protein, crude fiber, crude fat, ashes, nitrogen free extract, calcium and phosphorus. Milk samples were analyzed for total solids (Ts), fat and protein. Total solids were determined by oven drying at 60^{o} C while protein was determined using microkjedahl method. Gerber method was used for fat analysis.

2.6 Statistical analysis

Data of the experiment were analyzed using SPSS package. Analyses of variance (one way analysis of varies) for mean separation was applied.

Chapter Three

Results and Discussion

3.1 Hydroponic barley

A total of 10 and 12 kg of HB alone and HBOC (HB with olive cake) were produced out of 2kg and 1 kg barley seeds. These results were similar to that reported by other research (Steven, 1996). However utilizing olive cake as a media for germination increased the HB mass by 20%. The extra nutrients available in the raw olive cake could be responsible for that improvement in the HB nutritive value.

The chemical analysis of HB and HBOC is shown in table (5). The crude proteins content of the experiment diets range from 11to 16.9%. The crude proteins content of HBOC is similar to that of barley seeds while the crude proteins content of HB is similar to that of wheat bran (Table 5). These percentages resemble the protein contents of diets fed to ewes at this stage of production in local sheep farms.

Table 5. Chemical composition of HB and HBOC (DM basis).

Item	Crude protein %
Barley grain	11.1
HB	16.9
HBOC	11.0
Wheat bran	17.2

The crude protein content of HB is closed to the value reported (Global Atlas, 2004). However, protein contents of HBOC was consistent to that was reported by other researchers (Global Atlas, 2004).

Figure 4. Hydrponic Barley and Hydroponic barley with olive cake after 13 day from cultivated.

3.2 Milk production and chemical composition

Type of diet had an effect on both milk yield and milk quality (Table 6). The yield averages among groups were 185,190, 200, 180 and 251 g/day for the control group to the 4th group respectively. The relatively low averages of milk yield recorded can be explained by that the experiment was started one month after initiation of lactation and the general poor conditions of ewes used in the experiment. Most of available ewes in sheep farms are of similar quality. Group 2 and 4 which was fed the highest level of HB and HBOC diet had the highest ($P<0.05$) milk yield compared to other experimental groups. This result is in agreement with other findings reported by previous research (Slievenamon, 1998).

Table 6. Milk production and milk chemical composition:

Items	Control	Group 1	Group 2	Group 3	Group 4
Milk Yield (g/day)	185	190	200	180	251
Protein % Before	5.2	5.6	4.7	5.3	5.2
After	6.6	7.2	7.7	7.7	8.8
% change in protein	1.4b	1.6b	3.0a	2.4a	3.6a
Fat % before	6.4	5.0	6.4	6.6	4.3
After	6.6	6.2	5.5	7.6	5.8
% change in fat	.2b	.5b	1.4a	1.0a	1.5a
Total solids Before	15.4	16.5	17.8	18.5	16.2
After	17.4	18.5	20.8	20.5	20.1
% change in TS	2.0b	2.0b	3.0a	2.0b	3.9a

Milk from ewes fed diets with 25%HB and the two levels of HBOC had the highest ($p<.05$) percent change of both protein and fat content. Similar results were reported by other research (Global Atlas, 2004). Changes in Protein percent were 1.2, 1.6, 3, 2.4, 3.6 for the five experiment groups, respectively (table 6). The percent changes in fat content were 0.2, 0.5, 1.4, 1.0, 1.5 for the five groups, respectively (table 6). However, the change in milk total solids (TS) were lower ($P<0.05$) in milk of ewes fed diets including 15% HB and 15% HBOC (Table 6). These results showed the importance of both HB and HBOC in improving milk yield and quality.

