Hebron University

College of Graduate Studies & Academic Research

Determination of the Nutritive Value of Some Dominant Rangeland Plants in West Bank

By

Riham Majed Abu Munshar

Supervisor

Prof. Dr. Ayed Salama

This thesis is submitted in partial fulfillment of the requirements for the degree of Master in Program: Natural Resources and their Sustainable Management, College of Graduate Studies & Academic Research, Hebron University, Palestine.

July, 2023

Determination of the Nutritive Value of Some Dominant Rangeland Plants in West Bank

By

Riham Majed Abu Munshar

This thesis was successfully defended and approved on 6/7/2023 by:

Examination Committee		**Signature**
1- Prof. Dr. Ayed Salama	(Chairman of committee)	________
2- Prof. Dr. Rezq Basheer-Salimia	(Internal examiner)	________
3- Dr. Husameddin Isaid	(External examiner)	________

Dedication

To my true source of hope, to the person who keep my going through struggles, to reason of what I become today, my Mom ♥.

To my dearest brothers (Dr. Riyad ♥, Dr. Abdul Rahman ♥, Dr. Omar ♥ and Dr. Abdullah ♥) and sister (Reem ♥), your encouragement and continuous support are only matched by your big hearts and pure souls.

To my lovely husband (Mutaz ♥), the constant source of motivation and inspiration.

To the two pieces of my heart, my daughters Marya ♥ and Basima ♥, I just want you to know that you count so much.

To my friends, for all your prayers and benedictions.

Last but not least I am dedicating this to my father (Majed ♥♥) gone forever away from our loving eyes and who left a void never to be filled in my life. Though your life was short, I will make sure your memory lives on as long as I shall live. I love you and miss you beyond words. May Allah (SWT) grant you Jannat Al Firdaws.

Acknowledgements

First of all, I would like to start by thanking Allah for his blessing and giving me the strength to complete this thesis. Praise be to Allah in the beginning and in the end.

My deep gratitude goes for my university, Hebron University, this high standing edifice of knowledge.

I would like to express the deepest appreciation to my supervisor Prof. Dr. Ayed Salama for his continuous follow up and advices for this good completion, in addition to his motivation and guidance.

Thanks are extended to the committee members Prof. Dr. Rezq Basheer- Salimia and Dr. Husameddin Isaid, for their helpful feedback and suggestions.

Also, I would like to thank Mr. Omar Nasser and Mr. Salman Tomaizi for their help in laboratory work, Mr. Ibrahim Gannam who helped me in samples collection and I am deeply grateful to all members of Faculty of Agriculture at Hebron University; teachers and assistants who were and will always be our family.

I would like to thank Union of Agricultural Work Committees (UWAC), who funded my master study.

Thank you all from the depth of my heart.

Table of Contents

Chapter Two: Materials and Methods

Chapter Three: Results

Chapter Four: Discussion

List of Tables

List of Figures

List of Abbreviations

ADF:	Acid Detergent Fibers.
AOAC:	Association of Official Analytical Chemists.
ARIJ:	Applied Research Institute of Jerusalem.
Ca:	Calcium.
CF:	Crude Fibers.
CFt:	Crude Fat.
CP:	Crude Protein.
CRD:	Completely Randomized Design.
DM:	Dry Matters.
FAO:	Food and Agricultural Organization.
GIS:	Geographic Information System.
HSD:	Highest Significant Difference.
IFAD:	International Fund for Agricultural Development.
MC:	Moisture Content.
NDF:	Neutral Detergent Fibers.
NRC:	National Research Council.
PCBS:	Palestinian Central Bureau of Statistics.
PEnA:	Palestinian Environmental Authority.
RP:	Reproductive Parts.
IBM SPSS:	Integrated Best Management-Statistical Package for Social Science.
UWAC:	Union of Agricultural Work Committees.

Abstract

Determining the nutritional quality of the main botanical components (grasses and forbs) in semi-arid rangelands is essential for establishing a rangeland management plan to meet the grazing animals' nutrient requirements. The aim of this study is to determine the chemical components of selected dominant rangeland plants and the change in their chemical composition at different seasons and different parts for the same species. Seven dominant species of grasses (*Hordeum spontaneum* and *Avena sativa*) and forbs (*Medicago orbicularis, Onobryches crista-galli, Anthemis palaestina, Trifolium stellatum* and *Sinapis alba*) were collected during early spring of 2020 and early summer of 2020 from Bani Na'im site, samples were separated to leaves, stems and reproductive parts (RP), then prepared for chemical analysis. Completely randomized design (CRD) was used for statistical analysis with 3 replicates. The results showed significant differences ($P \leq 0.05$) between plant species and parts, effect of season was also appeared. It is found that crude fibers (CF), acid detergent fibers (ADF), neutral detergent fiber (NDF) and Ca levels increased in early summer. While, crude protein (CP), crude fat (CFt), K, P and N levels decreased. *S. alba* has the highest crude fat, fibers, ADF, NDF and mineral content when compared to other species. Grasses recorded relatively high CF and ADF levels in early spring.

When comparing chemical composition among seasons, dry matter (DM) content was ranged from (80.93 - 96.33) %, of *A. palaestina* was the highest in early summer, whereas in spring from (6.17 - 36.00) %, the highest value was found in *A. palaestina* leaves. Ash content was ranged from (3.73 – 26.32) % in spring, leaves of *O. crista-galli* were the highest and fruits of *A. sativa* were the lowest, whereas in summer ash content ranged from (5.29 – 30.48) %, the highest value was found in *O. crista-galli* leaves and the lowest was found in *S. alba* stems. In early spring, the highest values of protein levels were 28.61% and 28.34% for *M. orbicularis* (forbs) and *T. stellatum* (forbs) respectively. While in early summer, the lowest protein levels were 6.60% and 7.68% for *H. spontaneum* (grasses) and *A. sativa* (grasses) respectively. In early spring, fat content was ranged from (2.14 – 7.36) %, leaves of *A. palaestina* were the highest whereas in summer fat content ranged from (0.06 – 5.19) %, the highest value was found also in *A. palaestina* leaves.

CF ranged from (17.69-39.20) % in spring, whereas (21.99-61.55) % in summer. For ADF, in spring the value ranged from (22.02%-41.11%) whereas in summer it ranged from (26.06%-66.21%). In early spring, NDF ranged from (26.58%-62.78%) whereas in summer it ranged from (35.38%-73.79%).

At the level of comparing plant species, *M. orbicularis* (28.61%) *and T. stellatum* (28.34%) followed by *S. alba* (24.12%), are highly significantly different (P≤0.05) in CP compared with other species at early stage of growth. Likewise, at maturation stage, protein percentage in forbs were highest in *A. palaestina* (13.38%) > *M. orbicularis* (12.06%) > *T. stellatum* (10.38%) > *O. crista-galli* (9.08%), followed by grasses. *A. palaestina* is the richest plant in CFt (7.36% in spring and 5.91% in summer). At early stage of growth, *O. crista-galli* was significantly (P≤0.05) the highest in CF% (32.28%) compared with other plant species, whereas at maturation, *S. alba* was significantly (P≤0.05) the highest in CF% (47.12%). At spring, *A. sativa* and *M. orbicularis* were significantly higher (P≤0.05) in NDF than other plant species, they had (56.44% and 52.80%) NDF respectively.

So, to justify sustainable development targets, lands covered with the investigated species would satisfy ruminants needs during spring and early summer seasons especially *T. stellatum* and *S. alba*.

Keywords: Nutritive value of Rangeland plants, *H. spontaneum, A. sativa*, *M. orbicularis,* *O. crista-galli*, *A. palaestina, T. stellatum, S. alba*.

Introduction

The number of sheep and goats in West Bank and Gaza Strip is about 946,230 heads (PCBS, 2023). About 36% of the agricultural gross domestic product is from sheep and goats (Baumgarten-Sharon, 2017). A small proportion of these ruminants were raised totally under shed conditions while the majority utilize the natural rangeland to obtain part of its feed needs.

Rangeland in West Bank drastically suffer from deterioration, many causes led to such deterioration that includes: rainfall fluctuation, trees and shrubs uprooting for heating, the interchangeably use of marginal lands for crop cultivation and grazing without following the correct and new agricultural technique, early grazing and sever overgrazing with a presence of a large numbers of livestock around (ARIJ, 1994; PEnA, 1999). In addition to these destructive factors, rangeland for sorry was neglected during the years of Israeli occupation which led to increase the pressure of grazing since the number of sheep and goats was increased per area. The number of threatened plants in West Bank almost become 569 species according to Al-Sheikh and Qumsiyeh (2021). As a result, vegetation cover was almost disappeared, vegetation productivity was mightily decreased, presence of unwanted and poisonous plant species over beneficial ones, and so the soil was eroded which in turn led to desertification in those rangelands (Mohammad, 2005; Salama and Al-joaba, 2008). This retrogression in range condition caused lack in animal feed sources and quality, and hence reduction in meat production and increasing the cost of importing feedstuffs.

The chemical composition, which is the starting point for determining the nutritive value of feed, differs with different species, environmental conditions, soil characteristics and composition, and the plant growth rate (Davis, 1981; Jehanger et al., 1986; Augusto et al., 2017; Guessous, 2019; Neina, 2019; Sagala et al., 2020; Zemene et al., 2020; Wada et al., 2023).

The nutritive value of some forages in global rangeland still unknown (Kazemi, 2021). Few studies were conducted in Palestine about the rangeland vegetation. A study found that the amount of forage production (dry matter) in eastern slopes of the West Bank is about 60 Kg/dunum (Braighith, 1995). While Mohammad (2000 and 2005) in his two experiments carried about range production and range botanical composition in southern parts of West Bank mentioned a low vegetation productivity as it ranged between 71 to 98 Kg/dunum, whereas total plant cover percentage reached from 54% to 83% most of them were unpalatable plant species. The following plants are among dominant palatable species in Palestinian rangeland at eastern slopes according to Mohammad (2000 and 2005): *H. spontaneum, A. sativa, M. orbicularis, O. crista-galli, A. palaestina, T. stellatum* and *S. alba.*

Range improvement and development is an urgent need because of its social, economic, and environmental impacts (Abdo, 2005; Mohammad, 2005). Many years ago, and since the establishment of Palestinian National Authority, more attention has been directed towards the improvement of rangeland conditions (Baumgarten-Sharon, 2017). Several attempts had been done to rehabilitate the rangeland by setting polices, strategies and implementation of some local projects (Abdo, 2005). There is a keen need for building up a data base on rangeland components for proper managements (Mohammad, 2005).

Many important lands and plant species were exposed to extinction and soil became eroded which resulted in decreasing vegetation cover and so productivity, that made forage provided by rangeland support livestock for just a few months (Mohammad, 2005; Salama and Al-joaba, 2008). This condition was resulted as a consequence of ignorance to improve and maintain rangeland.

In West Bank rangeland, the basic information about the different range plant characteristics (morphology, physiology, chemical composition, etc.) is still lacking and the nutritive value of these herbaceous plants dominate in our rangeland are very limited (Abdo, 2005). Unfortunately, there is no reliable data available about the productivity and the vegetation type of rangeland in Palestine (Mohammad, 2000). As a result, it is necessary to study the nutritive value of these plants and to make a comparison between them in order to encourage the implantation and natural scattering of the most suitable plants under our conditions. Studying the nutritive value of these plant is essential for establishing suitable recommendations about the plants that meet the needs of livestock on the range, and to make a proper supplementation program. These, finally, should leads to increase livestock productivity and decrease the cost of production through improving the management of rangeland.

This study will be the first step in evaluating the nutritive status of the local rangelands, that will help the animal nutritionist in determining the degree of feed nutrients available from the rangeland and to determine the kind and amount of nutrients that should be supplemented to the animals in different seasons to meet their nutrient requirements.

Objectives

The major objective of this study was to evaluate the chemical composition of some dominant rangeland plants, which include: Grasses: (*H. spontaneum* and *A. sativa*) and, Forbs: (*M. orbicularis, O. crista-galli, A. palaestina, T. stellatum, S. alba*).

The detailed objectives were:

1. To study the change in chemical composition of dominant range plant through growing season (early spring) and maturation stage (early summer).
2. To evaluate the chemical composition of plant parts (leaves, stems and RP) in both seasons.
3. To compare nutritive value between species under investigation.

Chapter One

Literature review

1.1 Natural vegetation in Palestine

Palestine territories, in its present condition, is divided into two distinct regions covering a total area around 6,065 km^2. West Bank covers 5,700 km^2, while Gaza Strip, which is smaller, covers only 365 km^2 (Isaac and Gasteyer, 1995). In West Bank, there are four different ecological and climatic regions: The Jordan valley region, of low rainfall (100-300 mm annually); the Eastern Slopes, receiving moderate rainfall (200-400 mm); the Central Highlands that averaging relatively high rainfall about 650 mm; and the Semi Coastal region, receiving relatively high rainfall, around 500 mm (Ghodieh, 2022).

West Bank is affected by the Mediterranean climate due to its geographical location (Shadeed et al., 2020). The rainy season in West Bank would last for 5 to 6 months, starting from October to the end of May. The precipitation in West Bank decrease from north to south and from west to east (ARIJ, 1997). Most of the rangeland in Palestine are semi-arid with low rainfall, ranging between 153-698 mm annually (Shadeed et al., 2020). According to this climatic and topographic variation in Palestine in general and in West Bank in particular, there is a magnificent diversity in the vegetation cover of rangeland which provide a dietary resource for livestock since it holds a high nutritive value (Chebli et al., 2021). Thus, in Palestine, rangeland differs in nature, type, and density from one region to another, according to the area's environmental conditions (Mohammad, 2005; Al-joaba, 2006).

1.1.1 Rangeland in Palestine

As previously mentioned, in Palestine, there are a lot of diverse plant species that belong to several important families, because of its environmental diversity (Mohammad, 2005; Baumgarten-Sharon, 2017; Qumsiyeh and Abusarhan, 2021). Rangeland, or the so called; grazing areas, in Palestine is estimated at 2,180,000 dunums, which makes up nearly one third of the area of Palestine (Mohammad, 2009). Most of rangeland areas are mainly located at eastern slopes (ARIJ, 1994; Mohammad, 2000; Abdo, 2005). According to Braighith (1998), the total designated area as rangeland in West Bank is about 2,180,000 dunum, however, until 1998, only 700,000 dunum was reachable for Palestinian, since the rest was under the Israeli occupation. Most of rangeland area is used first and foremost for communal grazing of sheep and goats (Mohammad, 2000).

1.1.2 Importance of rangeland vegetation to livestock

World food demand is increasing, consequently, the importance of rangelands which in turn provide human food is increasing too (Palmer, 2017). Rangelands make up about 70% of global land area that contribute by 16% of food production (FAO, 2010; Holechek, 2013). Rangelands in arid and semi-arid areas of the glob provide primary products of grass, forbs, legumes and shrubs which are converted to animal protein (IFAD, 2000). Livestock productivity in rangelands is very important to the pastoral societies in the third world countries (Holechek et al., 2017; Getaneh et al., 2019), they provide the local people many ecosystem services for thousands of years (Roces-Diaz et al., 2021). Mayland and Shewmaker (2001) in their research found that forage is the main source of consumed mineral elements that have mineral nutrients exceeding animal requirements; nearly all mineral elements can adversely affect an animal if included at low levels in the diet. In the dry seasons, poor performance of ruminant is due to the protein, energy, minerals and phosphorus deficiency (Msangi and Hardesty, 1993). Rangelands in general play other important roles; they represent wildlife habitats, conservation of species, water catchments areas, genetic resources, and aesthetic values (West, 1993; Harris, 2000; Ren and Hu, 2022). Palestinian rangelands used to be the main source of livestock feeds, which hold a high nutritive value (ARIJ, 1997; Al-Joaba, 2006; Salama and Aljoaba, 2008).

Unfortunately, the decreasing of rangeland production also affects livestock productivity. Thus, Palestinian rangeland production covers about 14% of the livestock feeding needs only, and the rest has to be purchased by livestock owners at high costs from the market (Abu Omar, 1997; Mohammad, 2000; Abdo, 2005; Mohammad, 2005). According to Isaac and Hrimat (2007), about 1,700 tons of animal feeds were supplied by Palestinian rangeland which is a small amount of livestock feed requirements. The carrying capacity of sheep and goats at eastern slopes is limited depending on rainfall intensity while more than 150,000 heads are grazing in that area (Alataweneh, 2013). The cost of feeding constitutes about 70% of the total operating costs in the livestock farms (Baumgarten-Sharon, 2017). Hence, the less the percentage rangeland covers of livestock's feeding.

1.2 Livestock feed requirements

All animals require a daily supply of food to maintain their life, body structures, functions, pregnancy and growth (Holechek, et al., 1995; Rotta et al., 2023). Continuous supply of energy, protein, fat, fibers beside minerals is important to livestock health (Capstaff and Miller, 2018). Any deficiency in any element will badly influence the diet of ruminant (Ammerman and Goodrich, 1983; Msangi and Hardesty, 1993; Ruckle et al., 2017).

Range livestock require (7-9%) of crude protein for maintenance and (10-12%) for lactation (Holechek et al., 1989). Protein is the most limiting factor to range animal production. It is composed of chains of amino acids that contain nitrogen as well as carbon, hydrogen, and oxygen. Protein provides many functions in animal body, it is important as enzyme that powers many chemical reactions, hormones, anti-bodies against diseases, agent for transport and storage of nutrients within the body. Protein is the principal constituent of organs and skin of animals although it cannot be stored by animal body like minerals, so continuous supply is required (Holechek and Herbel, 1986; Grando et al., 2005). The microbial activity in the rumen will be depressed if crude protein is provided at low levels, also digestibility and intake of protein will be reduced (Msangi and Hardesty, 1993; Grando et al., 2005; Reynal and Broderick, 2005, Zhao et al., 2019). Extreme deficiency results in severe digestive disturbances, anemia, loss of weights and reduces immunity against diseases (NRC, 1985).

