

ISSN 2545 – 4439

ISSN 1857 - 923X

INTERNATIONAL JOURNAL

Institute of Knowledge Management

KNOWLEDGE



Vol. 34. 3.
Scientific Papers

NATURAL SCIENCES



KIJ

Vol. 34

No. 3

pp. 591 - 766

Skopje, 2019

KNOWLEDGE – International Journal

Vol.34.3

September, 2019

KNOWLEDGE



INTERNATIONAL JOURNAL

**SCIENTIFIC PAPERS
VOL. 34.3**

*Promoted in Kavala, Greece
2019*



KNOWLEDGE

International Journal Scientific papers Vol. 34.3

ADVISORY BOARD

Vlado Kambovski PhD, Robert Dimitrovski PhD, Siniša Zarić PhD, Maria Kavdanska PhD, Venelin Terziev PhD, Mirjana Borota – Popovska PhD, Cezar Birzea PhD, Ljubomir Kekenovski PhD, Veselin Videv PhD, Ivo Zupanovic, PhD, Savo Ashtalkoski PhD, Zivota Radosavljević PhD, Laste Spasovski PhD, Mersad Mujevic PhD, Nonka Mateva PhD, Rositsa Chobanova PhD, Predrag Trajković PhD, Dzulijana Tomovska PhD, Nedžad Korajlić PhD, Nebojsa Pavlović PhD, Nikolina Ognenska PhD, Baki Koleci PhD, Lisen Bashkurti PhD, Trajce Dojcinovski PhD, Jana Merdzanova PhD, Zoran Srzentić PhD, Nikolai Sashkov Cankov PhD, Marija Kostic PhD

Print: GRAFOPROM – Bitola

Editor: IKM – Skopje

Editor in chief

Robert Dimitrovski, PhD

KNOWLEDGE - International Journal Scientific Papers Vol. 34.3

ISSN 1857-923X (for e-version)

ISSN 2545 – 4439 (for printed version)

INTERNATIONAL EDITORIAL BOARD

President: Academic, Prof. Vlado Kambovski PhD, Skopje (Macedonia)

Vice presidents:

Prof. Robert Dimitrovski PhD, Institute of Knowledge Management, Skopje (Macedonia)

Prof. Sinisa Zaric, PhD, Faculty of Economics, University of Belgrade, Belgrade (Serbia)

Prof. Venelin Terziev PhD, University of Rousse, Rousse (Bulgaria)

Prof. Mersad Mujevic PhD, Public Procurement Administration of Montenegro (Montenegro)

Prof. Tihomir Domazet PhD, President of the Croatian Institute for Finance and Accounting, Zagreb (Croatia)

Members:

- Prof. Aleksandar Korablev PhD, Dean, Faculty for economy and management, Saint Petersburg State Forest Technical University, Saint Petersburg (Russian Federation)
- Prof. Azra Adjajlic – Dedovic PhD, Faculty of criminology and security, Sarajevo (Bosnia & Herzegovina)
- Prof. Anita Trajkovska PhD, Rochester University (USA)
- Prof. Anka Trajkovska-Petkoska PhD, UKLO, Faculty of technology and technical sciences, Bitola (Macedonia)
- Prof. Alisabri Sabani PhD, Faculty of criminology and security, Sarajevo (Bosnia & Herzegovina)
- Prof. Ahmad Zakeri PhD, University of Wolverhampton, (United Kingdom)
- Prof. Ana Dzumalieva PhD, South-West University “Neofit Rilski”, Blagoevgrad (Bulgaria)
- Prof. Aziz Pollozhani PhD, Rector, University Mother Teresa, Skopje (Macedonia)
- Prof. Branko Sotirov PhD, University of Rousse, Rousse (Bulgaria)
- Prof. Branko Boshkovic, PhD, College of Sports and Health, Belgrade (Serbia)
- Prof. Branimir Kampl PhD, Institute SANO, Zagreb (Croatia)
- Prof. Baki Koleci PhD, University Hadzi Zeka, Peja (Kosovo)
- Prof. Branislav Simonovic PhD, Faculty of Law, Kragujevac (Serbia)
- Prof. Bistra Angelovska, Faculty of Medicine, University “Goce Delcev”, Shtip (Macedonia)
- Prof. Cezar Birzea, PhD, National School for Political and Administrative Studies, Bucharest (Romania)
- Prof. Cvetko Andreevski, Dean, Faculty of Tourism, UKLO, Bitola (Macedonia)
- Prof. Drago Cvijanovic, PhD, Faculty of Hotel Management and Tourism, University of Kragujevac, Vrnjacka Banja (Serbia)
- Prof. Dusan Ristic, PhD Emeritus, College of professional studies in Management and Business Communication, Novi Sad (Serbia)
- Prof. Dimitar Radev, PhD, Rector, University of Telecommunications and Post, Sofia (Bulgaria)
- Prof. Daniela Todorova PhD, Rector of “Todor Kableshev” University of Transport, Sofia (Bulgaria)
- Prof. Dragan Kokovic PhD, University of Novi Sad, Novi Sad (Serbia)
- Prof. Dragan Marinkovic PhD, High health – sanitary school for professional studies, Belgrade (Serbia)
- Prof. Daniela Ivanova Popova PhD, Faculty of Public Health and Sport, SWU Neofit Rilski, Blagoevgrad (Bulgaria)
- Prof. Dzulijana Tomovska, PhD, Dean, Faculty of Biotechnical sciences, Bitola (Macedonia)
- Prof. Evgenia Penkova-Pantaleeva PhD, UNWE -Sofia (Bulgaria)

-
- Prof. Fadil Millaku, PhD, Rector, University “Hadzi Zeka”, Peja (Kosovo)
 - Prof. Fatos Ukaj, University “Hasan Prishtina”, Prishtina (Kosovo)
 - Prof. Georgi Georgiev PhD, National Military University “Vasil Levski”, Veliko Trnovo (Bulgaria)
 - Prof. Halit Shabani, PhD, University “Hadzi Zeka”, Peja (Kosovo)
 - Prof. Halima Sofradzija, PhD, University of Sarajevo, Sarajevo (Bosnia and Herzegovina)
 - Prof. Haris Halilovic, Faculty of criminology and security, University of Sarajevo, Sarajevo (Bosnia and Herzegovina)
 - Prof. Helmut Shramke PhD, former Head of the University of Vienna Reform Group (Austria)
 - Prof. Hristina Georgieva Yancheva, PhD, Rector, Agricultural University, Plovdiv (Bulgaria)
 - Prof. Hristo Beloev PhD, Bulgarian Academy of Science, Rector of the University of Rousse (Bulgaria)
 - Prof. Hristina Milcheva, Medical college, Trakia University, Stara Zagora (Bulgaria)
 - Prof. Izet Zeqiri, PhD, Academic, SEEU, Tetovo (Macedonia)
 - Prof. Ivan Marchevski, PhD, Rector, D.A. Tsenov Academy of Economics, Svishtov (Bulgaria)
 - Doc. Igor Stubelj, PhD, PhD, Faculty of Management, Primorska University, Koper (Slovenia)
 - Prof. Ivo Zupanovic, PhD, Faculty of Business and Tourism, Budva (Montenegro)
 - Prof. Ivan Petkov PhD, Rector, European Polytechnic University, Pernik (Bulgaria)
 - Prof. Isa Spahiu PhD, AAB University, Prishtina (Kosovo)
 - Prof. Ivana Jelik PhD, University of Podgorica, Faculty of Law, Podgorica (Montenegro)
 - Prof. Islam Hasani PhD, Kingston University (Bahrein)
 - Prof. Jova Ateljevic PhD, Faculty of Economy, University of Banja Luka, (Bosnia & Herzegovina)
 - Prof. Jove Kekenovski PhD, Faculty of Tourism, UKLO , Bitola (Macedonia)
 - Prof. Jonko Kunchev PhD, University „Cernorizec Hrabar“ - Varna (Bulgaria)
 - Prof. Jelena Stojanovic PhD, High medicine school for professional studies “Hipokrat”, Bujanovac (Serbia)
 - Prof Karl Schopf, PhD, Akademie fur wissenschaftliche forchung und studium, Wien (Austria)
 - Prof. Katerina Belichovska, PhD, Faculty of Agricultural Sciences, UKIM, Skopje (Macedonia)
 - Prof. Krasimir Petkov, PhD, National Sports Academy “Vassil Levski”, Sofia (Bulgaria)
 - Prof. Kamal Al-Nakib PhD, College of Business Administration Department, Kingdom University (Bahrain)
 - Prof. Kiril Lisichkov, Faculty of Technology and Metallurgy, UKIM, Skopje (Macedonia)
 - Prof. Lidija Tozi PhD, Faculty of Pharmacy, Ss. Cyril and Methodius University, Skopje (Macedonia)
 - Prof. Laste Spasovski PhD, Vocational and educational centre, Skopje (Macedonia)
 - Prof. Larisa Velic, PhD, Faculty of Law, University of Zenica, Zenica (Bosnia and Herzegovina)
 - Prof. Lujza Grueva, PhD, Faculty of Medical Sciences, UKIM, Skopje (Macedonia)
 - Prof. Lazar Stosic, PhD, Association for development of science, engineering and education, Vranje (Serbia)
 - Prof. Lisen Bashkurti PhD, Global Vice President of Sun Moon University (Albania)
 - Prof. Lence Mircevska PhD, High Medicine School, Bitola, (Macedonia)
 - Prof. Ljubomir Kekenovski PhD, Faculty of Economics, UKIM, Skopje (Macedonia)
 - Prof. Ljupce Kocovski PhD, Faculty of Biotechnical sciences, Bitola (Macedonia)