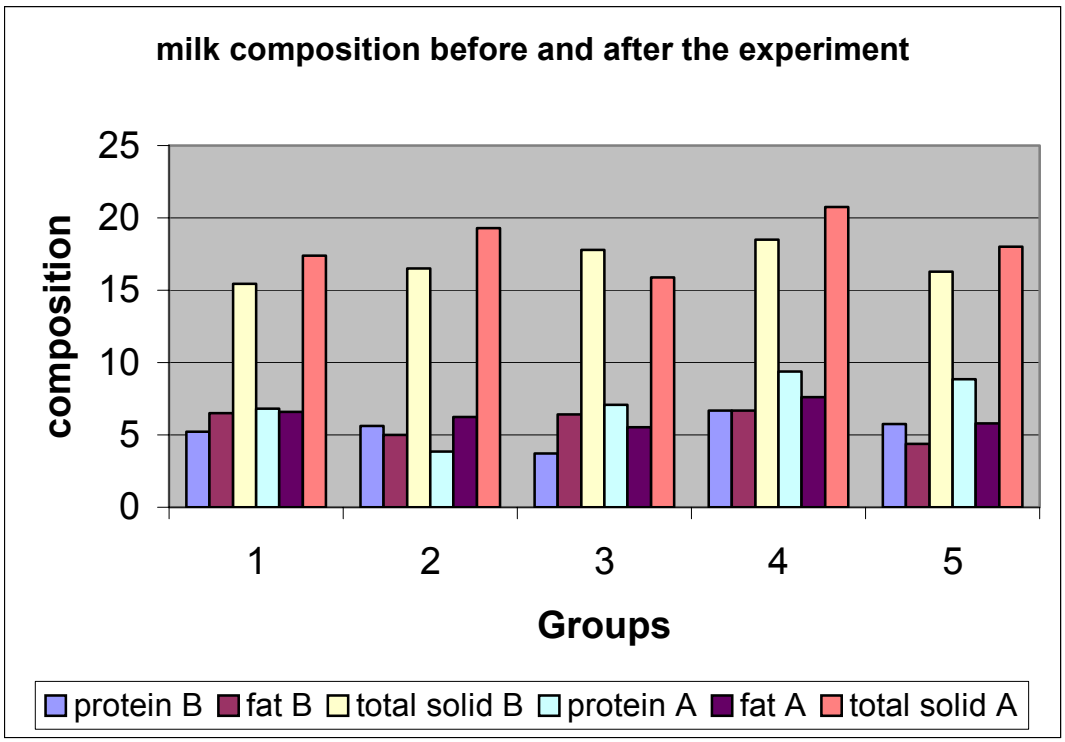

Figure 5. Compared between milk composition before the experiment and after the experiment. B; before the experiment / A; After the experiment

3.3. Body weight change

Table (7) shows the performance of ewes used in the experiment which lasted 120 days. Ewes fed the two levels of HB and 15% of HBOC had higher ($P<0.05$) weight gain compared to ewes in other groups. More than 25% increase in body gain was observed. This weight improvement can be explained by the availability of nutrient of the experimental materials. Similar trend was observed for average daily gain where ewes fed the two levels of HB and the 15% HBOC had the highest ($P<0.05$) daily gain. These results are similar to that reported by other research when ewes and does fed commercial lactating rations (Abu Omar, *et al.*, 1997).

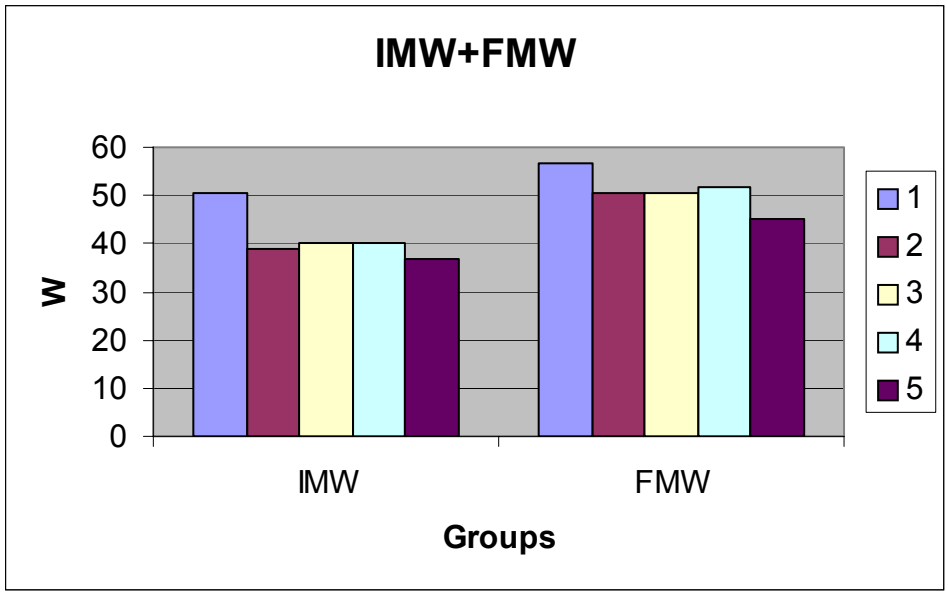

Figure 6. Compared between Initial Mean Weight and Final mean weight; IMW: Initial mean weight; FMW: Final mean weight