Animal takes its requirements of dietary fibers (crude fibers, acid detergent fibers and neutral detergent fibers) through digestible and indigestible fraction of feed, fibers are slowly digested matters that occupy a space in ruminant intestine (Mertens, 1997). ADF represents the least digestible fiber part of feed, it contains (cellulose, lignin and cutin), it reduces the energy consumption as its amount increases in animals' digestive system, also, when the levels of ADF increases, voluntary consumption of forages will decline too (Sharpe and Sharpe, 2019). NDF is made up of four main chemical components (ADF + hemicellulose), quantitatively the largest, cellulose and hemicelluloses are potentially digestible, and the other main components of NDF are lignin and cutin (Ahamefule, et al. 2006). NDF content of forage is important measurement because they provide an estimate of digestibility (Ahamefule, et al. 2006). Dietary Fibers play important roles in balancing the nutrient requirements and regulating the intake of animal, supplying energy to support maintenance, growth, lactation and reproduction (Lu et al., 2005). The amounts of fibers in plants frequently increase with maturity (Hussain and Durrani, 2009). In general, grasses have higher NDF levels than legumes (Hummel et al., 2006).

Around 40% of CF is required for ruminants to provide excellent intake (Robinson, 1999). About 41% of NDF and from 18 to 20% of ADF is adequate for goats for high production of lactation, and about 23% of ADF is recommended for growing goats. It is not good for livestock to eat fibers over its needs, increasing the level of fibers may slow the growing rates and decreased chemical fats (Lu et al., 2005).

Knowing the concentrations of plant elements is essential for analyzing their nutritional content (Khan et al., 2022). Phosphorus and Calcium are important for animal maintenance and development of skeletal system, P and Ca loss may result in abnormal bone development (NRC, 1985). Rumen needs (0.15-0.2%) of P for maintenance, while (0.25-0.3%) for lactation (NRC, 1985; Holechek, et al., 1989; Catling et al., 1994; Ganskopp and Bohnert, 2001). Nearly 0.2% of Ca is needed for animal maintenance and about 0.35 % for lactation (NRC, 1985).

Beside P and Ca, Mg is considered as important mineral for building bones (NRC, 1985). It is necessary for many enzymes and nervous systems (Underwood, 1981; Ammerman and Goodrich, 1983). Tetany and loss of appetite are the major signs of magnesium deficiency (Underwood, 1981; Schonewille et al., 2005). Ammerman et al., (1971) reported that at minimum 0.33% of Mg is to be supplied in animal food to prevent magnesium deficiency. Most of cereal grains are rich enough of magnesium, varying from (0.13 - 0.22%) of Mg (NRC, 1982).

K sorted as important mineral as well as the others for animal growth. It aids in activating several enzyme systems, protein synthesis and carbohydrate metabolism. K is essential for ruminant skin and muscles (Underwood, 1981). For animal diets, no more than 0.5% of K is required. In most grains, K content is (0.4-1%). Under most feeding conditions, K deficiency is rarely occurred (NRC, 1985).

Na serves many functions in animal body. It maintains osmotic pressure, controls water metabolism in tissues and regulates acid-base balance (Underwood, 1981). McClymont et al. (1957) concluded that Na requirement should be greater than 0.06% in the animal diet. While Delvin and Roberts (1963) estimated Na requirements for lamb's maintenance to be 0.18%. The signs of deficiency like declining in milk or plasma concentration will not appear until reaching extreme deficiency (Underwood, 1981).

In Palestine, during summer and autumn, when animal feed is in shortage in its quality and quantity, farmers have to provide livestock with commercial supplements in order to meet their minimum nutritional needs. Which makes ranching costly. Usually, the supplements used contain about 18% of crude protein, 3.5% fat, 7% fibers and many other nutrients (Hamidin Co.).

1.3 Species under investigation

Palestinian rangelands are rich in diverse forages, which can adapt with arid and semi-arid environments. The selected plant species were chosen according to Mohammad (2000 and 2005) and Al-joaba (2006) results, since they identified them as herbaceous dominant rangeland plants at southern parts of Eastern Slopes of West Bank. Beside information collected from local well-skilled farmers who confirmed the selection of these dominant species. In general, the favorable characteristics of the species include its ability to establish naturally in the rangeland, having wide environmental tolerance and high growth rate with the ability to produce large biomass quantities (George et al., 2007). In addition, plant species should be highly palatable with acceptable digestibility and free from toxins.

1.3.1 Wild barley (*Hordeum spontaneum)* (شعير بري)

H. spontaneum is commonly known as wild barley (Figure 1), from Gramineae family, it is a tall annual rain-fed grass that grows in wide range of habitats in the eastern Mediterranean and Southwest Asia as feed for small ruminants (Grando et al., 2005). Palestine is the primary and secondary habitat of barley in general (Nevo, 1992). Wild barley is adapted to highly diverse environments throughout its geographical distribution (Bedada et al., 2014). Further study was investigated the protein content of *H. spontaneum*'s grains, it revealed a value ranged from 10 to 17% (Quindi et al., 2004). Crude fiber ranges from 6.5 to 6.6%, NDF from 27.25 to 28%, ADF from 7.7-7.8% and crude ash from 2.33 to 2.35% (Yasar and Tosun, 2018). For macronutrients of *Hordeum sp.,* Ca content ranges from 0.019 to 0.098 %, while for K ranges from 0.035 to 0.077%, Mg from 0.1 to 0.2%, Na from 0.0056 to 0.063% and P from 0.23 to 0.54% (Gyawali et al., 2019).

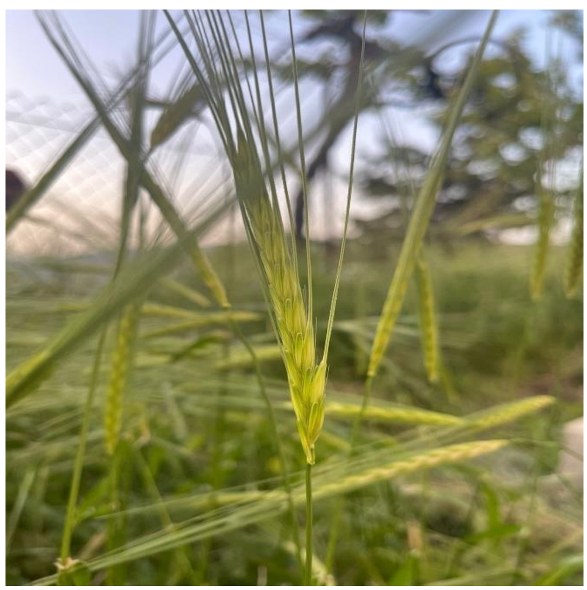

Figure 1: Wild barley; *H. spontaneum.* (Photo by author)

1.3.2 Oat *(Avens sativa)* (شوفان بري)

It is a tall annual grass from Gramineae family (Boczkowska et al., 2014), with a height range from 40-80 cm, flowering early from April to June (Figure 2). *A. sativa* is adapted with diverse environments since it tolerates different soil types, altitudes and rainfall variations (Ahmad et al., 2011). The ruminants like it due to its high palatability, energy richness, succulent and softness properties (Shah et al., 2015).

A. sativa is one of the essential crops of the glob (Coelho et al., 2020; Ibrahim et al., 2020). It is known as a nutritious crop, which is rich in protein and important minerals (Singh and Belkheir, 2013). Many researchers studied protein content of *A. sativa* under different environmental conditions (Niu et al., 2007; Mut et al., 2016; Gracia et al., 2017; Bityutskii et al., 2020; Ibrahim et al., 2020), a relatively high crude protein content was revealed, it was nearly ranged from 11% to 19%. Furthermore, a study was conducted in Turkey and showed *Avena's* ADF and NDF contents varied from 13.56 to 18.54% and 31.35 to 37.57%, respectively, and fat content from 3.1 to 6.37% (Mut et al., 2016).

Figure 2*:* Oat*; A. sativa.* (Photo by author)

1.3.3 Alfalfa *(Medicago orbicularis)* (خبزة الراعي)

It is annual herbaceous, self-reseeding forage, from Leguminosae family (Porqueddu, 2001; Fourquin et al., 2013) (Figure 3). *Medicago* species were used as animal feed due to its palatability and high feeding quality including high protein and digestible fiber content (Chebouti et al., 2000; Porqueddu, 2001; Hidosa and Kibret, 2021). In general, *Medicago sp*. is able to fix atmospheric nitrogen with soil with deep root system that gave drought tolerance forage (Werner et al., 2015; Mitchell, 2019). *Medicago sp*. contributes to planet's food security and rangeland's sustainable management at global level (Djedid et al., 2021). CP for *Medicago sp*. was analyzed; it ranged from 18 to 25% based on dry matters, while NDF ranged from 49.03 to 59.03%, ADF from 35.18 to 43.18% and ash content from 8.29 to 10.27% (Hidosa and Kibret, 2021). According to Kazemi and Valizadeh, (2019), the CP content regarding to the whole plant content for *Medicago sp.* was 24.95%.

Another research studied the chemical composition of *Medicago* varieties at growing stage and maturation in Mediterranean region, the CP at growing season was ranged from 25.8 to 30.6%, NDF from 15.5 to 27.1% and ADF from 10.1 to 19.6%. At maturation stage, CP was decreased, it ranged from 14.8 to 24.2%, NDF and ADF were obviously decreased, NDF was ranged from 61.2 to 85.5%, whereas ADF from 36.2 to 77.5% (Porqueddu, 2001).

Figure 1: Alfalfa*; M. orbicularis.* (Photo by author)

1.3.4 Sainfoin *(Onobryches crista-galli)* (ذريس)

It is an annual forage legume belongs to Fabaceae (Leguminosae) family (Figure 4), naturally grows in rangeland from Mediterranean to central Asia with a drought tolerance possibility. Sainfoin is the common name of *Onobryches sp.* (Carbonero et al., 2011; Ghanavati, 2012; kavandi et al., 2018). Sainfoin improves soil quality through deep root system as many legumes do (Yildiz and Ekiz, 2014; Kavandi et al., 2018). It is preferred by animals due to its palatability. Sheep and goats were being attracted to this kind of forage rather than grasses, they are safely consumed large quantities of sainfoin without being bloated. Hence, young animals grow fast and easily gain weight through feeding process (Carbonero et al., 2011). The chemical composition of *Onobryches sp.* was studied by many researchers. Kaplan (2011) on his study on *Onobryches viciaefolia* found that CP was ranged from 11.39 to 17.70%, NDF from 43.31 to 47.64% and ADF from 35.61 to 43.30%. Furthermore, Kocak et al. (2011) found a high protein content in *Onobryches viciaefolia* seeds which grown in Turkey, CP was 37.2%.

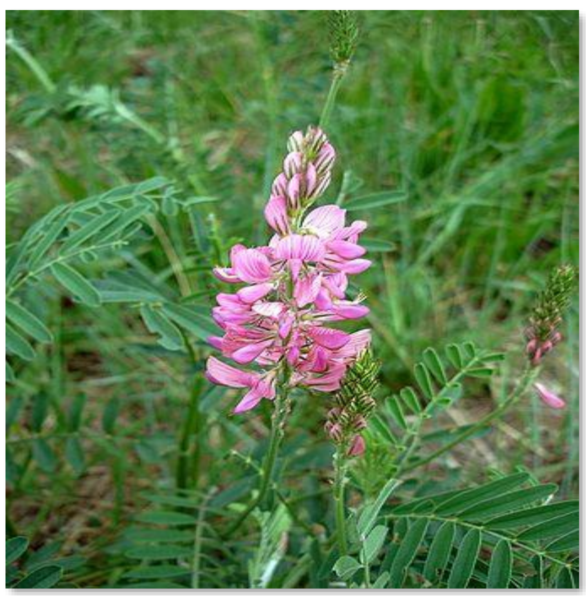

Figure 2: Sainfoin; *O. crista-galli.* (Photo by author)

1.3.5 Palestine chamomile *(Anthemis palaestina)* (أقحوان أبيض)

A. palaestina (Figure 5) is herbaceous forage grown in Palestine as animal feed (Salama and Aljoaba, 2008). It is belonging to Asteraceae family (Hatami et al., 2022). In general, *Anthemis sp.* is a Mediterranean plant that has aromatic traits (Alizadeh and Jafari, 2016; Orlando et al., 2019) and used as source of antioxidants (Hassanpour et al., 2021). Many studies have conducted the chemical composition of *Anthemis sp.* especially on oil extraction (Tawaha et al., 2015; Al-Snafi, 2016; Bursal et al., 2021). Chebli et al. (2021) in their study mentioned the chemical composition of Anthemis sp., they found that CP was decreased from 15.6% during spring to 7.83% in summer, NDF slightly increased from 51.7% to 56.8% and ADF increased from 46.3% to 63.1% between spring and summer.

Figure 3: Palestine chamomile; *A. palaestina.* (Photo by author)

1.3.6 Starry clover *(Trifolium stellatum)* (نفلة)

T. stellatum is herbaceous, annual and highly palatable forage species (Sayar et al., 2015) (Figure 6). It belongs to Leguminosae family (Papilionaceae) (Mahmoudi et al., 2021). It is distributed in temperate regions and used as feed crop for range animals in Mediterranean areas due to its highly nutritious content such as protein and minerals (Lamont et al., 2001; Sabudak and Guler, 2009; Kamalak and Canbolat, 2010). *Trifolium sp.* is a nitrogen fixer as any leguminous species which improve the quality of rangeland soil (Lamont et al., 2001). *T. stellatum* knows as starry clover. Crude protein and ADF were tested in a study conducted in Spain on some *Trifolium* species, it was 13.4% based on dry matters, whereas ADF was 30.2% at flowering stage (Lloveras and Iglesias, 2001). Ertiken (2021) in his study carried out in Turkey to make a comparison of nutritive value of some Mediterranean clover species and found that CP ranged from 18.47 to 22.05%, NDF from 33.95 to 49.80% and ADF from 21.32 to 34.28% based on dry matters.

Figure 4: Starry clover**;** *T. stellatum.* (Photo by author)

1.3.7 Yellow mustard *(Sinabis alba)* (خردل أصفر)

S. alba (Figure 7) or commonly known as yellow mustard, is an annual forage crop from Cruciferae family, which grow in Mediterranean regions (Mitrovic et al., 2020). It is used as forage for range animals (Kristic et al., 2010) for its high protein and energy content, *S. alba* tolerates heat and drought, also resists many diseases such as blacking disease (Slominski et al., 1999). Some researches study the chemical composition of *S. alba*, Damian (2014) mentioned a relatively high protein content of *S. alba* seeds. Another study analyzed the chemical composition of mustards seeds, CP were found 37.5%, ash content 5.4% and Ca content were 0.66% based on DM (Slominski et al., 1999).

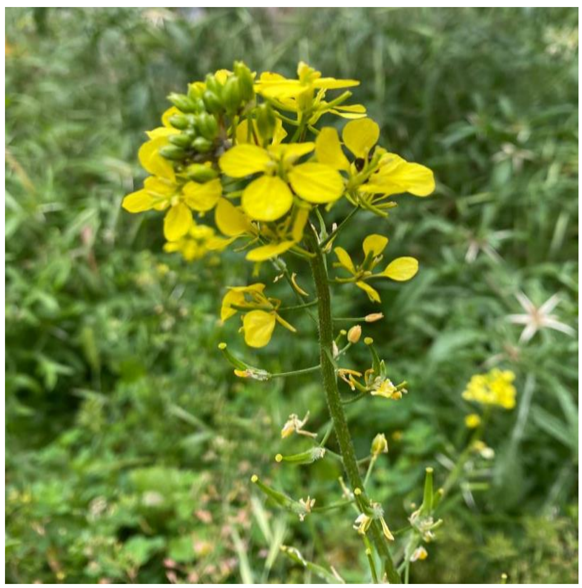

Figure 5: Yellow mustard**;** *S. alba.* (Photo by author)

1.4 Chemical composition of rangeland plants

Rangeland plants composed of nutritive and chemical compounds that maintain animal's life, these components are protein, fats, carbohydrates, fibers, minerals, water and vitamins (Holechek et al., 1989; Ruckle et al., 2017). Chemical composition of forage differs with different factors such as plant species, plant parts, morphological and phenological traits, stage of maturity (seasonal variations), environmental conditions, soil characteristics and composition (edaphic factors) (Jehanger, 1986; Porqueddu, 2001; Augusto et al., 2017; Guessous, 2019; Zemene et al., 2020; Chebli et al., 2021; Wada et al., 2023).

1.5 Factors affecting the chemical composition of rangeland plants

1.5.1 Plant species

Range plants (grass, legumes or shrubs) varies in composition and nutritive content among life form (Ganskopp and Bohnert, 2001; Tuna, 2004; Distel et al., 2005; Arzani et al., 2006). In general, forbs showed higher CP and lower ADF, NDF and CF than grasses (Tuna, 2004; Arzani et al., 2006). Barnes et al. (1990) found a significant difference in mineral concentrations between three plant groups (grasses, forbs and shrubs).

The nutritive value also varies between species, Warly et al. (2005) proved that the chemical composition of seven grass species were differed among species, the CP were ranged from 6.6 to 16.2% in the rainy season, and from 8.7 to 12% in dry season.

1.5.2 Plant part

The nutritive value of herbaceous plants differs among plant parts (stem, leaf, fruit, seed, root, … etc.). Plenty of studies have made their researches on herbaceous plant parts at different seasons (Buxton et al., 1985; Holechek, et al., 1989; Rumbaugh et al., 1993; Gintzburger et al., 2000; Lloveras and lglesias, 2001; Zeng et al., 2017; Butkute et al., 2018; Prinsi et al., 2019).