-
- Prof. Marusya Lyubcheva PhD, University “Prof. Asen Zlatarov”, Member of the European Parliament, Burgas (Bulgaria)
 - Prof. Maria Kavdanska PhD, Faculty of Pedagogy, South-West University Neofit Rilski, Blagoevgrad (Bulgaria)
 - Prof. Maja Lubenova Cholakova PhD, Faculty of Public Health and Sport, SWU Neofit Rilski, Blagoevgrad (Bulgaria)
 - Prof. Mirjana Borota-Popovska, PhD, Centre for Management and Human Resource Development, Institute for Sociological, Political and Juridical Research, Skopje (Macedonia)
 - Prof. Mihail Garevski, PhD, Institute of Earthquake Engineering and Engineering Seismology, Skopje (Macedonia)
 - Prof. Misho Hristovski PhD, Faculty of Veterinary Medicine, Ss. Cyril and Methodius University, Skopje (Macedonia)
 - Prof. Mitko Kotovchevski, PhD, Faculty of Philosophy, UKIM, Skopje (Macedonia)
 - Prof. Milan Radosavljevic PhD, Dean, Faculty of strategic and operational management, Union University, Belgrade (Serbia)
 - Prof. Marija Topuzovska-Latkovikj, PhD, Centre for Management and Human Resource Development, Institute for Sociological, Political and Juridical Research, Skopje (Macedonia)
 - Prof. Marija Knezevic PhD, Academic, Banja Luka, (Bosnia and Herzegovina)
 - Prof. Margarita Bogdanova PhD, D.A.Tsenov Academy of Economics, Svishtov (Bulgaria)
 - Prof. Mahmut Chelik PhD, Faculty of Philology, University “Goce Delchev”, Shtip (Macedonia)
 - Prof. Marija Mandaric PhD, Faculty of Hotel Management and Tourism, University of Kragujevac, Vrnjacka Banja (Serbia)
 - Prof. Marina Simin PhD, College of professional studies in Management and Business Communication, Sremski Karlovci (Serbia)
 - Prof. Miladin Kalinic, College of professional studies in Management and Business Communication, Sremski Karlovci (Serbia)
 - Prof. Mitre Stojanovski PhD, Faculty of Biotechnical sciences, Bitola (Macedonia)
 - Prof. Miodrag Smelcerovic PhD, High Technological and Artistic Vocational School, Leskovac (Serbia)
 - Prof. Nadka Kostadinova, Faculty of Economics, Trakia University, Stara Zagora (Bulgaria)
 - Prof. Natalija Kirejenko PhD, Faculty For economic and Business, Institute of Entrepreneurial Activity, Minsk (Belarus)
 - Prof. Nenad Taneski PhD, Military Academy “Mihailo Apostolski”, Skopje (Macedonia)
 - Prof. Nevenka Tatkovic PhD, Juraj Dobrila University of Pula, Pula (Croatia)
 - Prof. Nedžad Korajlic PhD, Dean, Faculty of criminal justice and security, University of Sarajevo (Bosnia and Herzegovina)
 - Prof. Nikolay Georgiev PhD, “Todor Kableshkov” University of Transport, Sofia (Bulgaria)
 - Prof. Nikolina Ognenska PhD, Faculty of Music, SEU - Blagoevgrad (Bulgaria)
 - Prof. Nishad M. Navaz PhD, Kingdom University (India)
 - Prof. Oliver Iliev PhD, Faculty of Communication and IT, FON University, Skopje (Macedonia)
 - Prof. Oliver Dimitrijevic PhD, High medicine school for professional studies “Hipokrat”, Bujanovac (Serbia)
 - Prof. Paul Sergius Koku, PhD, Florida State University, Florida (USA)
 - Prof. Primoz Dolenc, PhD, Faculty of Management, Primorska University, Koper (Slovenia)
 - Prof. Predrag Trajkovic PhD, JMPNT, Vranje (Serbia)
 - Prof. Petar Kolev PhD, “Todor Kableshkov” University of Transport, Sofia (Bulgaria)
 - Prof. Pere Tumbas PhD, Faculty of Economics, University of Novi Sad, Subotica (Serbia)