3.4 Feed intake

Feed intake was declined as the pregnancy advances. Other factors described as influencing feed intake are milk production level, condition, temperature, shearing, type and quality of forage, pasturing system, breed, concentrate ration (Verkaik, 2001).

The experimental diets had an effect on feed intake. Feed intake was higher ($P<0.05$) in ewes fed the two levels of HB and 15% HBOC (Table 7). The high intake observed could be due to the high palatability of HB used. The feed conversion efficiency ratios (kg feed /kg gain) were the best ($P<0.05$) in ewes fed the low levels of HB and HBOC. However, cost of total gain was the same of all treatment groups (Table 7). This proves that use of HB is of an economical importance. These results may prove the feasibility of using both HB and HBOC as feed ingredients for ewes.

Table 7. The economical results of the experiment

No. of Sheep	Unit	Contro	1	2	3	4
Number	Ewe	4	4	4	4	4
Duration	Day	120	120	120	120	120
Age	Year	2	2	2	2	2
Mean weight change	Kg	6.0b	11.5a	10.3a	11.2a	8.3b
Mean Daily Gain	g/day	50b	95.5a	85.8a	93.7a	68.7b
Daily Feed Intake	Kg/day	2.91b	3.83a	3.22a	4.8a	2.7b
Feed conversion efficiency	Kg diet/kg Gain	58.2a	40.0a	37.5b	51.4a	39.0b
Cost of total gain	NIS	314.3	538.2	363.1	518.1	284.8
Cost of diets	NIS/kg diet	0.9	1.17	0.94	0.9	.88
Cost of 1kg gain	NIS/kg gain	2.619	3.86	3.27	3.69	2.87

3.5 Health problems

Along with the course of the experiment one of pregnant ewe was infected with pregnancy toxemia at last stage of pregnancy it yielded a healthy single lamb. As precaution the whole heard was treated with vitamin b12 and does of honey.

3.6 Conception rate

The rate of conception was the best in ewes fed the lowest level of HB, compared to ewes in the rest of the experimental groups.

3.7 Abortion

No cases of abortion were observed in the experimental ewes. This indicated availability of nutrients in HB and HBOC that is required by

ewes to maintain pregnancy. Adequate levels of vitamin A (carotene) might be the explanation of maintaining pregnancy while consuming this type of diet.

3.8. Mortality

The survival rate in experimental ewes was 100%. The nutrient supply was enough to maintain and cover energy requirements of experimental ewes. Good healthy conditions were observed along with the experiment route. Sizable mortalities are observed in similar heard consuming traditional feeds, especially is the area around the experimental site. Experimental rations are good enough to prevent mortalities

3.9 Twins

Type of diet had an effect on twin percent. Under normal raising conditions, this percent in Awassi breed is lower than 10%. However, HB increased the twin percent by 10%. This will add to the advantages of HB when used in Awassi ewes rations. The vitamin A content of the HB and HBOC played a role in thin aspect through improving the ovulation and conception ratio.

3.10 Conclusion

1- The Hydroponic barley (HB) and Hydroponic barley with olive cake (HBOC) mass produced were 10 and 12 kg of the raw product /tray

2- Milk yield and milk total solids were the highest ($p<0.05$) in ewes fed 25% of HB and HBOC.

3- Milk protein and fat had increased ($p<0.05$) as a result of feeding the high level of HB and the two levels of HBOC.

4- The body weight change was increased ($p<0.05$) in ewes fed the two levels of HB and the low level of HBOC.

5- Both conception rate and twin percentages were improved in ewes fed the experimental forage.

6- No health problems were observed in ewes.