Leaves of some forage contain two to three folds of CP more than stems, while the last have more crude fibers at the same stage of maturity. Chemical composition of leaves and stems changes with advancing maturity, but the change is more rapid in stems (Mowat et al., 1965). Leaves of grasses have more protein content than fruits and stems during growing stage (Holechek, et al., 1989; Rumbaugh et al., 1993; Gintzburger et al., 2000), whereas, at maturation stage, CP in fruits is more than leaves and stems. It could be explained as the process of nutrient translocation from leaves and stems to crowns when plant becomes mature (Gintzburger et al., 2000). Holechek, et al. (1989) in his study indicated that fat content in vegetative part of plant was more than seeds. A study made by El-Shantawi and Ereifej (2001) on the chemical composition of carob pods and seeds, it was found that CP in carob pods was 6.8%, whereas in seeds reached 16.7% at the same stage, crude fiber it was 9.1% and 11.5% in seeds, crude fat was 1.2% in pods and 2.9% in seeds and another variation in Ca and P content were found. Red clover stems had greater DM concentration than did leaves until flowering (Buxton et al., 1985).

In rangeland, there are a quality difference between stems and leaves, so under some grazing condition, it was provided that the animal prefers to eat the leaf part, because it cares about the leaf fraction quality and quantity more than the total forage according to Minson (1983) study. Also, Oelberg, 1956 mentioned the selectivity of sheep and goats when grazing in rangelands.

Grazing animals prefer the forages richer in CP, sugar and digestive organic matter content and poorer in NDF. Selectivity is limited when the pasture is dense and uniform, in contrast, it increased when heterogeneity of forages is available (Pulina et al., 2013).

1.5.3 Season (Growth stage)

Nutritive value of most forage rangeland extremely varies among seasons. Many studies mentioned the decrease in CP, crude fats and phosphorus contents towards stage of maturity, while a noticeable increase in DM, fiber content and some minerals (Droushiotis and Wilman, 1987; Long et al., 1999; Ayed et al., 2001; El-Shantawi and Ereifej, 2001; Lloveras and Iglesias, 2001; El-Shantawi et al., 2004; Gulsen et al., 2004; Kamalak et al., 2005; Mountousis et al., 2008; Abusuwar and Ahmed, 2010; Chebli et al., 2021). When plants reach maturation, their tissue growth decreased, that what makes protein and other nutrients to decline (Ismail et al., 2014). El-Shantawi et al. (2004) asserted that growth stage significantly affects the protein content of grasses where the crude protein content decreases with advancing maturity as it declined from 25 to 2.5%. As well, Droushiotis and Wilman (1987) stated that the crude protein content of *H. spontaneum* shoots was decreased to 20-30% at the tillering stage. Whitman et al., (1951) in their study mentioned that the native and tame grasses of western North Dakota lose about 71% of their protein till growth stage. During dry season, annual grass lost about 75% of their protein and up to 52% of phosphorus (El-Shantawi and Ereifej, 2001). In general, the nutritional condition in rangeland changed from season to another depending on rainfall intensity received at that time (Ismail et al., 2014).

1.5.4 Environmental factors

Chemical composition of plants is affected by abiotic environmental factors such as climate, topography (Altitude, slope and slope aspect) and soil characteristics (Mohammad, 2008; Guessous, 2019; Zemene et al., 2020; Chebli et al., 2021). Realizing the nutritive value of our selected dominant rangeland plants at different seasons, locations and environmental conditions will help the animal nutritionist determining the degree of feed nutrients available from the rangeland, and to determine the amount of nutrients that should be supplemented to the animals in different seasons to meet their nutrient requirements.

Chapter Two

Materials and Methods

2.1 Study site

Bani Na'im rangeland also called Al Masafer is located at eastern slopes of the West Bank, (15) Km east from Hebron city (Al-Seikh, 2006). The geographical position is 35.1 E and 31.4 N (GIS, 2023). It is covering an area of mountainous topography of about 45 hectares with elevation ranges from 596 to 704 m above sea level (GIS, 2023). This area was classified as semi-arid rangelands (Mohammad, 2008). It is in the rain shadow, with average rainfall 250-300 mm, most of rain fall with high intensity in short time. The soil bedrock is calcareous (limestone or hard chalk) with shallow soil (Al-Seikh, 2006). The site used for many years as grazing lands, it is characterized by thin vegetation cover and low productivity due to overgrazing which led to soil erosion and land degradation (Mohammad, 2005; Al-joaba, 2006; Al-Seikh, 2006). The study area was surrounded by a fence and grazing was prohibited during the study period.

2.2 Samples collection and preparation

Samples of grasses and forbs were randomly collected at ground level from Bani Na'im site (Figure 8), during early spring 17th March 2020 at vegetative growing stage and early summer 20th June 2020 when plants become mature. Three representative samples from each plant species were collected from 3 different niches as replicates from the rangeland during each study season. Samples were separated to stems, leaves and fruits (productive parts). Samples were placed separately in labeled paper bags. Fresh and dry weight were recorded, samples were prepared for chemical analysis which include: Moisture content (MC), CP, CFt, CF, ash, NDF, ADF and minerals (Ca, Mg, K, Na, P and N).

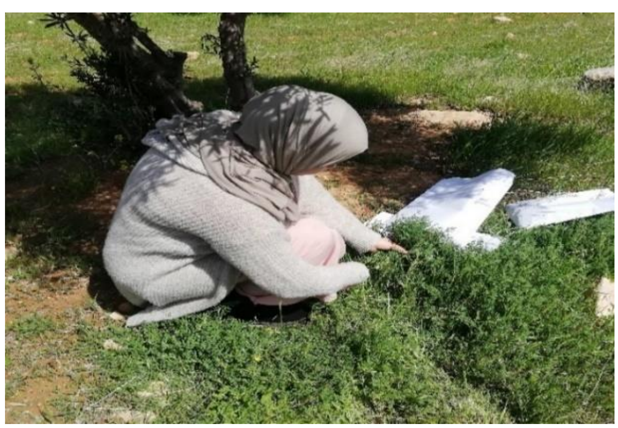

Figure 6: Collecting samples from Bani Na'im site

2.3 Selected rangeland plants

Seven rangeland plant species were selected for this study as illustrated in Table (1) which shows the visual observation of plant species, their scientific and common name, plant group, growth form, palatability and stage of growth at sampling time.

Table 1: The rangeland plant species under investigation.

Arabic name	Common name	Scientific name	Family name (Plant group)	Palatability	Stage of growth in spring	Stage of growth in summer
شعير بري	Wild barley	***H. spontaneum***	Gramineae (grasses)	Palatable	Early fruiting	Fruiting
شوفان بري	Oat	***A. sativa***	Gramineae (grasses)	Highly palatable	early fruiting	Fruiting
خبزة الراعي	Alfalfa	***M. orbicularis***	Leguminosae (forbs)	Palatable	Early flowering	Seeding
ذريس	Sainfoin	***O. crista-galli***	Fabaceae (forbs)	Palatable	Early flowering & fruiting	Seeding
أقحوان أبيض	Palestine chamomile	***A. palaestina***	Asteraceae (forbs)	Palatable	Early flowering	Fruiting
نفلة	Starry clover	***T. stellatum***	Leguminosae (forbs)	Highly palatable	Early flowering	Fruiting
خردل أصفر	Yellow mustard	***S. alba***	Cruciferae (forbs)	palatable	Early flowering & fruiting	Fruiting

2.4 Chemical analysis

Samples were grounded in a Wiley mill and stored in sealed jars for chemical analysis (AOAC, 1990). Chemical analysis was conducted on a dry matter basis. Crude protein was determined by estimating nitrogen (N) content using Kjeldahl procedure. Nitrogen levels were multiplied by 6.25 and expressed as CP (AOAC, 1990). Crude fibers, ADF and NDF were estimated according to AOAC (1990) and Van Soest (1991). Soxhlet extraction method were used to derive CF (AOAC, 1990), samples were ashed at 550 ˚C in muffle furnace for 8 hrs. P content was determined by using spectrophotometer device (Milton Roy Spectronic 1201) (Barnes, et al., 1990; EL-Shatnawi & Ereifej, 2001). Ca, Mg, K and Na concentrations were determined with an atomic absorption spectrophotometer device (Perkin Elmer/ A Analyst 100) (AOAC, 1990; Estefan et al, 2013). All chemical analysis were conducted at Hebron University labs.

2.5 Statistical analysis

CRD with 3 replicates was used to compare the nutrient content of the seven plant species at each growing season (early spring and early summer). The difference between plant parts, plant species and difference among seasons were analyzed by using IBM SPSS statistics 21 analytical program with significance set at $P \leq 0.05$.

Chapter Three

Results

3.1 Dry matter content

3.1.1 Dry matter content between plant parts

Nearly, in spring, there is a significant difference in dry matter content (DM) between plant parts for most plant species except for *S. alba* (Table 2), the DM in fruits were the highest compared to other part except in *A. sativa* and *A. palaestina*. The smallest value of DM was 6.17% in the stems of *O. crista-galli* while DM highest value (30.10%) was found in *M. orbicularis* fruit. However, in summer, leaves are significantly (P≤0.05) the lowest in DM content for most plant species. For example, leaves of *H. spontaneum* had 89.37% DM, also leaves of *S. alba* had 88.17% DM.

3.1.2 Dry matter content between plant species

There is a high significant difference (P≤0.05) in DM content between plant species with no appeared trend between grasses and forbs during early stage of growth (Table 3). *A. palaestina* had the highest value (36% DM), while *O. crista-galli* is the lowest in DM content (8.5%) . On the other hand, at maturation, *A. sativa* is significantly (P≤0.05) the highest DM percentage (92.7%), while *T. stellatum* showed significantly lower DM percentage (80.93%) compared with other plant species (Table 3). The results showed also that grasses have higher DM percentage during maturation than most of forb species.

3.1.3 Dry matter content among seasons

DM increases with advancing maturity. The DM content of all plant parts (stems, leaves and fruits) for all plant species is significantly (P≤0.05) have higher values during the summer season than spring (Table 2). In summer, DM content were ranged from (80.93 - 96.33) %, fruits of *A. palaestina* was the highest, whereas in spring from (6.17 - 36.00) %, the highest value was found in *A. palaestina* leaves (Table 2).

Table 2: Chemical composition of plant species showing plant parts (stem, leaf and RP) during spring and summer based on dry matters.

Plant Species	Plant Part	% Dry Matters		% Ash		% Crude Protein		% Crude Fat	
		Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Hordium spntaneum	stem	20.47 B*ab**	94.60 Aa	13.39 Ab	9.60 Bb	12.10 Ac	4.48 Bc	3.54 Ab	0.56 Bb
	leaf	18.63 Bbc	89.37 Ac	22.14 Aa	12.35 Ba	18.67 Aa	6.60 Bb	3.44 Ac	0.46 Bc
	RP	23.83 Ba	92.97 Ab	6.99 Ac	5.57 Bc	14.91 Ab	9.87 Ba	2.58 Aa	1.33 Ba
A. sativa	stem	24.50 Bb	93.00 Ab	9.03 Ab	8.33 Bb	10.98 Ab	6.28 Bc	2.37 Ab	0.68 Bc
	leaf	29.27 Ba	92.70 Ab	12.53 Ba	13.60 Aa	22.78 Aa	7.68 Bb	3.77 Aa	1.66 Ba
	RP	22.03 Bb	96.03 Aa	3.73 Bc	5.51 Ac	12.03 Ab	8.98 Ba	2.19 Ac	1.25 Bb
M. orbicularis	stem	18.23 Bb	96.00 Aa	8.87 Aa	7.47 Bb	16.16 Ab	6.93 Bc	2.29 Ac	1.10 Bc
	leaf	31.10 Ba	81.63 Ab	6.01 Bb	9.75 Aa	28.61 Aa	12.06 Bb	2.79 Ab	1.76 Bb
	RP	30.10 Ba	94.67 Aa	6.32 Ab	6.49 Ac	25.14 Aa	21.68 Ba	5.95 Aa	2.74 Ba
O. crista-galli	stem	6.17 Bb	91.37 Aa	22.54 Ab	12.52 Bb	14.21 Ab	5.56 Bc	2.57 Ac	0.06 Bc
	leaf	8.50 Bb	86.63 Ab	26.32 Aa	30.48 Aa	18.82 Aa	9.08 Bb	2.74 Ab	0.64 Bb
	RP	18.83 Ba	85.80 Ab	11.88 Ac	8.67 Bc	20.26 Aa	20.02 Aa	5.87 Aa	4.19 Ba
A. palaestina	stem	35.53 Ba	93.80 Aa	12.72 Ab	6.32 Bc	10.09 Ab	4.23 Bc	2.14 Ac	0.49 Bc
	leaf	36.00 Ba	83.57 Ab	14.69 Aa	10.33 Ba	18.43 Aa	13.83 Ba	7.36 Aa	5.91 Ba
	RP	28.60 Bb	96.33 Aa	9.80 Ac	7.51 Bb	17.52 Aa	11.38 Bb	3.84 Ab	1.37 Bb
T. stellatum	stem	18.47 Bb	91.30 Aa	13.06 Aa	6.53 Bb	13.96 Ac	4.84 Bc	4.69 Aa	2.95 Bc
	leaf	28.77 Ba	80.93 Ab	11.85 Ba	15.69 Aa	28.34 Aa	10.38 Bb	3.98 Ab	3.68 Ba
	RP	27.53 Ba	90.23 Aa	7.12 Ab	5.37 Bc	22.79 Ab	18.69 Ba	2.36 Ac	3.29 Bb
S. alba	stem	22.70 Ba	93.93 Aa	9.17 Ab	5.29 Bc	12.27 Ac	6.50 Bc	30.92 Aa	12.77 Ba
	leaf	23.40 Ba	88.17 Ac	17.30 Aa	5.70 Bb	24.12 Ab	8.24 Bb	3.75 Ac	0.74 Bc
	RP	23.13 Ba	91.93 Ab	8.50 Ab	6.65 Ba	28.30 Aa	13.85 Ba	10.18 Ab	3.70 Bb

*Means in the same row for same parts of each species for same parameter with different capital letters are significantly different according to HSD test at P≤0.05.

**Means in the same column for same species with different small letters are significantly different according to HSD test at P≤0.05.

Table 3: Chemical composition of plant species (leaf part) during spring and summer based on dry matters.

Plant species	% Dry Matters		% Ash		% Protein		% Crude Fat		% Crude Fibers		% ADF		% NDF	
	spring	Summer	spring	summer	spring	summer	Spring	summer	spring	summer	spring	summer	spring	summer
H. spontaneum	18.63 c*	89.37 ab	22.14 b	12.35 d	18.67 d	6.60 f	3.44 d	0.46 g	26.86 c	33.94 c	34.01 ab	43.57 c	33.97 cd	52.18 d
A. sativa	29.27 b	92.70 a	12.53 de	13.60 c	22.78 bc	7.68 e	3.77 c	1.66 d	29.56 b	34.09 c	24.56 ab	44.52 b	56.44 a	64.10 b
M. orbicularis	31.10 ab	81.63 d	6.01 f	9.75 f	28.61 a	12.06 b	2.79 e	1.76 c	20.56 d	26.21 d	36.29 a	41.74 d	52.80 a	55.58 c
O. crista-galli	8.50 d	86.63 bcd	26.32 a	30.48 a	18.82 cd	9.08 d	2.74 f	0.64 f	32.28 a	44.08 b	22.02 b	31.90 e	29.61 de	35.38 g
A. palaestina	36.00 a	83.57 cd	14.69 d	10.33 e	18.43 d	13.83 a	7.36 a	5.91 a	17.69 e	21.99 f	24.22 ab	28.84 f	26.58 e	35.83 fg
T. stellatum	28.77 b	80.93 e	11.85 e	15.69 b	28.34 a	10.38 c	3.98 b	3.68 b	21.59 d	23.37 e	24.05 ab	26.60 g	39.82 b	50.67 e
S. alba	23.40 c	88.17 abc	17.30 c	5.70 g	24.12 b	8.24 de	3.75 c	0.74 e	29.10 b	47.12 a	23.06 ab	48.49 a	35.83 bc	66.44 a

* Means in the same column for same species with different small letters are significantly different according to HSD test at $P \leq 0.05$

3.2 Ash content

3.2.1 Ash content between plant parts

In grasses (*H. spontaneum* and *A. sativa*), there was a highly significant difference ($P \leq 0.05$) in ash content between those plant parts. As it shown in (Table 2), leaves of *H. spontaneum* and *A. sativa* have the highest value (22.14% and 12.53%) in spring and (12.35% and 13.60%) in summer comparing to stems and fruits.

For forbs, leaves of *O. crista-galli* have significantly ($P \leq 0.05$) higher ash% than stems and fruits in both seasons, ash content was 26.32% in spring and 30.48% in summer, also leaves of *A. palaestina* have significantly ($P \leq 0.05$) higher ash% than stems and fruits in both seasons, it was 14.69% in spring and 10.33% in summer. Fruits of *T. stellatum* were significantly ($P \leq 0.05$) the lowest comparing to stems and fruits, ash content was 7.12% in spring, but in summer, leaves were significantly ($P \leq 0.05$) the highest (15.69%). For *S. alba*, leaves were significantly ($P \leq 0.05$) the highest in spring (17.30%) and fruits were in summer (6.65%) (Table 2).

3.2.2 Ash content between plant species

The ash percentage were almost in all species significantly different from each other in both seasons (Table 3). *O. crista-galli* was significantly ($P \leq 0.05$) the highest in ash content based on leaves analysis in both seasons (spring (26.32%) and summer (30.48%)), whereas *M. orbicularis* was significantly ($P \leq 0.05$) the lowest in spring (6.01%) and *S. alba* in summer (5.70%) (Table 3).

3.2.3 Ash content among seasons

Results showed a decrease in ash content from spring to summer for most plant species except *M. orbicularis* and *T. stellatum*'s leaves, also, *A. sativa*'s fruits and leaves (Table 2). In spring, ash content was ranged from (3.73 – 26.32) %, leaves of *O. crista-galli* were the highest and fruits of *A. sativa* were the lowest, whereas in summer ash content ranged from (5.29 – 30.48) %, the highest value was found in *O. crista-galli* leaves and the lowest was found in *S. alba* stems (Table 2).

3.3 Crude protein content

3.3.1 Protein content between plant parts

Leaves of grasses (*H. spontaneum* & *A. sativa*) have significantly (P≤0.05) higher protein content than fruits and stems during growing stage, 18.67 % and 22.78% respectively (Table 2). Whereas during maturation stage, fruits have significantly (P≤0.05) higher protein content than leaves and stems of those grasses (9.67% and 8.98%). In both seasons, stems have significantly the lowest amount of protein contents compared with leaves and fruits, except for *A. sativa* during the growing season the difference was not significant between stems and fruits. For forbs, during spring, the leaves and fruits of *M. orbicularis*, *O. crista-galli*, and *A. palaestina* have significantly (P≤0.05) a higher protein content than stems (Table 2). The leaves of *T. stellatum* (28.34%) and the fruits of *S. alba* (28.30%) are significantly (P≤0.05) higher in protein content than other parts. At summer, all forbs, except *A. palaestina*, gave similar results where the fruits showed significantly the highest protein content followed by leaves and then stems.

3.3.2 Protein content between plant species

As shown in Table (3), at early stage of growth, those Forbes; *M. orbicularis* (28.61%) *and T. stellatum* (28.34%) followed by *S. alba* (24.12%), are highly significantly different (P≤0.05) in protein content compared with other species. Likewise, at maturation stage, protein percentage in forbs were highest in *A. palaestina* (13.38%) > *M. orbicularis* (12.06%) > *T. stellatum* (10.38%) > *O. crista-galli* (9.08%), followed by grasses.

3.3.3 Protein content among seasons

All plants of our study significantly tended to lose their protein content from early spring to early summer (Table 2). For example, *A. sativa* had 43% protein drop in stems, 66% in leaves and 25% in fruits. Other species have a drop range in protein percentage from 58% to 65% in their leaves, from 57% to 65% in their stems and from 14% to 34% in the fruits. In early spring, the highest values of protein levels were 28.61% and 28.34% for *M. orbicularis* (forbs) and *T. stellatum* (forbs) respectively. While in early summer, the lowest protein levels were 6.60% and 7.68% for *H. spontaneum* (grasses) and *A. sativa* (grasses) respectively.

3.4 Crude fat content

3.4.1 Crude fat content between plant parts

There was a significant difference ($P \leq 0.05$) between plant parts in crude fat content (CFt) but the results of plant samples did not follow the same trend, in grasses, fruits of *H. spontaneum* (2.58% CFt) and leaves of *A. sativa* (3.77% CFt) were significantly ($P \leq 0.05$) higher than the other plants parts during growing season (spring). In some forbs (*M. orbicularis* and *O. crista-galli*) fruits, (*T. stellatum* and *S. alba*) stems, and leaves of *A. palaestina* have significantly higher crude fat content ($P \leq 0.05$) than other parts during spring season (Table 2).

In summer, fruits of *H. spontaneum* (1.33% CFt) and leaves of *A. sativa* (1.66% CFt) were significantly ($P \leq 0.05$) the highest compared with other plant parts. *M. orbicularis* and *O. crista-galli* fruits, *A. palaestina* and *T. stellatum* leaves, and stems of *S. alba* were significantly the highest in CFt percentage ($P \leq 0.05$) (Table 2).

3.4.2 Crude fat content between plant species

A. palaestina is the richest plant in CFt (7.36% in spring and 5.91% in summer) compared with other species, the results showed that it had significantly the highest ($P \leq 0.05$) fat content followed by *T. stellatum* in both seasons (Table 3). At early stage of growth, *O. crista-galli* had the lowest fat content (2.74%), while at maturation stage, *H. spontaneum* had the lowest CFt % (0.46%) (Table 3).

3.4.3 Crude fat content among seasons

Results showed a high significant difference ($P \leq 0.05$) in fat content between two stages of growth. All plants (grasses and forbs) were tended to significantly lose their fat content from early stage towards maturity (Table 2). In early spring, fat content was ranged from (2.14 – 7.36) %, for the leaves of *A. palaestina* were the highest whereas in summer fat content ranged from (0.06 – 5.19) %. The highest value was found also in *A. palaestina* leaves. *S. alba* was not concluded in the range because it showed a high (odd) fat content in both seasons, in early spring, stems of *S. alba* had 30.92% and 12.77% in early summer (Table 2).

3.5 Crude fibers

3.5.1 Crude fibers content between plant parts

Results showed a significant difference (P≤0.05) in crude fiber content (CF) between plant parts. For grasses (*H. spontaneum* and *A. sativa*), stems were significantly (P≤0.05) the highest in both seasons, *H. spontaneum*'s stems had 33.07% CF in spring and 38.81% CF in summer whereas *A. sativa*'s stems had 32.56% CF in spring and 38.59% CF in summer followed by leaves then fruits except for *H. spontaneum* during the spring season where leaves and stems are not different (Table 4).

In forbs, stems of (*A. palaestina* and *S. alba*) and leaves of *O. crista-galli* were significantly (P≤0.05) the highest in both seasons, for *M. orbicularis*, there was no significant difference (P≤0.05) between stems and fruits but they were both significantly higher than leaves at growing stage, while at maturation, stems were significantly (P≤0.05) the highest (46.48%) in CF%. Finally, for *T. stellatum*, fruits were significantly (P≤0.05) the highest in CF in spring (39.20%) while in summer stems were the highest in CF% (48.80%) (Table 4).

3.5.2 Crude fibers content between plant species

At early stage of growth, *O. crista-galli* was significantly (P≤0.05) the highest in CF% (32.28%) compared with other plant species, whereas at maturation, *S. alba* was significantly (P≤0.05) the highest in CF% (47.12%) compared with other plant species. *A. palaestina* was significantly (P≤0.05) the lowest at both seasons (17.69% at spring and 21.99% at summer) compared with other plant species (Table 3).

3.5.3 Crude fiber content among seasons

Results have shown an increase in CF content from early stage of growth towards maturation for all plant species and parts (Table 4). As shown in table (4), there was a highly significant difference (P≤0.05) in CF levels due maturation stage, except for Trifolium fruits which showed no significant difference (P≤0.05) between seasons. In spring, CF ranged from (17.69-39.20) % whereas (21.99-61.55) % in summer (Table 4).

Table 4: Chemical composition ((CF) Crude fibers, (ADF) Acid detergent fibers and (NDF) Neutral detergent fibers) of plant species showing plant parts (stem, leaf and RP) during spring and summer based on dry matters.

Plant Species	Plant Part	% Crude Fibers		% ADF		% NDF	
		Spring	Summer	Spring	Summer	Spring	Summer
H. spontaneum	stem	33.07 B*a **	38.81 Aa	39.69 Ba	47.41 Ab	33.52 Ba	70.29 Aa
	leaf	26.86 Bb	33.94 Ab	34.01 Bb	43.57 Ac	33.97 Ba	52.18 Ab
	RP	27.16 Bb	31.17 Ac	35.53 Bb	50.29 Aa	28.04 Bb	73.53 Aa
A. sativa	stem	32.56 Ba	38.59 Aa	35.33 Ba	43.09 Ab	61.30 Ba	74.31 Aa
	leaf	29.56 Bb	34.09 Ab	24.56 Bb	44.52 Aa	56.44 Bb	64.10 Ac
	RP	26.88 Bc	31.31 Ac	27.79 Bb	36.03 Ac	62.78 Ba	70.21 Ab
M. orbicularis	stem	29.87 Ba	46.48 Aa	37.40 Ba	54.03 Aa	49.54 Bb	64.69 Aa
	leaf	20.56 Bb	26.21 Ac	36.29 Bb	41.74 Ab	52.80 Ba	55.58 Ac
	RP	30.63 Ba	34.44 Ab	29.73 Bc	32.63 Ac	47.08 Bc	56.87 Ab
O. crista-galli	stem	24.12 Bc	39.90 Ab	36.47 Ba	45.44 Ab	40.69 Bb	59.00 Aa
	leaf	32.28 Ba	44.08 Aa	22.02 Bb	31.9 Ac	29.61 Bc	35.38 Ac
	RP	30.27 Bb	35.77 Ac	36.47 Ba	47.32 Aa	47.62 Ba	49.46 Ab
A. palaestina	stem	35.14 Ba	46.03 Aa	36.40 Ba	47.92 Aa	51.04 Ba	70.88 Aa
	leaf	17.69 Bc	21.99 Ac	24.22 Bb	28.84 Ac	26.58 Bc	35.83 Ac
	RP	27.31 Bb	38.31 Ab	26.95 Bb	38.01 Ab	39.11 Bb	53.78 Ab
T. stellatum	stem	33.60 Bb	49.80 Aa	35.40 Bb	53.18 Aa	53.97 Bb	69.72 Aa
	leaf	21.59 Bc	23.37 Ac	24.05 Bc	26.60 Ac	39.82 Bc	50.67 Ab
	RP	39.20 Aa	38.91 Ab	37.40 Ba	42.21 Ab	56.30 Ba	68.21 Aa
S. alba	stem	38.60 Ba	61.55 Aa	41.11 Ba	66.21 Aa	56.72 Ba	73.79 Aa
	leaf	29.10 Bb	47.12 Ab	23.06 Bc	48.49 Ab	35.83 Bb	66.44 Ab
	RP	18.81 Bc	33.06 Ac	27.01 Bb	33.56 Ac	35.77 Bb	52.79 Ac

*Means in the same row for same parts of each species for same parameter with different capital letters are significantly different according to HSD test at P≤0.05.

3.6 ADF content

3.6.1 ADF content between plant parts

In spring, stems of *H. spontaneum, A. sativa, M. orbicularis, A. palaestina* and *S. alba* were significantly ($P \leq 0.05$) the highest in acid detergent fiber content (ADF) compared with leaves and fruits of each species. Whereas in *O. crista-galli*, stems and fruits had no significant difference ($P \leq 0.05$) but higher than leaves. For *T. stellatum*, the fruits were significantly the highest ($P \leq 0.05$) in ADF content at growing season (Table 4).

In summer, stems of some forbs (*M. orbicularis*, *A. palaestina* and *S. alba*) still significantly the highest ($P \leq 0.05$) in ADF content, fruits of *O. crista-galli* and *T. stellatum*'s stems were also significantly the highest. For grasses, fruits of *H. spontaneum* and leaves of *A. sativa* showed a significant difference ($P \leq 0.05$) in ADF content than other parts as they were the highest (Table 4).

3.6.2 ADF content between plant species

The ADF levels were very close at spring. Only *M. orbicularis* was significantly (36.29% ADF) higher than *O. crista-galli* (22.02% ADF), the difference between the other plant species were not significant ($P \leq 0.05$) (Table 3).

At summer, there was a significant difference ($P \leq 0.05$) in ADF content between plant species. *S. alba* was significantly the highest ($P \leq 0.05$), it had 48.49% ADF while *A. palaestina* was significantly the lowest ($P \leq 0.05$) and it had 28.84% ADF (Table 3).

3.6.3 ADF content among seasons

Results showed an increase in ADF with advancing maturity. There was a significant difference ($P \leq 0.05$) in ADF content of all plant species between the two seasons (Table 4). In spring, ADF ranged from (22.02%-41.11%) whereas in summer it ranged from (26.06%-66.21%) (Table 4).

3.7 NDF content

3.7.1 NDF content between plant parts

At growing season, NDF levels were different, for example, leaves of *A. sativa* (56.44%), *O. crista-galli* (29.61%), *A. palaestina* (26.58%) and *T. stellatum* (39.82%) were significantly (P≤0.05) the lowest comparing to other parts. However, at summer, stems were significantly (P≤0.05) the highest for all plant species (Table 4). In early spring, stems of *S. alba* and *A. palaestina*, fruits of *T. stellatum*, *O. crista-galli* and *A. sativa*, leaves of *H. spontaneum* and *M. orbicularis* have the highest values of NDF (Table 4). In early summer. When comparing NDF within the same plant, stems of all investigated species, except for *H. spontaneum* fruits, have the highest values.

3.7.2 NDF content between plant species

At spring, *A. sativa* and *M. orbicularis* were significantly higher (P≤0.05) in NDF than other plant species, they had (56.44 and 52.80) % NDF respectively. *A. palaestina* had significantly the lowest (26.58 %) NDF content compared with other plant species except *O. crista-galli* (Table 3).

At summer, *S. alba* was significantly (P≤0.05) the highest (66.44 %) in NDF content compared with other plant species, while *O. crista-galli* had the lowest content of NDF (35.38%) compared with other plant species.

3.7.3 NDF content among seasons

Results showed an increase in NDF with advancing maturity. There was a significant difference (P≤0.05) in NDF content between two seasons. ADF levels at maturation stage were significantly higher (P≤0.05) than early stage for all plant species (Table 4). In early spring, NDF ranged from (26.58%-62.78%) whereas in summer it ranged from (35.38%-74.31%) (Table 4).

3.8 Nutrients content

3.8.1 Nutrient content between plant parts

For *H. spontaneum*, leaves in spring were significantly (P≤0.05) the highest for Ca (0.08%), Mg (0.15%), P (0.07%) and N (2.99%) content, while for K and Na the difference was not significant between some plant parts. In summer, leaves were significantly (P≤0.05) the highest for Ca and Mg, but for K and Na content, stems were significantly (P≤0.05) the highest, and for P and N (3.20%) content, fruits were significantly the highest (Table 5).

In spring, leaves of *A. sativa* were significantly (P≤0.05) the highest for Ca, Mg, Na, and N (3.64%). Except the Na showed no difference between leaves and stems. Fruits were significantly (P≤0.05) the highest for P, while for K content showed no significant (P≤0.05) difference between plant parts (Table 5). In summer, leaves were significantly (P≤0.05) the highest for Ca, Mg and K, but for Na and P content, stems were significantly (P≤0.05) the highest, and for N content, fruits were the highest (1.44%) (Table 5).

For *M. orbicularis*, in spring, fruits were significantly (P≤0.05) the highest for Ca content, fruits and leaves were also the highest for Mg and N, leaves for K and Na, finally stems for P. In summer, same trend was appeared as *H. spontaneum* whereas leaves were significantly (P≤0.05) the highest for Ca and Mg, but for K and Na content, stems were significantly (P≤0.05) the highest, and for N and P content, fruits were the highest (Table 5).

Ca content of *O. crista-galli* leaves was significantly (P≤0.05) the highest in both seasons, it was 1.62% Ca in spring and 1.36% Ca in summer. In addition, Na content of stems, P and K content of fruits were significantly (P≤0.05) the highest in both seasons, but for Mg content of *O. crista-galli* fruits, it was significantly (P≤0.05) the lowest in both seasons. N content in leaves was 3.01% in spring and 1.32% in summer (Table 5).

In spring, leaves and stems of *A. palaestina* were significantly (P≤0.05) the highest for Ca, Mg and Na content. For P and N content, leaves and fruits were significantly (P≤0.05) the highest, but for K content, there was no significant (P≤0.05) difference between plant parts at early stage of maturation. In summer, leaves of *A. palaestina* were significantly (P≤0.05) the highest for Ca, Mg, K, Na and N content, while for P content, fruits were significantly the highest followed by leaves then the stems (Table 5).

Leaves of *T. stellatum* were significantly (P≤0.05) the highest in Ca content in both seasons. In spring, fruits were significantly ($P \leq 0.05$) the highest for Mg, K and Na content, while stems were significantly ($P \leq 0.05$) the highest for P content and leaves were for N content. In summer, leaves were significantly ($P \leq 0.05$) the highest for Mg content, while stems were significantly ($P \leq 0.05$) the highest for Na content and fruits were for P and N content. For *T. stellatum* K content in summer, there was no significant ($P \leq 0.05$) difference between plant parts (Table 5).

Ca content of *S. alba* leaves was significantly ($P \leq 0.05$) the highest in both seasons. Mg content in spring showed no significant difference between plant parts, but in summer, leaves and fruits were significantly ($P \leq 0.05$) the highest. Stems of *S. alba* were significantly ($P \leq 0.05$) the highest in K content in spring and fruits were in summer. Na content in spring showed no significant difference between plant parts, but in summer, stems were significantly ($P \leq 0.05$) the highest. Finally, P and N content of *S. alba* fruits were significantly ($P \leq 0.05$) the highest in both seasons (Table 5).

Table 5: Nutrient composition of plant species showing plant parts (stem, leaf and RP) during spring and summer based on dry matters.