3.11 Recommendation

Due to lack of pastures and high cost of fodder, it is so important to utilize alternative fodders with low cost and with high nutritive value. Hydroponic is one of the future solutions of the shortage in the green fodder. The results obtained from the experiment on the local Awassi sheep are of great encourage. Therefore, it is recommended to local farmers to use HB as an alternative fodder not only for sheep but also for all different types of livestock. More research is needed to assure our findings.

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Appendices

- **Tests Prove Results**
- **The Green Machine**
- **Costs of Fodder Factory**
- **Concern over feeding shoots to cattle and sheep**

Tests Prove Results

An independent study of hydroponic fodder production was made by Prof. C.A. Arano of Buenos Aires through the 1970's and 80's. The following is drawn from his published results:

"Each kilogram of fodder is equivalent nutritionally to 3kgs of lucern. In a test of milk production with a diet of fodder versus one of normal feeds such as grain, hay or silage, the group of 60 cows on a fodder diet increased their milk production by 10.07% over the control group. In addition, the group fed on fodder produced a butter-fat content of 14.26% higher than those fed on a regular diet.

Racehorses fed on fodder performed better and zoo animals which are accustomed to a grass diet in their natural habitat were healthier in confinement when fed fresh fodder all year round."

LABORATORY REPORT - MN96/8826/M

NSW Agriculture
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Owner Fodder Factory Aust P/L, Wingham

Subject Feeds Evaluation.

Final report

LABORATORY RESULTS, FEEDS EVALUATION SERVICE

RUMINANT FEED PACKAGE - RESULTS OF ANALYSIS All Results Expressed on a Dry Matter Rasis Proximate Analysis	Result
Dry Matter	% 15.43
Nitrogen	% 12.76
Crude Protein	% 17.3
Acid Detergent Fibre	% 15.09
Digestible Dry Matter	% 78.4
Metabolizable Energy	Mj/kg 11.8

Mineral Analysis All results expressed on a dry matter basis	Result
Phosphorous	% 0.30
Potassium	% 0.56
Calcium	% 0.07
Magnesium	% 0.4
Sodium	% 0.1
Manganese	mg/kg 20.83
Copper	mg/kg 8.00
Zinc	mg/kg 31.80
Iron	mg/kg 168.00

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The Green Machine
Hydroponic Fodder Feeder

Along with its' wholly owned subsidiary All Hydroponic and Horticultural Supplies are one of the newest manufacturers of hydroponic fodder equipment, with our involvement in horticulture since 1979, supplying solar greenhouse materials to Waikato University in New Zealand. To cover a greenhouse, which grew the first fresh vegetables grown in Antarctica , with outside temperatures rarely exceeding 0°C and inside temperatures exceeding 40°C on occasions. Along with our distributorship of Growth Technology products it enables us access to their well know nutrient chemist, with whom we have developed our own crop specific barley nutrient.

Manufactures plastic bubble material for pool, greenhouse, aquatic weed control and dam covers as well as solar greenhouse and root zone heating. All hydroponics and Horticultural Supplies wholesale crop specific nutrients and horticultural hardware, i.e. temperature controllers, mishing equipment co2, hydroponic controllers and metering equipment. We commenced our research on hydroponic fodder some 18 months ago after a number of enquiries from farmers seeking information/sourcing equipment to grow hydroponic fodder.

We first researched traditional controlled environment growing which proved to be complicated by a number of factors. We then researched how barley grows in field conditions with high daytime and low night time temperatures with the driving force to its' growth being soil temperature with our experience in root zone heating we are able to emulate ideal root

zone temperature all year round. This eliminates the need for a purpose built controlled environment, we are presently commissioning our first unit, which is a fully organic one tone per day unit in machinery shed, with current outside night temperatures below 0°C. We have also taken into consideration, farmers and small producers' needs, by building our units in 250 kilo per day modules, enabling start up with a small investment and growth with additional 250 kilo modules as confidence and needs permit.

Mould is one of the main concerns with hydroponic fodder, under certain conditions it can produce ochratoxins which is severe cases, can affect an animals central nervous system (staggers) and in some extreme cases result in death. Mould spores are present on all grains, especially aspergillus and penicillin, to reduce mould we add live bacteria which attacks the mould reducing the amount of spores developing while being soaked. These same moulds present themselves in badly stored grain and silage that has not been properly sealed and also in silage pits that have been opened and resealed.