Plant Species	Plant Part	% Ca		% Mg		% K		% Na		% P		% N	
		spring	summer	spring	Summer	spring	summer	spring	summer	spring	summer	spring	summer
H. spontaneum	stem	0.01 c*	0.03 b	0.10 b	0.08 c	0.40 b	0.46 a	0.07 b	0.21 a	0.05 b	0.020 a	1.94 c	0.89 c
	leaf	0.08 a	0.13 a	0.15 a	0.12 a	0.49 a	0.38 b	0.16 a	0.15 b	0.07 a	0.017 b	2.99 a	1.45 b
	RP	0.02 b	0.03 b	0.09 b	0.09 b	0.47 ab	0.26 c	0.15 a	0.06 c	0.06 b	0.020 a	2.39 b	3.20 a
A. sativa	stem	0.02 b	0.01 c	0.08 b	0.08 c	0.41 a	0.38 b	0.18 a	0.21 a	0.03 c	0.032 a	1.76 b	1.01 c
	leaf	0.05 a	0.16 a	0.12 a	0.13 a	0.40 a	0.42 a	0.20 a	0.19 b	0.04 b	0.028 c	3.64 a	1.23 b
	RP	0.01 b	0.04 b	0.08 b	0.10 b	0.38 a	0.27 c	0.08 b	0.08 c	0.05 a	0.029 b	1.92 b	1.44 a
M. orbicularis	stem	0.15 b	0.97 c	0.17 b	0.16 c	0.41 b	0.46 a	0.16 b	0.21 a	0.07 a	0.01 c	2.59 b	1.11 c
	leaf	0.35 b	1.29 a	0.18 a	0.19 a	0.49 a	0.4 b	0.2 a	0.15 b	0.04 c	0.02 b	4.58 a	1.93 b
	RP	0.56 a	1.16 b	0.19 a	0.17 b	0.33 c	0.31 c	0.16 b	0.07 c	0.05 b	0.05 a	4.02 a	3.47 a
O. crista-galli	stem	1.31 b	1.20 b	0.23 a	0.19 b	0.49 c	0.45 a	0.25 a	0.26 a	0.05 b	0.006 c	2.27 b	1.04 c
	leaf	1.62 a	1.36 a	0.23 a	0.22 a	0.50 b	0.31 c	0.22 b	0.17 b	0.06 b	0.01 b	3.01 a	1.32 b
	RP	0.66 c	0.98 c	0.20 b	0.18 c	0.52 a	0.35 b	0.18 c	0.09 c	0.09 a	0.04 a	3.24 a	2.22 a
A. palaestina	stem	0.41 a	0.64 b	0.16 a	0.13 c	0.50 a	0.40 c	0.21 a	0.17 b	0.07 b	0.017 c	1.61 b	0.68 c
	leaf	0.44 a	0.87 a	0.17 a	0.21 a	0.45 a	0.49 a	0.23 a	0.19 a	0.10 a	0.066 b	2.95 a	2.21 a
	RP	0.16 b	0.58 c	0.15 b	0.17 b	0.52 a	0.43 b	0.17 b	0.12 c	0.10 a	0.073 a	2.80 a	1.82 b
T. stellatum	stem	0.28 c	1.04 b	0.18 b	0.19 b	0.39 b	0.31 a	0.08 c	0.15 a	0.05 a	0.01 c	2.23 c	0.72 c
	leaf	1.05 a	1.54 a	0.19 a	0.21 a	0.36 b	0.31 a	0.11 b	0.11 b	0.04 b	0.02 b	4.54 a	1.06 b
	RP	0.87 b	0.69 c	0.20 a	0.17 c	0.48 a	0.31 a	0.14 a	0.06 c	0.03 c	0.04 a	3.17 b	1.58 a
S. alba	stem	0.46 b	0.31 c	0.17 a	0.16 b	0.48 a	0.316 c	0.16 a	0.23 a	0.05 b	0.02 b	1.96 c	0.77 c
	leaf	1.20 a	0.55 a	0.22 a	0.18 a	0.42 b	0.322 b	0.17 a	0.14 b	0.06 b	0.02 b	3.86 b	1.66 b
	RP	0.08 c	0.34 b	0.16 a	0.18 a	0.46 ab	0.366 a	0.10 a	0.13 c	0.11 a	0.06 a	4.53 a	3.65 a

* Means in the same column for same species with different small letters are significantly different according to HSD test at P≤0.05

3.8.2 Nutrient content between plant species

In spring, Ca content for *O. crista-galli* was significantly (P≤0.05) the highest (1.62% Ca), whereas in summer, *T. stellatum* was significantly (P≤0.05) the highest in Ca content (1.54%) (Table 6).

For Mg levels, *O. crista-galli* and *S. alba* were significantly (P≤0.05) higher than other species in spring, they have 0.23% Mg and 0.22% Mg respectively. In summer, *O. crista-galli* was significantly (P≤0.05) the highest (0.22% Ca) (Table 6).

In spring, *O. crista-galli* was (P≤0.05) the highest in K content (0.5% K) and it was significantly higher than that in *A. sativa*, *T. stellatum*, and *S. alba*. However, *A. palaestina* has 0.49% K in summer and it was significantly (P≤0.05) the highest compared with other plant species (Table 6).

A. palaestina showed the highest Na content (0.23%) followed by *O. crista-galli* (0.22%). In summer, *A. palaestina* and *A. sativa* were significantly (P≤0.05) higher than other species, they both have 0.19% Na (Table 6).

For P content, *A. palaestina* was significantly (P≤0.05) the highest in both seasons, it has 0.1% P in spring and 0.07% P in summer (Table 6).

Finally, in spring, *M. orbicularis* and *T. stellatum* were significantly (P≤0.05) the highest in N content (4.58% and 4.54%), respectively. *A. palaestina* was significantly (P≤0.05) the highest in summer, it has 2.21% N (Table 6).

Table 6: Nutrient composition of plant species (leaf part) during spring and summer based on dry matters.

Plant species	% Ca		% Mg		% K		% Na		% P		% N	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
H. spontaneum	0.08 e*	0.13 g	0.15 e	0.12 f	0.49 ab	0.38 d	0.16 b	0.15 c	0.07 b	0.02 d	2.99 d	1.45 d
A. sativa	0.05 e	0.16 fg	0.12 f	0.13 e	0.40 cd	0.42 bc	0.20 a	0.19 a	0.04 d	0.03 b	3.64 bc	1.23 e
M. orbicularis	0.35 d	1.29 c	0.18 c	0.19 c	0.49 ab	0.40 cd	0.20 a	0.15 cd	0.04 d	0.02 c	4.58 a	1.93 b
O. crista-galli	1.62 a	1.36 b	0.23 a	0.22 a	0.50 a	0.31 e	0.22 a	0.17 b	0.06 c	0.01 f	3.01 cd	1.32 de
A. palaestina	0.44 d	0.87 d	0.17 d	0.21 b	0.45 abc	0.49 a	0.23 a	0.19 a	0.10 a	0.07 a	2.95 d	2.21 a
T. stellatum	1.05 c	1.54 a	0.19 bc	0.21 b	0.36 d	0.31 e	0.11 c	0.11 e	0.04 d	0.02 e	4.54 a	1.06 f
S. alba	1.20 b	0.55 e	0.22 a	0.18 d	0.42 bcd	0.32 e	0.17 b	0.14 d	0.06 c	0.02 d	3.86 b	1.66 c

* Means in the same column for same species with different small letters are significantly different according to HSD test at P≤0.05.

Chapter Four

Discussion

4.1 Effect of seasonal change on the selected species

DM content for our selected plant species was significantly ($P \leq 0.05$) higher at early summer than early spring (Table 2), these results confirmed with (Chebli et al., 2021). DM is a descriptive measure of forages that showed a rapid increase towards maturity when plants become dried and senescence (McInnis et al., 1993). As summer proceeds, plants lose their water content and the presence of DM increased. This will affect picky eaters livestock. Sheep and goats prefer juicy leaves rather than dried ones. So, based on these results for all the examined plants, sheep and goats should graze in spring, while cows could graze perfectly in summer. In general, the values of DM at both seasons were normal and make sense. At early summer DM ranged between (80.93 - 96.33) %, which is normal for dried species that was collected at dry season with high rate of evaporation. While at early summer, DM ranged from 6.17% to 36.00% which is low since the plants still fresh and keep their water content (McInnis et al., 1993). Grasses had higher DM content than forbs during spring than summer, this is due to the higher stems to leaves ratios in grasses than forbs (McInnis et al., 1993; Pessarakli et al., 2005; Mountousis et al., 2008; Perotti et al., 2021).

Ash content of forbs in some of their parts were decreased with advancing maturity (Table 2). This may be due to the increase of seeds ratios relatively to other parts, this agrees with EL-Shatnawi & Ereifij (2001). The results proved by the negative relation between ash content and CP content trends in the current data, that means when the CP increased with maturity due to increase of seeds and fruits, ash content was decreased. Similar results were found also by (Long et al., 1999; Ayed et al., 2001; Aganga et al., 2003; Gulsen et al., 2004; kamalak et al., 2005; Mountousis et al., 2006).

Crude fat measurements are good indicator for the energy stored in the plants and transformed to animals (Range, 2023). In early spring, *S. alba* has the highest CFt levels in both seasons, the results was predictable since *S. alba* was known and still be used in energy production due to its high fat content. Many researches have made their studies on this plant species (Ciubota-Rosie et al., 2013; Peng et al., 2014; Mitrovic et al., 2020). Also, this is probably due to the high ratio of seeds than stem and leaf parts, vegetable parts of plants relatively lower in fats than seeds and fruits (Holechek et al., 1989). A crude fat content of at least 6-8% in forage is needed (Range, 2023). As shown in Table (2) and especially in summer, CFt was limited and below the animal needs for most plant species except for *S. alba*. So, it is recommended to add fat as supplements since it is below requirements.

Protein levels are considered an important indicator for rangelands characteristics. Protein levels reflects the digestibility of the livestock forage and considered a very good indicator for the nutritional value of the species. In this study, for all selected species, protein levels in early summer are much lower than protein levels in early spring. In early spring, the highest values of protein levels were 28.61% and 28.34% for *M. orbicularis* (forbs) and *T. stellatum* (forbs) respectively. While in early summer, the lowest protein levels were 6.60% and 7.68% for *H. spontaneum* (grasses) and *A. sativa* (grasses) respectively. The protein levels decrease while proceeding in summer season due to maturation, decline of cell soluble content and the deficiency in soil fertility and moisture. This decline might be due to the decrease in N availability to the plant because of low soil moisture (Evitayani et al., 2004). The studied plants tend to lose their protein content from early stage of growth to maturation stage as confirmed in literature (Ganskopp and Bohnert 2001; Abusuwar and Bakshawain 2012; Abusuwar and Al-Solimani 2013; Basheer-Salimia and Atawnah 2014; Edelman and Colt, 2016). The range of protein levels in grasses is lower than forbs as indicated in Table (2). This is caused by the decline in the stem to leave ratio in the plants. Also, increasing the DM content in grasses, caused the decreasing in protein levels. Forbs had more CP due to the increase of seeds and pods ratios than stems and leaves parts (McInnis et al., 1993).

Range livestock require (7%-9%) of crude protein for maintenance and (10%-12%) for lactation (Ganskopp and Bohnert, 2001). In the studied plants, in early spring, all the species fulfill the livestock protein requirements. It ranged between 10.98% and 28.61% which is much higher than (7%-9%) needed. While in early summer, lower levels of protein were found and it ranged between 4.23% and 21.68% (Table 2). For *H. spontaneum* and *A. sativa*, the protein levels were below the livestock requirements. As a result, the animals feeding forages begin losing weight. So, in summer, animals need feed supplementation to substitute protein deficiency.

CP percentage mainly depend on the N concentration in plant content. Data showed that N % of all species were decreased through time and during dry seasons (Table 5). This result is due to N leaching and decomposition, also protein in older leaves and plant parts were hydrolyzed and its products translocated to other plant parts like roots (Msangi and Hardesty, 1993; Abad et al., 2004).

CF levels in all the examined plants increased from early spring to early summer. In the early growth period (early spring), plants have low fiber content (Table 4). In general, plants contain high protein level and low crude fiber content in early growth season. When maturation progress, the crude fibers content increase (Fatur et al., 2007; Basheer-Salimia and Atawnah, 2014). Grasses recorded relatively high CF levels in early spring, this is probably due to the increase in stems to leaves ratio, as declared in (Table 4), stems of grasses were significantly ($P \leq 0.05$) the highest of CF comparing to other parts in both seasons. Species with low fiber content are associated with higher digestibility and higher dry matter intake by livestock (George et al., 2007; Towhidi, 2007). As shown in (Table 4), these levels of fiber (17.69 – 39.2%) in early spring in the under investigated species were accepted comparing to suitable level of CF which provide excellent intake (40%) (Robinson, 1999), but in early summer, the levels were (21.99 – 61.55%), some species had higher levels that may hinder digestion process such like *S. alba*.

ADF reflect levels of cellulose, lignin and cutin. ADF measurements are important indicator for forage digestibility (Robinson, 1999). Forage with low ADF levels is more digestible for ruminants (Sharpe and Sharpe, 2019). In early spring, ADF levels range between 22.02% and 41.11%. In early summer, ADF levels range between 26.60% and 66.21% (Table 4). In agreement with findings of Long et al., (1999); Ayed et al., (2001); Hussain and Durrani, (2009); Kamalak and Canbolat, (2010), results showed an increase in ADF with advancing maturity in all the investigated species. This is due to maturity which raises cell wall content.

In general, the studied grasses have higher levels of ADF since they have hollow stems and large fraction of fibrous tissues (Tuna, 2004; Guslin et al., 2004). So, grasses are less digestible than forbs. Recommendations of 18% - 20% of ADF is adequate for goat production and lactation, and about 23% for maintenance (Lu et al., 2005). Some species recorded an increase in ADF content during summer (Table 4), due to maturity that associated with increase in cell wall content, while other species like forbs which have pods and seeds in summer had low ADF content (Ganskopp and Bohnertn, 2001).

Neutral detergent fiber consists of ADF and hemicellulose. NDF is an essential indicator for forage digestibility. If the ratio of NDF to ADF increases, the food consumption and intake will increase (Holechek, et al. 1989; Ahamefule et al., 2006). In early spring, NDF values ranged between 26.58% and 62.78%. However, NDF values in early summer were increased and ranged between 35.38% and 74.31% (Table 4). Distel et al., (2005) mentioned the increase in NDF towards growing is due to maturity and the increase of stem to leave ratios of plants. *A. sativa* and *S. alba* have the highest NDF values in early spring and early summer respectively. In general, grasses have relatively high NDF levels, which means that ruminants would consume large amounts of grass to fulfill their needs (Hummel et al., 2006). Livestock requirements of NDF is around 41% (Lu et al., 2005). In early spring, the NDF of studied plants were around livestock needs for perfect digestion. On the other hand, in early summer, NDF were high. The resulted work complies with findings of Hussain and Durrani, 2009, Peprah et al., 2021 and Khan et al., 2022.

4.2 Comparison between plant parts

In early spring, for DM content, within the same plant, fruits of *H. spontaneum* and *O. crista-galli*, leaves of the rest have the highest values when compared with other (same) plant' parts. This is due to high rates of photosynthesis that take place in leaves in spring which cause rapid increase in the dry matter content (Sevlm, 2018). In early summer, within the same plant, fruits of *A. sativa* and *A. palaestina*, stems of the rest have the highest values when compared with other (same) plant parts. Table (2) demonstrates that DM content are mainly high in fruits and leaves in early spring. While stems and fruits have high levels of DM content in early summer. Similar results were found in literature (Arduini et al., 2006), it declared that increasing the surrounding temperature (summer proceeding) would cause dry matter accumulation in stems and fruits instead of leaves.

When comparing ash content within the same plant, all species have the highest ash values in their leaves except for *S. alba* (Table 2). Since ash content is a measure of minerals present (Oduntan et al., 2012), this means leaves mainly rich in elements and could contain traces of silicate, carbonate and phosphates (Oduntan et al., 2012). Clearly, ash content decrease in all species when summer proceeds except for fruits and leaves of *A. sativa* and *M. orbicularis* and leaves of *O. crista-galli* and *T. stellatum*. In literature, it is found that ash content decrease with maturity. Due to mineral loss in soil and leaves dry off (Emebu and Anyika, 2011).

In early spring, leaves of all species had higher CP levels except for *S. alba* fruits, it had 28.30% CP (Table 2), this value comply with Damian (2014) who mentioned a relatively high protein content of *S. alba* seeds, it ranged from 28 to 36%. The lowest values of CP were found in stems of *A. palaestina*, leaves of *A. palaestina* and fruits of *A. sativa*. Similar results were found in literature (Ma et al., 2015). In early summer, when comparing within the same plant, all species have the highest values of CP in their fruits except for *A. palaestina* leaves. It could be explained as the process of nutrient translocation from leaves and stems to crowns when plant becomes mature (Gintzburger et al., 2000). In summer seeds and fruits have the highest protein levels compared to other parts. This is mainly referred to that seeds are the main element for plant reproduction; it contains the genetic material (Edelman and Colt, 2016). Generally, grasses have lower protein than forbs as declared. These results were emphasized in Allen et al., 2013 study. These results showed the importance of our species as high-quality forage especially in grasses which hold up their leaves and fruits during maturation other than forbs. Here the importance of grasses would appear to provide the animals a good source of protein in dry seasons although they have less CP than forbs. So, the existence of these dominant grasses naturally in rangelands is essential during the shortage of protein in other plants (forages).

Generally, crude fat decreased in all parts of all investigated plants except for fruits of *T. stellatum*. *S. alba* has the highest overall crude fat content in all of its parts when compared to other species in both early spring and early summer (Table 2). Similar results were found in literature (Sabudak and Guler, 2009). For *S. alba*, the high content of crude fat in the fruits is due to plants' preparation to produce seeds and its richness in glyceride oil (Antova et al., 2017).

In early spring, when comparing crude fibers within the same plant, fruits of *T. stellatum* and *M. orbicularis*, leaves of *Onobryches crista-galli*, stems of *S. alba*, *H. spontaneum*, *A. sativa* and *A. palaestina* have the highest values (Table 4).

In early summer, *A. sativa*, *T. stellatum*, *M. orbicularis*, *S. alba*, *H. spontaneum* and *A. palaestina* have the higher values of CF in their stems. Mainly, crude fiber increased in all parts of all investigated plants except for fruits of *T. stellatum*. Literature named summer season as peak values of crude fibers (Gonz· lez-Hern· ndez et al., 2000), since the highest fiber levels are obtained in summer due to species maturation and full growth. Similar results were found by Singh et al., (2022).