Costs of Fodder Factory

What?s your problem in weight gain production-Lack of profit? Weather? Drought? Quality and quantity of land? Or just plain old inconsistencies in all the above on a daily basis? Producing green year round can be difficult, expensive and time consuming.

Feed costs must be reduced to restore the profit margin to the farmer. Fodder Factories have done this for many farmers and will do it for you. One Australian farmer who recently purchased a series 960,did accurate weight gain tests on a large herd of steers and said **"I found that the herd, when fed at a rate of 2kg of fodder per 100kg of body weight, gained an average of 1.36kg per animal per day."** This was nine times greater than the same group could gain in the paddock.

- Fodder Factories will? Finish your? stock
- Fodder Factories will? Drought proof? your property
- Fodder Factories will take the gamble out of farming
- Fodder Factories produce you more feed and save you time and money
- Fodder Factories produce fodder for you every day regardless of the weather conditions.

Series 480 is a stand alone model with all components.

- Produces in excess of 480 kg of fodder per day
- Only uses about 400 litres of water per day
- Total cost on your slab $44,990 excluding G.S.T and Freight

Series 960, our most popular model also with all components

- Produces in excess of 780kg of fodder per day
- Only uses about 960 litres of water per day

- Total cost on your slab $ 59,990, excluding GST and freight

K1400 is a stand alone model with all components

- Produces 11/2 tonnes of fodder per day
- Only uses about 1,300 litres of water per day
- Total cost on your slab $64,990 excluding G.S.T and Freight

Mach 2 is the culmination of 14 years of research and development.

- Trailer access doorway.
- Produces in excess of 2 tonne of fodder per day
- Total cost on your slab $69,990, excluding GST and freight

Stage production techniques allow you to operate the Fodder Factory to suit animal growth rates, for example , if you have young stock coming on, you can operate the system at a quarter then and so on as the animals grow , or conversely, as you can gradually add to your herd. The Fodder Factories give you predictability? It is the type of control you should have to be successful. Reported yields of up to 9.6kg of fodder per 1 kg of grain can be produced regularly. Not all farms need a fodder factory; however, if more farmers had Fodder Factories there would be a more successful. This is an Australian innovation borne out of necessity. If you would like to increase not only your bottom line? Then phone me today for further information.

PETER RYAN

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Concern over feeding shoots to cattle and sheep

NSW Agriculture says producers weighing up the pros and cons of feeding cereal shoots to their livestock need to adequately assess their value before investing in infrastructure and ongoing costs. Reports of seven to ten fold increases in weight obtained from cereal shoots when compared to the initial weight of grain are misleading, according to NSW Agriculture Technical Specialist (Grazing Systems), Alan Bell. "A comparison of this nature is not like comparing apples with apples," Mr Bell said. "To make a valid comparison, the grain and shoots need to be compared on a dry matter basis. "Barley grain contains about 90 per cent dry matter and 10 percent water, while barley shoots contain about 13 per cent dry matter and 87 per cent water. "Nutrients needed to maintain and grow livestock, such as energy, protein, minerals and vitamins, are contained in the dry matter. There is no nutritional value in water." He said a more valid comparison would be along the following lines.

"If 100 kg of barley grain (90 per cent dry matter) is the initial grain weight, then this is equivalent to 90 kg of grain dry matter. "If that grain is then grown out over seven days to say 700 kg of barley shoots (13 per cent dry matter), which includes both the plant shoots and roots, the amount of dry matter is 91 kg, which is essentially the same as the initial weight of the grain"

If this example accurately reflects the production benefits of producing shoots, potential investors need to seriously ask whether it is worth investing in high-cost shoot production facilities, according to Mr Bell. "It would be better to feed a ration based on the grain, maybe adding additional feed supplements if required to ensure the ration is nutritionally

balanced," he said. "Therefore, the question of whether there is a difference in nutritional value between the dry matter of grain and the dry matter of shoots is an important one." Energy derived from carbohydrates such as sugars, starches and protein is the most important component of feed - the amount consumed largely determining the level of livestock production.