In early spring, the stems of *A. sativa*, leaves of *O. crista-galli* and fruits of *A. palaestina* have the lowest levels of ADF (Table 4). When comparing parts within the same plant, stems of *H. spontaneum*, *S. alba*, *A. palaestina*, *A. sativa* and *M. orbicularis*, fruits of *T. stellatum* have the highest values of ADF. In early summer, the lowest values of ADF were found in *A. sativa* stems, leaves of *T. stellatum* and fruits of *M. orbicularis*. When comparing within the same plant, *T. stellatum*, *M. orbicularis*, *S. alba* and *A. palaestina* have the highest values of ADF in their stems. While leaves of *A. sativa* have the highest values. On the other hand, fruits of *O. crista-galli* and *H. spontaneum* have the highest values. Generally, ADF increased in all parts of all investigated plants when summer proceeds agreeing with Aydin and Nuh, (2022) and Naydenova et al. (2022). Our results are reasonable, were fibers increased when summer proceeds, so, ADF increased too.

In early spring, stems of *S. alba* and *A. palaestina*, fruits of *T. stellatum*, *O. crista-galli* and *A. sativa*, leaves of *H. spontaneum* and *M. orbicularis* have the highest values of NDF (Table 4). In early summer, when comparing NDF within the same plant, stems of all investigated species except for *H. spontaneum* fruits have the highest values. Generally, NDF increased in all parts of all investigated plants. Similar results were found in literature (Kamalak and Canbolat, 2010; Koukolová et al., 2010). As plants mature, NDF values will increase as a result of total fibers increase in the stems (Rasby, 2023). Increasing NDF levels will improve animal digestion process.

For the seven investigated species, concentrations of Na were within the accepted limits except for *A. palaestina* and *O. crista-galli* in early spring (Table 5). For Mg and K levels, all of the investigated plants comply with the requirements. K levels decrease in early summer due to leaching of soluble K out of the species. P levels decrease in early summer for all the examined species. This is due to soil drought and low content of stored P in soil. For Ca, investigated forbs satisfy ruminants needs both in early spring and early summer (Table 5). For P, results agree with Petit Bon et al., (2020).

Ca/P ratio is a very descriptive indicator for the nutritional value of forage (Loughrill et al., 2017). Ca/P ratios of 1:1 or 2:1 is perfect for ruminants (Loughrill et al., 2017). In early spring, ratios were 1.14:1, 1.25:1, for *H. spontaneum*, *A. sativa*. While, in early summer, ratios were 6.50:1, 5.33:1, the ratios were accepted for those two species of grasses when they were dominant in the range, otherwise, P should be supplemented if other forbs species were found.

4.3 Comparison between plant species

Ash content decreased for *S. alba*, *A. palaestina* and *H. spontaneum* and increased for the rest (Table 3). Similar results were found in literature (Blair, 1969).

For all the investigated species, protein levels in early summer are much lower than protein levels in early spring. In early spring, the highest values of protein levels were 28.61% and 28.34% for the forbs *M. orbicularis* and *T. stellatum* respectively. While in early summer, the lowest protein levels were 6.60% and 7.68% for the grasses *H. spontaneum* and *A. sativa* respectively. All the investigated species are within the requirements except for *H. spontaneum* in early summer (Ganskopp and Bohnert 2001).

It is found that only *A. palaestina* fulfill livestock needs of crude fat if it is dominant in the rangeland, it was 7.36% in early spring and 5.91% in early summer (Table 3).

In all the studied species, ADF levels in early summer are higher than levels in early spring. This is due to maturity which raises cell wall content. In agreement with findings of Long et al., (1999); Ayed et al., (2001); Gülşen et al., (2004); Kamalak and Canbolat (2010). All the examined species have relatively high ADF content which may complicate the digestion process. *T. stellatum* has 24.05% ADF which is the lowest value in early spring and 26.60% ADF in early summer (Table 3). NDF is an essential indicator for forage digestibility. If the ratio of NDF to ADF increases, the food consumption and intake will increase. It is found that grasses have relatively high NDF levels. Which means that ruminants would consume large amounts of grass to fulfill their needs (NRC, 1982; NRC, 1985). Considering the ratio of NDF/ADF, *T. stellatum* has the perfect ratio (Table 3). It means high level of NDF and low level of ADF to balance between forage consumption and digestion.

Growth usually depends on carbon, hydrogen and oxygen with various essential elements such as nitrogen, potassium, calcium, magnesium, sodium and phosphorous. Minerals are very important for species metabolism and productivity. For the examined species Mg, K, and Na levels both in early spring and summer comply with the requirements. For Ca, only *A. sativa* and *H. spontaneum* do not fill the requirements (Table 6). Considering all the minerals' levels and requirements, only *T. stellatum* and *S. alba* fulfill all the requirements if they were dominant (NRC, 1982).

A. sativa showed higher values of protein, ADF and NDF comparing to other studies (Niu et al., 2007; Mut et al., 2016; Gracia et al., 2017; Bityutskii et al., 2020; Ibrahim et al., 2020), while for fat content, it was within the range (Mut et al., 2016) (Table 3). *H. spontaneum* results for CF, ADF and NDF were higher comparing to Yasar and Tosun (2018) findings (Table 3). For *M. orbicularis*, results for CP, NDF and ADF were closed to the findings of these researches (Kazemi and Valizadeh, 2019; Hidosa and Kibret, 2021). The results of *T. stellatum* for NDF and ADF were closed to Ertiken (2021) study, but CP in our study recorded higher values (Table 3). *A. palaestina* and *O. crista-galli* recorded higher values of NDF and ADF comparing to other studies (Kaplan, 2011; Chebli et al., 2021) (Table 3).

Conclusion

In conclusion, various parameters affect the chemical composition of rangeland plants. Such as: plant type, plant part, plant structure, season, climate, soil fertility, location and other parameters. In this study, the effect of season change was studied on seven different species parts. It is found that crude fibers, ADF, NDF and calcium levels increased in early summer. While, protein, crude fat, potassium, phosphorous and nitrogen levels decreased in early summer. *S. alba* has the highest crude fat, fibers, ADF, NDF and mineral content when compared to other species.

Rangeland nutritional study is very essential to determine dominant useful species and to select which ones are perfect for forage production.

Recommendations

1. If the investigated species were used to produce forage, fat and phosphorus should be added to the mix, to fulfill livestock requirements.
2. To justify sustainable development targets, lands covered with our investigated species would satisfy ruminants needs during the spring and early summer especially *T. stellatum* and *S. alba*.
3. Further research is needed to study the effect of climate, location and soil elements on the nutritional value of rangeland plants.
4. Nutrient blocks are not necessarily needed if one of the seven investigated species were dominant in the rangeland during studt period.
5. It is recommended when scheduling the grazing period to consider both the livestock requirements and the seasonal nutritional value of the rangeland.
6. Considering the importance of livestock nutritional needs, it is suggested for the investigated species to be reseeded in the lands since their nutritional value was rich.

References (Supporting Literature)

1. Abad, A., Lloveras, J., & Michelena, A. (2004). Nitrogen fertilization and foliar urea effects on durum wheat yield and quality and on residual soil nitrate in irrigated Mediterranean conditions. *Field Crops Research*, *87*(2-3), 257-269.

2. Abdo, K. (2005). Land Management in Palestinian Strategic Planning. *Drafting appropriate policies and guidelines*, 76.

3. Abu Omar, J. (1997). The feed industry in Palestine: problems and prospects. Center for Palestine Research and Studies (CPRS). Research Report serioes No. 3.

4. Abusuwar, A. O., & Ahmed, E. O. (2010). Seasonal variability in nutritive value of ruminant diets under open grazing system in the semi-arid rangeland of Sudan (South Darfur State). *Agriculture and Biology Journal of North America*, *1*(3), 243-249.

5. Abusuwar, A. O., & Al-Solimani, S. J. (2013). Effect of chemical fertilizers on yield and nutritive value of intercropped *sorghum bicolor* and *lablab purpureus* forages grown under saline conditions. *The Journal of Animal and Plant Sciences*, *23*(1), 271-276.

6. Abusuwar, A. O., & Bakshawain, A. A. (2012). Effect of chemical fertilizers on yield and nutritive value of intercropped Sudan grass (*Sorghum sudanense*) and cowpea (*Vigna unguiculata* L. Walp) forages grown in an adverse environment of western Saudi Arabia. *African Journal of Microbiology Research*, *6*(14), 3485-3491.

7. Aganga, A. A., Mthetho, J. K., & Tshwenyane, S. (2003). Atriplex nummularia (Old Man Saltbush): a potential forage crop for arid regions of Botswana.

8. Ahamefule, F. O., Obua, B. E., Ibeawuchi, J. A., & Udosen, N. R. (2006). The nutritive value of some plants browsed by cattle in Umudike, Southeastern Nigeria. *Pakistan Journal of Nutrition*, *5*(5), 404-409.

9. Ahmad, A. H., Wahid, A., Khalid, F., Fiaz, N., & Zamir, M. S. I. (2011). Impact of organic and inorganic sources of nitrogen and phosphorus fertilizers on growth, yield and quality of forage oat (*A. sativa* L.). *Cercetari agronomice in Moldova*, *147*, 39-49.

10. Alataweneh, H. (2013). Role of agriculture in economic growth in Palestine (Doctoral dissertation, Aristotle University of Thessaloniki (APTH). Faculty of Agriculture. Department of Agricultural Economics).

11. Alizadeh, M. A., & Jafari, A. A. (2016). Variation and relationships of morphological traits, shoot yields and essential oil contents of four *Anthemis* species. *Folia*

Horticulturae, *28*(2), 165.

12. Al-Joaba, O. (2006). Studies of Natural Vegetation Characteristics at Different Environments and Range Improvement Practices at Southern West Bank. *Master of Science in Natural Resources & Sustainable Management. Hebron Univ*.

13. Allen, E., Sheaffer, C., & Martinson, K. (2013). Forage Nutritive Value and Preference of Cool-Season Grasses under Horse Grazing. *Agronomy Journal*, *105*(3), 679–684.

14. Al-Seikh, S. (2006). The effect of different water harvesting techniques on Runoff, Sedimentation, and soil characteristics. *College of Graduate Studies and Academic Research, Hebron University, Palestine*.

15. Al-Sheikh, B., & Qumsiyeh, M. B. (2021). Imperiled ecosystems in Palestine: Rare plants as Indicators. *Imperiled: The Encyclopedia of Conservation", Reference Modules in Earth Systems and Enviromental Sciences, Elsevier*, 1-7.

16. Al-Snafi, A. E. (2016). Medical importance of Anthemis nobilis (Chamaemelum nobile)-a review. *Asian Journal of Pharmaceutical Science & Technology*, *6*(2), 89-95.

17. Ammerman, C. B., Chicco, C. F., Moore, J. E., Van Walleghem, P. A., & Arrington, L. R. (1971). Effect of dietary magnesium on voluntary feed intake and rumen fermentations. *Journal of dairy science*, *54*(9), 1288-1293.

18. Ammerman, C. B., & Goodrich, R. D. (1983). Advances in mineral nutrition in ruminants. *Journal of Animal Science*, *57*(suppl_2), 519-533.

19. Antova, G., Angelova-Romova, M., Petkova, Z. Y., Teneva O. and Marcheva M. (2017). "Lipid composition of mustard seed oils (*S. alba* L.)." Bulgarian Chemical Communications, 49: 55-60.

20. AOAC. (1990). Official Methods of Analysis of the Association of Official Analytical Chemists, Vol. II, 15th ed. Sec.985.29. The Association: Arlington, VA.

21. Arduini, I., Masoni, A., Ercoli, L., & Mariotti, M. (2006). Grain yield, and dry matter and nitrogen accumulation and remobilization in durum wheat as affected by variety and seeding rate. *European Journal of Agronomy*, *25*(4), 309–318.

22. ARIJ. (1994). Dry Land Farming in Palestine. Bethlehem, Palestine.: ARIJ.

23. ARIJ. (1997). *The Status of the Environment in the West Bank.* Bethlehem Palestine: Applied Research Institute Jerusalem.

24. Arzani, H., Basiri, M., Khatibi, F., & Ghorbani, G. (2006). Nutritive value of some Zagros Mountain rangeland species. *Small Ruminant Research*, *65*(1-2), 128-135.

25. Augusto, L., Achat, D. L., Jonard, M., Vidal, D., & Ringeval, B. (2017). Soil parent material—a major driver of plant nutrient limitations in terrestrial ecosystems. *Global change biology*, *23*(9), 3808-3824.

26. Aydin, İ., Betül, P., & Nuh, O. (2022). Comparison of cultivated and wild relatives of several forage species in mixed rangeland based on some nutritional characteristics. *Black Sea Journal of Agriculture*, *5*(2), 91-99.

27. Ayed, M. H., González, J., Caballero, R., & Alvir, M. R. (2001). Effects of maturity on nutritive value of field-cured hays from common vetch and hairy vetch. *Animal Research*, *50*(1), 31-42.

28. Barnes, T. G., Varner, L. W., Blankenship, L. H., Fillinger, T. J., & Heineman, S. G. (1990). Macro and trace mineral content of selected south Texas deer forages.

29. Basheer-Salimia, R., & Atawnah, S. (2014). Morphological features, yield components and genetic relatedness of some wheat genotypes grown in Palestine. *World Journal of Agricultural Research*, *2*(1), 12-21.

30. Baumgarten-Sharon, N. (2017). Towards Sustainable Food Security in the Occupied Palestinian Territory: Strengthening rangeland governance.

31. Bedada, G., Westerbergh, A., Müller, T., Galkin, E., Bdolach, E., Moshelion, M., ... & Schmid, K. J. (2014). Transcriptome sequencing of two wild barley (*H. spontaneum* L.) ecotypes differentially adapted to drought stress reveals ecotype-specific transcripts. *BMC Genomics*, *15*(1), 1-20.

32. Bityutskii, N. P., Loskutov, I., Yakkonen, K., Konarev, A., Shelenga, T., Khoreva, V., ... & Ryumin, A. (2020). Screening of *A. sativa* cultivars for iron, zinc, manganese, protein and oil content and fatty acid composition in whole grains. *Cereal Research Communications*, *48*(1), 87-94.

33. Blair, R. M. (1969). Seasonal distribution of nutrients in plants of seven browse species in Louisiana, Southern Forest Experiment Station, Forest Service, US Department of Agriculture.

34. Boczkowska, M., Nowosielski, J., Nowosielska, D., & Podyma, W. (2014). Assessing genetic diversity in 23 early Polish oat cultivars based on molecular and morphological

studies. *Genetic Resources and Crop Evolution*, *61*(5), 927-941.

35. Braighith, A. (1995). Forest and Woodland in Palestine from 1950 to 1995. Palestinian Ministry of Agriculture. Report.

36. Braighith, A. (1998). Palestinian Agricultural Policy, Forests, Pastures and Wildlife. Ministry of Agriculture (Report).

37. Bursal, E., Aras, A., Kılıç, Ö., & Buldurun, K. (2021). Chemical constituent and radical scavenging antioxidant activity of *Anthemis kotschyana* Boiss. *Natural Product Research*, *35*(22), 4794-4797.

38. Butkutė, B., Lemežienė, N., Padarauskas, A., Norkevičienė, E., & Taujenis, L. (2018). Chemical composition of zigzag clover (*Trifolium medium L*.). In *Breeding Grasses and Protein Crops in the Era of Genomics* (pp. 83-87). Springer, Cham.

39. Buxton, D. R., Hornstein, J. S., Wedin, W. F., & Marten, G. C. (1985). Forage quality in stratified canopies of alfalfa, birdsfoot Trefoil, and red clover 1. *Crop Science, 25*(2), 273-279.

40. Capstaff, N. M., & Miller, A. J. (2018). Improving the yield and nutritional quality of forage crops. *Frontiers in Plant Science, 9*, 535.

41. Carbonero, C. H., Mueller-Harvey, I., Brown, T. A., & Smith, L. (2011). Sainfoin (*Onobrychis viciifolia*): a beneficial forage legume. *Plant Genetic Resources*, *9*(1), 70-85.

42. Catling, P. M., McElroy, A. R., & Spicer, K. W. (1994). Potential forage value of some eastern Canadian sedges (Cyperaceae: Carex). *Rangeland Ecology & Management/Journal of Range Management Archives*, *47*(3), 226-230.

43. Chebli, Y., El Otmani, S., Chentouf, M., Hornick, J. L., & Cabaraux, J. F. (2021). Temporal variations in chemical composition, in vitro digestibility, and metabolizable energy of plant species browsed by goats in southern Mediterranean forest rangeland. *Animals*, *11*(5), 1441.

44. Chebouti, A., Abdelguerfi, A., & Mefti, M. (2000). Effet du stress hydrique sur le rendement en gousses et en graines chez trois espèces de luzernes annuelles: *Medicago aculeata*, *M. orbicularis* et *Medicago truncatula*. *Opt. Médit*, 163-166.

45. Ciubota-Rosie, C., Macoveanu, M., Fernández, C. M., Ramos, M. J., Pérez, A., & Moreno, A. (2013). *S. alba* seed as a prospective biodiesel source. *Biomass and Bioenergy*, *51*, 83-90.

46. Coelho, A. P., Faria, R. T. D., Leal, F. T., Barbosa, J. D. A., & Lemos, L. B. (2020). Biomass and nitrogen accumulation in white oat (*A. sativa* L.) under water deficit 1. *Revista Ceres*, *67*, 1-8.

47. Damian, C. (2014). Physical properties of mustard seeds (*S. alba* L.). *Lucrări Ştiinţifice-Universitatea de Ştiinţe Agricole şi Medicină Veterinară, Seria Zootehnie*, *61*, 39-44.

48. Davis, A.M. (1981). The oxalate, tannin, crude fiber and crude protein composition of young plants of some atriplex species. J. *Range. Manage*, *34*,329-331.