A recent study by NSW Agriculture compared barley from a number of sources and the same barley grown out into shoots. It found the energy content between the two was similar and the crude protein content of the shoots was on average 4.2 percentage units higher. Most feed testing laboratories analyse the level of nitrogen in the feed to predict crude protein. This was the method used to derive the figures in NSW Agriculture's study. As the hydroponic solution sprayed regularly over the shoots contains nitrogen, the above crude protein may not reflect true protein because of the non-protein nitrogen remaining on the leaves and roots. While highlighting the obvious disadvantages, Mr Bell said there were some positive aspects to feeding cereal shoots to cattle and sheep.

"Energy in grain is largely in the form of starch, whereas the energy in shoots is primarily derived from soluble sugars," he explained. "It is starch that predisposes livestock to grain poisoning or acidosis. So while there is a risk of this problem in grain based diets unless managed properly, there is minimal risk of acidosis with shoots. Acidosis on grain-based diets can be managed by slowly introducing the grain component to stock. "Also, unless grain is processed (rolled, cracked or steam flaked) some will pass through cattle undigested.

"Wastage of this nature will not occur with shoots. However, wastage may also occur in the case of shoots with reports of sheep and young cattle refusing to consume the shoot roots."

Producers feeding or contemplating feeding shoots should be aware that a number of separate incidences of nerve damage and livestock deaths have been reported after being fed shoots. These have been attributed to poisoning cause by a commonly occurring fungus. Stock should not be fed any feed where moulds are present unless the risks have been thoroughly evaluated.

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جامعة النجاح الوطنية
كلية الدراسات العليا

مصدر جديد لمادة علفية خضراء من Hydroponic Barley لأغنام العواسي

إعداد
انتصار فايز عادل اشتية

إشراف
الدكتور جمال ابو عمر

قدمت هذه الدراسة استكمالاً لمتطلبات درجة الماجستير في العلوم البيئية بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2003

مصدر جديد لمادة علفية خضراء من
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الملخص

تهدف هذه الدراسة لمعرفة تأثير المادة العلفية Hydroponic Barley على الأغنام العواسي وهي مادة علفية خضراء يتم زراعتها في صواني بدون تربة ولا يستخدم اي من الكيماويات ولكن في هذه الدراسة تم إضافة جفت الزيتون, حيث تم زراعة بذور الشعير في صواني خاصة للإنبات, جزء من الصواني تم زراعتها فقط بالشعير اما الجزء الأخر فقد تم إضافة طبقة من جفت الزيتون.

تم عمل الدراسة على 20 راس من الغنم العواسي , حيث تم تقسيمها إلى خمس مجموعات، المجموعة الولى مشاهدة , الثانية والثالثة تم تغذيتها بالمادة العلفية غلى مستويان 20%, 25% , المجوعة الربعة والخامسة غذيت ب Hydroponic barley with olive cake بمستويين 20 %, 25 % , حيث تم استبدال جزء من العلف المركز بالمادة العلفية الخضراء والذي استخدم في مجموعة المشاهدة.

هذا وقد تم في الدراسة قياس العوامل التالية: إنتاج الحليب ومكوناته, اختلاف الوزن, المشاكل الصحية, نسبة الخصوبة, ونسبة التوائم. كل 2 كغم من الشعير تعطي 10- 12 كغم من المادة العلفية الخضراء. أظهرت النتائج أن تغذية الأغنام ب Hydroponic Barley و Hydroponic Barley with olive cake أعطت نتائج مختلفة على العوامل التي تم دراستها . فقد كان هناك فرق معنوي في إنتاج

الحليب والمواد الصلبة ($P<0.05$) في المجوعات التي غذيت على 20% من Hydroponic Barley و Hydroponic Barley with Olive cake , وهناك زيادة وفرق معنوي نسبة البروتين والدهن في الحليب ($P<0.05$) في المجموعة الثانية و والرابعة والخامسة.

وفي عامل التغير في الوزن كان هناك زيادة في الوزن وفرق معنوي ($P<0.05$) في المجوعتان اللواتي تم تغذيتها على 20% ,25% Hydroponic Barley و المجموعة التي غذيت على 20% Hydroponic barley with olive cake.

اما نسبة الخصوبة ونسبة التوائم كان هناك تحسن بشكل عام، وأيضا لم يكن هناك مشاكل صحية أثناء التجربة, وأظهرت النتائج اهمية الأعلاف الخضراء للأغنام.