49. Devlin, T. J., & Roberts, W. K. (1963). Dietary maintenance requirement of sodium for wether lambs. *Journal of Animal Science*, *22*(3), 648-653.

50. Distel, R. A., Didone, N. G., & Moretto, A. S. (2005). Variations in chemical composition associated with tissue aging in palatable and unpalatable grasses native to central Argentina. *Journal of Arid Environments*, *62*(2), 351-357.

51. Djedid, I. K., Terzaghi, M., Brundu, G., Cicatelli, A., Laouar, M., Guarino, F., & Castiglione, S. (2021). Genetic diversity and differentiation of eleven medicago species from campania region revealed by nuclear and chloroplast microsatellites markers. *Genes*, *13*(1), 97.

52. Droushiotis, D. N., & Wilman, D. (1987). Effects of harvesting programme and sowing date on the forage yield, digestibility, nitrogen concentration, tillers and crop fractions of barley in Cyprus. *The Journal of Agricultural Science*, *109*(1), 95-106.

53. Edelman, M., & Colt, M. (2016). Nutrient value of leaf vs. seed. *Frontiers in Chemistry*, *4*, 32.

54. El-Shatnawi, M., Al-Qurran, L. Z., Ereifej, K. I., & Saoub, H. M. (2004). Management optimization of dual-purpose barley (*H. spontaneum* C. Koch) for forage and seed yield. *Journal of Range Management*, *57*(2), 197-202.

55. El-Shatnawi, M. K. J., & Ereifej, K. I. (2001). Chemical composition and livestock ingestion of carob (*Ceratonia siliqua* L.) seeds. *Rangeland Ecology & Management/Journal of Range Management Archives*, *54*(6), 669-673.

56. Emebu, P. & Anyika, J. (2011). "Vitamin and antinutrient composition of kale (*Brassica oleracea*) grown in Delta State, Nigeria." *Pakistan Journal of Nutrition 10*(1), 76-79.

57. Ertekin, İ. (2021). Comparison of chemical composition and nutritive values of some clover species. *International Journal of Chemistry and Technology*, *5* (2), 162-166. DOI: 10.32571/ijct.1004113

58. Estefan, G., Sommer, R., & Ryan, J. (2013). Methods of soil, plant, and water analysis. *A Manual for the West Asia and North Africa Region*, *3*, 65-119.

59. Evitayani, E., Warly, L., Fariani, A., Ichinohe, T., & Fujihara, T. (2004). Study on nutritive value of tropical forages in North Sumatra, Indonesia. *Asian-Australasian Journal of Animal Sciences*, *17*(11), 1518-1523.

60. FAO (2010). Challenges and Opportunities for Carbon Sequestration in Grassland Systems: A Technical Report on Grassland Management and Climate Mitigation. (Rome: Food and Agriculture Organization of the United Nations).

61. Fatur, M., Khadiga, A. A., & Ati, A. (2007). Assessment of the nutritive value of three pasture grasses for growing goats. *Research Journal of Animal and Veterinary Science*, *2*, 5-8.

62. Fourquin, C., del Cerro, C., Victoria, F. C., Vialette-Guiraud, A., de Oliveira, A. C., & Ferrándiz, C. (2013). A change in shatterproof protein lies at the origin of a fruit morphological novelty and a new strategy for seed dispersal in Medicago genus. *Plant Physiology*, *162*(2), 907-917.

63. Ganskopp, D., & Bohnert, D. (2001). Nutritional dynamics of seven northern great basin grasses. J. *Rangeland Ecology & Management*, *54*(6), 640-647.

64. Geographic Information System Unit (GIS). 2023. Hebron University. Data base.

65. George, N., Henry, D., Yan, G., & Byrne, M. (2007). Variability in feed quality between populations of *Acacia saligna* (Labill.) H. Wendl. (Mimosoideae)—implications for domestication. *Animal Feed Science and Technology*, *136*(1-2), 109-127.

66. Getaneh, D., Banerjee, S., & Taye, M. (2019). Morphometrical traits and structural indices of malle cattle reared in the South Omo Zone of Southwest Ethiopia. *International Journal of Veterinary Sciences Research*, *5*(2), 32-47.

67. Ghanavati, F. (2012). Notes on the *Onobrychis crista-galli* (L.) Lam. (Fabaceae) in Iran.

68. Ghodieh, A. (2022). Studying the water resources and hydrological characteristics of the west bank and gaza strip, palestine using gis and remote sensing data. In *Satellite*

Monitoring of Water Resources in the Middle East (pp. 219-249). Cham: Springer International Publishing.

69. Gintzburger, G., Bounejmate, M., & Nefzaoui, A. (2000). Fodder shrub development in arid and semi-arid zones. In Workshop on Native and Exotic Fodder Shrubs in Arid and Semi-Arid Zones (1996: Ḥammāmāt, Tunisia). International Center for Agricultural Research in the Dry Areas (ICARDA).

70. Gonz· lez-Hern· ndez, M., Starkey E. and Karchesy J., (2000). "Seasonal variation in concentrations of fiber, crude protein, and phenolic compounds in leaves of red alder (*Alnus rubra*): nutritional implications for cervids." *Journal of Chemical Ecology 26*: 293-301.

71. Gracia, M. B., Armstrong, P. R., Rongkui, H., & Mark, S. (2017). Quantification of betaglucans, lipid and protein contents in whole oat groats (*A. sativa* L.) using near infrared reflectance spectroscopy. *Journal of Near Infrared Spectroscopy*, *25*(3), 172-179.

72. Grando, S., Baum, M., Ceccarelli, S., Goodchild, A., El-Haramein, F. J., Jahoor, A., & Backes, G. (2005). QTLs for straw quality characteristics identified in recombinant inbred lines of a *Hordeum vulgare*× *H. spontaneum* cross in a Mediterranean environment. *Theoretical and Applied Genetics*, *110*(4), 688-695.

73. Guessous, F. (2019, September). Age, date of cutting, and temperature as factors affecting chemical composition of berseem (Trifolium alexandrinum L.). In *Proceedings of the XIV International Grassland Congress* (pp. 475-478). CRC Press.

74. Gülşen, N., Coşkun, B., Umucalılar, H. D., & Dural, H. (2004). Prediction of nutritive value of a native forage, Prangos uechritzii, using of in situ and in vitro measurements. *Journal of Arid Environments*, *56*(1), 167-179.

75. Gyawali, S., Otte, M. L., Jacob, D. L., Abderrazek, J., & Singh Verma, R. P. (2019). Multiple element concentration in the grain of spring barley (Hordeum vulgare L.) collection. *Journal of Plant Nutrition*, *42*(9), 1036-1046.

76. Hassanpour, H., Eydi, A., & Hekmati, M. (2021). Electromagnetic field improved nanoparticle impact on antioxidant activity and secondary metabolite production in *Anthemis gilanica* seedlings. *International Journal of Agronomy, 2021,* 1-9.

77. Harris, P. S. (2000). *Grassland resource assessment for pastoral systems*.

78. Hatami, F., Jaimand, K., Rezaee, M. B., Sefidkon, F., Azimi, R., Morady, A., ... &

Karimi, S. (2022). Investigation of Chemical Composition of Anthemis coelopoda Boiss. Essential Oil from Three Regions in Gilan Province.

79. Hidosa, D., & Kibret, S. (2021). dry matter yield and chemical composition of alfalfa (*Medicago sativa*) varieties as animal feed in the South Omo Zone of South-western Ethiopia. *Acta Scientific Veterinary Sciences (ISSN: 2582-3183)*, *3*(4).

80. Holechek, J. L. (2013). Global trends in population, energy use and climate: implications for policy development, rangeland management and rangeland users. *The Rangeland Journal*, *35*(2), 117-129.

81. Holechek, J. L., Cibils, A. F., Bengaly, K., & Kinyamario, J. I. (2017). Human population growth, African pastoralism, and rangelands: a perspective. *Rangeland ecology & management*, *70*(3), 273-280.

82. Holechek, J. L., & Herbel, C. H. (1986). Supplementing range livestock. Rangelands, 8(1), 29-33.

83. Holechek, J. L., Pieper, R. D., & Herbel, C. H. (1989). *Range Management.* Principles and Practices. Prentice-Hall.

84. Holechek, J. L., Pieper, R. D., & Herbel, C. H. (1995). *Range Management:* principles and Practices (No. Ed. 2). Prentice-Hall.

85. Hummel, J., Südekum, K. H., Streich, W. J., & Clauss, M. (2006). Forage fermentation patterns and their implications for herbivore ingesta retention times. *Functional Ecology*, *20*(6), 989-1002.

86. Hussain, F., & Durrani, M. J. (2009). Nutritional evaluation of some forage plants from Harboi rangeland, Kalat, Pakistan. *Pak. J. Bot*, *41*(3), 1137-1154.

87. Ibrahim, M. S., Ahmad, A., Sohail, A., & Asad, M. J. (2020). Nutritional and functional characterization of different oat (*A. sativa* L.) cultivars. *International Journal of Food Properties*, *23*(1), 1373-1385.

88. International Fund for Agricultural Development (IFAD) (2000). The rangelands of arid and semi-arid areas. www.IFAD.org.

89. Isaac, J., & Gasteyer, S. (1995). The issue of biodiversity in Palestine. *Applied Research Institute-Jerusalem, Palestine*, *1*, 1-15.

90. Isaac, J., & Hrimat, N. (2007). A Review of the Palestinian Agricultural Sector. *Applied Research Institute–Jerusalem*.

91. Ismail, A. B. O., Sulaiman, Y. R., Ahmed, F. A., & Ali, H. A. M. (2014). Effect of stages of maturity on nutritive value of some range herbage species in low-rainfall woodland savanna southern Darfur, Sudan. *Open Journal of Animal Sciences*, *5*(01), 1.

92. Jehangir, K.K., Wajih, N.S. & Syed Z.H. (1986). "Nutrient composition of atriplex leaves grown in Saudi Arabia". *J. Range Manage*., *39*,104-107.

93. Kamalak, A., & Canbolat, O. (2010). Determination of nutritive value of wild narrow-leaved clover (Trifolium angustifolium) hay harvested at three maturity stages using chemical composition and in vitro gas production. *Trop Grassland*, *44*(2), 128-133.

94. Kamalak, A., Canbolat, O., Gurbuz, Y., Erol, A., & Ozay, O. (2005). Effect of maturity stage on chemical composition, in vitro and in situ dry matter degradation of tumbleweed hay (*Gundelia tournefortii* L.). *Small Ruminant Research*, *58*(2), 149-156.

95. Kaplan, M. (2011). Determination of potential nutritive value of sainfoin (*Onobrychis sativa*) hays harvested at flowering stage. *Journal of Animal and Veterinary Advances*, *10*(15), 2028-2031.

96. Kavandi, A., Jafari, A. A., & Jafarzadeh, M. (2018). Effect of seed priming on enhancement of seed germination and seedling growth of annual sainfoin (*Onobrychis crista-galli* (L.) Lam.) in medium and long-term collections of gene bank. *Journal of Rangeland Science*, *8*(2), 117-128.

97. Kazemi, M. (2021). Nutritional value of some rare forage plants fed to small ruminants. *Tropical and Subtropical Agroecosystems*, *24*(1).

98. Kazemi, M., & Valizadeh, R. (2019). Nutritive value of some rangeland plants compared to *Medicago sativa*. *Journal of Rangeland Science*, *9*(2), 136-150.

99. Khan, W. A., Shabala, S., Cuin, T. A., Zhou, M., & Penrose, B. (2022). Using portable X-ray fluorescence spectroscopy for inexpensive and quick determination of micronutrients in barley shoots. *Communications in Soil Science and Plant Analysis*, *53*(11), 1379-1384.

100. Koçak, A., Kökten, K., Bağcı, E., Akçura, M., Hayta, Ş., Bakoğlu, A., & Kılıç, Ö. (2011). Chemical analyses of the seeds of some forage legumes from Turkey. A chemotaxonomic approach.

101. Koukolová, V., Homolka, P., Koukol, O., & Jančík, F. (2010). Nutritive value of *Trifolium pratense* L. for ruminants estimated from in situ ruminal degradation of neutral detergent fibre and in vivo digestibility of organic matter and energy. *Czech Journal of*

Animal Science, *55*(9), 372-381.

102. Krstić, Đ., Ćupina, B., Antanasović, S., Erić, P., Čabilovski, R., Manojlović, M., & Mikić, A. (2010). Potential of white mustard (*S. alba* L. *subsp. alba*) as a green manure crop. *Crucif Newsl*, *29*, 12-13.

103. Lamont, E. J., Zoghlami, A., Hamilton, R. S., & Bennett, S. J. (2001). Clovers (*Trifolium* L.). In *Plant genetic resources of legumes in the Mediterranean* (pp. 79-98). Springer, Dordrecht.

104. Lloveras, J., & Iglesias, I. (2001). Morphological development and forage quality changes in crimson clover (*Trifolium incarnatum* L.). *Grass and Forage Science*, *56*(4), 395-404.

105. Long, R. J., Apori, S. O., Castro, F. B., & Ørskov, E. R. (1999). Feed value of native forages of the Tibetan Plateau of China. *Animal Feed Science and Technology*, *80*(2), 101-113.

106. Loughrill, E., Wray, D., Christides, T., & Zand, N. (2017). Calcium to phosphorus ratio, essential elements and vitamin D content of infant foods in the UK: Possible implications for bone health. *Maternal & child nutrition*, *13*(3), e12368.

107. Lu, C. D., Kawas, J. R., & Mahgoub, O. G. (2005). Fibre digestion and utilization in goats. *Small Ruminant Research*, *60*(1-2), 45-52.

108. Liu, Ma, B., C., Wet Y. Li, Z. and Cao D. (2015). "Analysis and evaluation on the nutrition components of Huaiyang *Medicago polymorpha* with different mowing crops." Wei Sheng yan jiu, *Journal of Hygiene Research 44*(4), 532-537.

109. Mahmoudi, S., Khoramivafa, M., Hadidi, M., Jalilian, N., & Bagheri, A. (2021). Overgrazing is a critical factor affecting plant diversity in Nowa-Mountain rangeland, West of Iran. *Journal of Rangeland Science*, *11*(2), 141-151.

110. Mayland, H. F., & Shewmaker, G. E. (2001). Animal health problems caused by silicon and other mineral imbalances. *J. Range Manage. 54*, 441–446

111. McClymont, G. L., Wynne, K. N., Briggs, P. K., & Franklin, M. C. (1957). Sodium chloride supplementation of high-grain diets for fattening Merino sheep. *Australian Journal of Agricultural Research*, *8*(1), 83-90.

112. McInnis, M. L., Larson, L. L., & Miller, R. F. (1993). Nutrient composition of whitetop. *Rangeland Ecology & Management/Journal of Range Management*

Archives, *46*(3), 227-231.

113. Mertens, D. R. (1997). Creating a system for meeting the fiber requirements of dairy cows. *Journal of Dairy Science*, *80*(7), 1463-1481

114. Minson, D. (1983). Forage quality: assessing the plant-animal complex [Intake, grazing behavior].

115. Mitchell, M. (2019). Between genotype variation of lucerne (*Medicago spp*.) in grazing preference by sheep.

116. Mitrović, P. M., Stamenković, O. S., Banković-Ilić, I., Djalović, I. G., Nježić, Z. B., Farooq, M., ... & Veljković, V. B. (2020). White mustard (*S. alba* L.) oil in biodiesel production: A review. *Frontiers in Plant Science*, *11*, 299.

117. Mohammad, A. (2000). Vegetation cover and productivity of the rangeland in the southern parts of West Bank. *Bethlehem University Journal*, 74-87.

118. Mohammad, A. (2005). Rangeland condition at southern West Bank.

119. Mohammad, A. (2008). Growth and development of range plants in Southern West Bank.

120. Mohammad, A. (2009). Effect of grazing on soil properties at southern part of West Bank Rangeland.

121. Mountousis, I., Papanikolaou, K., Stanogias, G., Chatzitheodoridis, F., & Karalazos, V. (2006). Altitudinal chemical composition variations in biomass of rangelands in Northern Greece. *Development*, *18*, 08.

122. Mountousis, I., Papanikolaou, K., Stanogias, G., Chatzitheodoridis, F., & Roukos, C. (2008). Seasonal variation of chemical composition and dry matter digestibility of rangelands in NW Greece. *Journal of Central European Agriculture*, *9*(3), 547-555.

123. Mowat, D. N., Fulkerson, R. S., Tossell, W. E., & Winch, J. E. (1965). The in vitro digestibility and protein content of leaf and stem portions of forages. *Canadian Journal of Plant Science*, *45*(4), 321-331.

124. Msangi, R. B., & Hardesty, L. H. (1993). Forage value of native and introduced browse species in Tanzania. *J. Range Manage, 46,* 410-415,

125. Mut, Z., Kose, Ö. E., & Akay, H. (2016). Grain yield and some quality traits of different oat (*A. sativa* L.) genotypes. *International Journal of Environmental & Agriculture Research*, *2*(12), 83-88.

126. National Research Council. (1982). United States-Canadian tables of feed composition.

127. National Research Council. (1985). *Nutrient requirements of sheep* (Vol. 5). National Academies Press.

128. Naydenova, G., Bozhanski, B., & Bozhanska, T. (2022). Wild Alfalfa in The Semi-Natural Grasslands of Central Northern Bulgaria.

129. Neina, D. (2019). The role of soil pH in plant nutrition and soil remediation. *Applied and Environmental Soil Science*, *2019*, 1-9.

130. Nevo, E. (1992). Origin, evolution, population genetics and resources for breeding of wild barley, *H. spontaneum* in the Fertile Crescent. *Barley: Genetics, Biochemistry, Molecular Biology And Biotechnology*, 19-43.

131. Niu, Z., Rossnagel, B. G., & Yu, P. (2007). Chemical characteristics and nutritive values of super-genotype of oat vs normal varieties of oats for ruminants. *Journal of Animal and Feed Sciences*, *16*(2), 266-271.

132. Oduntan, A., Olaleye, O. and Akinwande, B. (2012). "Effect of plant maturity on the proximate composition of *Sesamum radiatum* Schum leaves." J*ournal of Food studies, 1(1),* 69-76.

133. Oelberg, K. (1956). Factors affecting the nutritive value of range forage. *Rangeland Ecology & Management/Journal of Range Management Archives*, *9*(5), 220-225.

134. Orlando, G., Zengin, G., Ferrante, C., Ronci, M., Recinella, L., Senkardes, I., ... & Menghini, L. (2019). Comprehensive chemical profiling and multidirectional biological investigation of two wild Anthemis species (*Anthemis tinctoria* var. pallida and *A. cretica* subsp. tenuiloba): focus on neuroprotective effects. *Molecules*, *24*(14), 2582.

135. Palestinian Central Bureau of Statistics (PCBS). Agricultural Statistics. (2023).

136. Palmer, L. (2017). *Hot, Hungry Planet: The Fight to Stop a Global Food Crisis in the Face of Climate Change*. St. Martin's Press.

137. PEnA. (1999). National biodiversity strategy and action plan for Palestine. (a regional Project).1st ed. Palestinian environmental authority. Palestine.

138. Peng, C., Zhao, S. Q., Zhang, J., Huang, G. Y., Chen, L. Y., & Zhao, F. Y. (2014). Chemical composition, antimicrobial property and microencapsulation of mustard (*S. alba*) seed essential oil by complex coacervation. *Food Chemistry*, *165*, 560-568.

139. Peprah, S., Darambazar, E., Biligetu, B., Iwaasa, A. D., Larson, K., Damiran, D., & Lardner, H. A. (2021). Harvest date effect on forage yield, botanical composition, and nutritive value of novel legume-grass mixtures. *Agronomy*, *11*(11), 2184.

140. Perotti, E., Huguenin-Elie, O., Meisser, M., Dubois, S., Probo, M., & Mariotte, P. (2021). Climatic, soil, and vegetation drivers of forage yield and quality differ across the first three growth cycles of intensively managed permanent grasslands. *European Journal of Agronomy*, *122*, 126194.

141. Pessarakli, M. M., Morgan, P. V., & Gilbert, J. J. (2005). Dry-matter yield, protein synthesis, starch, and fiber content of barley and wheat plants under two irrigation regimes. *Journal of Plant Nutrition*, *28*(7), 1227-1241.

142. Petit Bon, M., Gunnarsdotter Inga, K., Jónsdóttir, I. S., Utsi, T. A., Soininen, E. M., & Bråthen, K. A. (2020). Interactions between winter and summer herbivory affect spatial and temporal plant nutrient dynamics in tundra grassland communities. *Oikos*, *129*(8), 1229-1242.

143. Porqueddu, C. (2001). Screening germplasm and varieties for forage quality: Constraints and potential in annual medics. *Quality in Lucerne and Medics for Animal Production. Proceedings of the XIVth Eucarpia Medicago spp., Zaragoza and Lleida (Spain), Options Mediterranennes, Serie A*, *45*, 89-98.

144. Prinsi, B., Morgutti, S., Negrini, N., Faoro, F., & Espen, L. (2019). Insight into composition of bioactive phenolic compounds in leaves and flowers of green and purple basil. *Plants*, *9*(1), 22.

145. Pulina, G., Avondo, M., Molle, G., Francesconi, A. H. D., Atzori, A. S., & Cannas, A. (2013). Models for estimating feed intake in small ruminants. *Revista Brasileira de Zootecnia*, *42*, 675-690.

146. Quinde, Z., Ullrich, S. E., & Baik, B. K. (2004). Genotypic variation in color and discoloration potential of barley-based food products. *Cereal Chemistry*, *81*(6), 752-758.

147. Qumsiyeh, M. B., & Abusarhan, M. A. (2021). Biodiversity and Environmental Conservation in Palestine. In *Biodiversity, Conservation and Sustainability in Asia* (pp. 1-22). Springer, Cham.

148. Range, M. (2023). "https://www.megalac.com/fats-in-animal-nutrition/ruminants." 2023.

149. Rasby, R. (2023). "Understanding Feed Analysis." UNL beef.

150. Ren, J., & Hu, Z. (2022). Preface to the Special issue of the rangeland journal on the comprehensive sequential classification system of rangeland. *The Rangeland Journal*, *43*(6), 283-284.

151. Reynal, S. M., & Broderick, G. A. (2005). Effect of dietary level of rumen-degraded protein on production and nitrogen metabolism in lactating dairy cows. *Journal of Dairy Science*, *88*(11), 4045-4064.

152. Robinson, P. H. (1999, December). Neutral detergent fiber (NDF) and its role in alfalfa analysis. In *Proc. 29 California Alfalfa Symposium. Fresno, Cal*.

153. Roces-Díaz, J. V., Vayreda, J., De Cáceres, M., García-Valdés, R., Banqué-Casanovas, M., Morán-Ordóñez, A., ... & Martínez-Vilalta, J. (2021). Temporal changes in Mediterranean forest ecosystem services are driven by stand development, rather than by climate-related disturbances. *Forest Ecology and Management*, *480*, 118623.

154. Rotta, P. P., Marcondes, M. I., & Engle, T. (2023). Nutritional requirements in production animals. *Frontiers in Veterinary Science*, *10*.

155. Ruckle, M. E., Meier, M. A., Frey, L., Eicke, S., Kölliker, R., Zeeman, S. C., & Studer, B. (2017). Diurnal leaf starch content: an orphan trait in forage legumes. *Agronomy*, *7*(1), 16.

156. Rumbaugh, M. D., Mayland, H. F., Pendery, B. M., & Shewmaker, G. E. (1993). Element concentrations in globemallow herbage. *Journal of Range Management*, *46*, 114-117.

157. Sabudak, T., & Guler, N. (2009). *Trifolium* L.–a review on its phytochemical and pharmacological profile. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, *23*(3), 439-446.

158. Sagala, J. I., Gachuiri, C. K., Kuria, S. G., & Wanyoike, M. M. (2020). Nutritive value of selected preferred forage species by lactating camels in the peri-urban area of Marsabit town, Kenya. *Indian Journal of Animal Nutrition*, *37*(3), 218-226.

159. Salama, A., & Aljoaba, O. (2008). Influence of excluding grazing on vegetation attributes at the eastern slopes of West bank.

160. Sayar, M. S., Han, Y., Basbag, M., Gul, İ., & Polat, T. (2015). Rangeland

improvement and management studies in the Southeastern Anatolia Region of Turkey. *Pakistan Journal of Agricultural Sciences*, *52*(1).

161. Schonewille, J. T., Beynen, A. C., & Veevoederbureau, C. (2005). Reviews on the mineral provision in ruminants (III): Magnesium and Metabolism.

162. Sevlm, U. (2018). "Dry matter contents and dry matter accumulation rates of plant parts of wheat under normal and high temperature conditions." *International Journal of Eastern Mediterranean Agricultural Research, 1(2),* 51-65.

163. Shadeed, S., Judeh, T., & Riksen, M. (2020). Rainwater harvesting for sustainable agriculture in high water-poor areas in the West Bank, Palestine. *Water*, *12*(2), 380.

164. Shah, S. A. S., Akhtar, L. H., Minhas, R., Bukhari, M. S., Ghani, A., & Anjum, M. H. (2015). Evaluation of different oat (*A. sativa* L.) varieties for forage yield and related characteristics. *Science Letters*, *3*(1), 13-16.

165. Sharpe, P., & Sharpe, P. (2019). Nutritional value of pasture plants for horses. *Horse Pasture Manag*, *1*, 37-64.

166. Singh, B., Kumar, M., Cabral-Pinto, M. and Bhatt, B. P. (2022). "Seasonal and altitudinal variation in chemical composition of *Celtis australis* L. Tree Foliage." *Land 11(12)*: 2271.

167. Singh, R., De, S., & Belkheir, A. (2013). *A. sativa* (Oat), a potential neutraceutical and therapeutic agent: an overview. *Critical Reviews in Food Science And Nutrition*, *53*(2), 126-144.

168. Slominski, B. A., Kienzle, H. D., Jiang, P., Campbell, L. D., Pickard, M., & Rakow, G. (1999, September). Chemical composition and nutritive value of canola-quality *S. alba* mustared. In *Proceedings of the 10th International Rapeseed Congress, Canberra, Australia* (pp. 26-29).

169. Tawaha, K. A., Alali, F. Q., & Hudaib, M. M. (2015). Chemical composition and general cytotoxicity evaluation of essential oil from the flowers of *Anthemis palestina* Reut. ex Boiss., growing in Jordan. *Journal of Essential Oil-Bearing Plants*, *18*(5), 1070-1077.

170. Towhidi, A. (2007). Nutritive value of some herbages for dromedary camel in Iran. *Pak. J. Biol. Sci*, *10*(1), 167-170.

171. Tuna, C. (2004). Determination of nutritional value of some legume and grasses. *Pakistan Journal of Biological Sciences (Pakistan)*.

172. Underwood, E. J. (1981). *The Mineral Nutrition of Livestock: Eric J. Underwood*. Commonwealth Agricultural Bureaux.

173. Van Soest, P. J., Robertson, J. B., & Lewis, B. A. (1991). Symposium: carbohydrate methodology, metabolism, and nutritional implications in dairy cattle. *Journal of Dairy Science*, *74*(10), 3583-3597.

174. Wada, N., Kondo, I., Tanaka, R., Kishimoto, J., Miyagi, A., Kawai-Yamada, M., ... & Noguchi, K. (2023). Dynamic seasonal changes in photosynthesis systems in leaves of Asarum tamaense, an evergreen understorey herbaceous species. *Annals of Botany*, *131*(3), 423-436.

175. Warly, L., Fariani, A., Ichinohe, T., Abdulrazak, S. A., Hayashida, M., & Fujihara, T. (2005). Nutritive value of selected grasses in North Sumatra, Indonesia. *Animal Science Journal*, *76*(5), 461-468.

176. Werner, G. D., Cornwell, W. K., Cornelissen, J. H., & Kiers, E. T. (2015). Evolutionary signals of symbiotic persistence in the legume–rhizobia mutualism. *Proceedings of the National Academy of Sciences*, *112*(33), 10262-10269.

177. West, N. E. (1993). Biodiversity of rangelands. *Rangeland Ecology & Management/Journal of Range Management Archives*, *46*(1), 2-13.

178. Whitman, W. C., Bolin, D. W., Klosterman, E. W., Klostermann, H. J., Ford, K. D., Moomaw, L., ... & Buchanan, M. L. (1951). Carotene, protein, and phosphorus in range and tame grasses of western North Dakota. *Carotene, protein, and phosphorus in range and tame grasses of western North Dakota.*

179. Yasar, S., & Tosun, R. (2018). Predicting chemical, enzymatic and nutritional properties of fermented barley (*Hordeum vulgare* L.) by second derivate spectra analysis from attenuated total reflectance-Fourier transform infrared data and its nutritional value in Japanese quails. *Archives of Animal Nutrition*, *72*(5), 407-423.

180. Yildiz, M., & Ekiz, H. (2014). The effect of sodium hypochlorite solutions on in vitro seedling growth and regeneration capacity of sainfoin (*Onobrychis viciifolia* Scop.) hypocotyl explants. *Canadian Journal of Plant Science*, *94*(7), 1161-1164.

181. Zemene, M., Mekuriaw, Y., & Asmare, B. (2020). Effect of plant spacing and harvesting age on plant characteristics, yield and chemical composition of Para grass (*Brachiaria mutica*) at Bahir Dar, Ethiopia. *Scientific Papers: Animal Science and*

Biotechnologies, *53*(2), 137-145.

182. Zeng, H., Su, S., Xiang, X., Sha, X., Zhu, Z., Wang, Y., ... & Duan, J. (2017). Comparative analysis of the major chemical constituents in *Salvia miltiorrhiza* roots, stems, leaves and flowers during different growth periods by UPLC-TQ-MS/MS and HPLC-ELSD methods. *Molecules*, *22*(5), 771.

183. Zhao, J., Zhang, X., Liu, H., Brown, M. A., & Qiao, S. (2019). Dietary protein and gut microbiota composition and function. *Current Protein and Peptide Science*, *20*(2), 145-154.

Abstract (Arabic)

الملخص

تحديد القيمة الغذائية لبعض نباتات المراعي السائدة في الضفة الغربية

يعد تحديد الجودة الغذائية للنباتات الرعوية السائدة في المناطق الجافة وشبه الجافة أمرًا ضروريًا لإنشاء خطة إدارة المراعي لتلبية الاحتياجات الغذائية لحيوانات الرعي. الهدف من هذه الدراسة هو تحديد القيمة الغذائية لنباتات المراعي السائدة والتغير في التركيب الكيميائي في مواسم مختلفة وأجزاء مختلفة لنفس النوع. تم جمع ثلاث عينات تمثيلية (مكررات) من كل نوع نباتي بتصميم عشوائي CRD، نجيليات (شوفان بري وشعير بري) وحشائش (خردل أصفر، عنبريس، نفلة، أقحوان ابيض وخبزة الراعي) خلال أوائل ربيع 2020 وأوائل صيف 2020 من موقع بني نعيم. أظهرت النتائج وجود فروق معنوية($P\leq0.05$) بين أنواع النباتات وأجزائها، كما ظهر تأثير الموسم. لقد وجد أن الألياف الخام، الألياف الذائبة في المحلول الحامضي، الالياف الذائبة في المحلول المتعادل ومستويات الكالسيوم زادت في أوائل الصيف. بينما مستويات البروتين الخام، الدهون الخام، البوتاسيوم، الفوسفور والنيتروجين قلت. يحتوي الخردل الأصفرعلى أعلى محتوى من الدهون، الألياف الخام والمعادن مقارنة بالأنواع الأخرى. سجلت النجيليات مستويات عالية نسبيًا من الألياف الخام والألياف الذائبة في المحلول الحمضي في أوائل الربيع.

عند دراسة تأثير الموسم تبين ان نسبة المادة الجافة في الصيف تراوحت من (80.93 - 96.33)% ، كانت ثمار الأقحوان الابيض الأعلى، بينما في الربيع من (6.17 - 36.00)% ، أعلى قيمة وجدت في أوراق الأقحوان الابيض ايضاً. تراوح محتوى الرماد من (3.73 - 26.32)% في الربيع، وكانت أوراق العنبريس هي الأعلى، وكانت ثمار الشوفان البري هي الأقل. بينما تراوح محتوى الرماد في الصيف من (5.29 - 30.48)% ، أعلى قيمة وجدت في أوراق العنبريس وأقلها وجدت في الخردل البري. في أوائل الربيع، كانت أعلى قيم للبروتين 28.61% و 28.34% لخبزة الراعي والنفلة على التوالي. بينما في أوائل الصيف ، كانت أدنى مستويات البروتين 6.60% و 7.68% للشعير البري والشوفان البري على التوالي. في أوائل الربيع تراوح محتوى الدهن من (2.14 - 7.36)% ، وكانت أوراق نبات الأقحوان الأبيض هي الأعلى، بينما تراوحت نسبة الدهون في الصيف بين (0.06 - 5.19)% ، حيث وجدت أعلى قيمة في أوراق الأقحوان الأبيض. نسبة الألياف الخام تراوحت بين (17.69-39.20)% في الربيع بينما (21.99-61.55)% في الصيف. بالنسبة إلى الألياف الذائبة في المحلول الحمضي، تراوحت القيمة بين (22.02 -41.11)% في الربيع بينما تراوحت في الصيف بين (26.06 -66.21)%. وتراوحت قيم الألياف الذائبة في المحلول المتعادل في الربيع بين (26.58 -62.78)% بينما تراوحت في الصيف بين (35.38-73.79)%.

أما على مستوى مقارنة أنواع النباتات مع بعضها (بناءاً على تحليل الورقة) في المرحلة المبكرة من النمو، فكانت أعلى نسبة للبروتين في النفلة (28.34%) تليها نبتة الخردل الابيض (24.12%) حيث أن الاختلاف كان معنوياً مقارنة بأصناف النباتات الأخرى. وبالمثل، في مرحلة النضج ، كانت نسبة البروتين في الحشائش أعلى في الأقحوان الأبيض

(13.38%)، خبزة الراعي (12.06%)، النفلة (10.38%) ثم العنبريس (9.08%) تليها باقي أنـواع النباتـات الأخـرى من النجيليات. الأقحوان الأبيض هو أغنى نبـات مـن حيـث نسـبة الـدهون الخـام (7.36%) فـي الربيـع و(5.91%) فـي الصيف. في المرحلة المبكرة من النمو، كانت الألياف الخام في العنبريس (32.28%) هـي الأعلـى معنويـاً ($P\leq0.05$) مقارنة مع الأنواع النباتية الأخرى، بينما عند النضج، كان الخردل الأبيض هو الأعلى. أمـا بالنسـبة الـى محتـوى النبـات من الألياف الذائبة في المحلول الحمضي، في الربيع كان الشوفان البري وخبـزة الراعـي الأعلـى معنويـاً ($P\leq0.05$) من الأنواع النباتية الأخرى، وكان لديهم 56.44 % و 52.80 % على التوالي.

لذلك ، لتحقيق أهداف التنمية المستدامة، فإن الأراضـي التـي تحتـوي علـى الأنـواع التـي تـم فحصـها سـتلبي احتياجـات الحيوانات الرعوية خلال فصل الربيع وبداية فصل الصيف وخاصة النفلة والخردل الأبيض.

الكلمات المفتاحية: القيمة الغذائية للنباتات الرعوية، شعير بري، شوفان بري، خبـزة الراعـي، ذريـس، أقحـوان أبـيض، نفلة، خردل أصفر.