- Prof. Rade Ratkovic PhD, Faculty of Business and Tourism, Budva (Montenegro)
- Prof. Rositsa Chobanova PhD, University of Telecommunications and Posts, Sofia (Bulgaria)
- Prof. Rumen Valcovski PhD, Imunolab Sofia (Bulgaria)
- Prof. Rumen Stefanov PhD, Dean, Faculty of public health, Medical University of Plovdiv (Bulgaria)
- Prof. Sasho Korunoski, Rector, UKLO, Bitola (Macedonia)
- Prof. Sashko Plachkov PhD, Faculty of Pedagogy, University Neofit Rilski, Blagoevgrad (Bulgaria)
- Prof. Snezhana Lazarevic, PhD, College of Sports and Health, Belgrade (Serbia)
- Prof. Stojan Ivanov Ivanov PhD, Faculty of Public Health and Sport, SWU Neofit Rilski, Blagoevgrad (Bulgaria)
- Prof. Snezana Stoilova, PhD, High Medicine School, Bitola, (Macedonia)
- Prof. Stojna Ristevska PhD, High Medicine School, Bitola, (Macedonia)
- Prof. Suzana Pavlovic PhD, High health – sanitary school for professional studies, Belgrade (Serbia)
- Prof. Sandra Zivanovic, PhD, Faculty of Hotel Management and Tourism, University of Kragujevac, Vrnjacka Banja (Serbia)
- Prof. Shyqeri Kabashi, College “Biznesi”, Prishtina (Kosovo)
- Prof. Trayan Popkochev PhD, Faculty of Pedagogy, South-West University Neofit Rilski, Blagoevgrad (Bulgaria)
- Prof. Todor Krystevich, Vice Rector, D.A. Tsenov Academy of Economics, Svishtov (Bulgaria)
- Prof. Todorcka Atanasova, Faculty of Economics, Trakia University, Stara Zagora (Bulgaria)
- Doc. Tatyana Sobolieva PhD, State Higher Education Establishment Vadiym Getman Kiyev National Economic University, Kiyev (Ukraine)
- Prof. Tzako Pantaleev PhD, NBUniversity , Sofia (Bulgaria)
- Prof. Violeta Dimova PhD, Faculty of Philology, University “Goce Delchev”, Shtip (Macedonia)
- Prof. Volodymyr Denysyuk, PhD, Dobrov Center for Scientific and Technological Potential and History studies at the National Academy of Sciences of Ukraine (Ukraine)
- Prof. Valentina Staneva PhD, “Todor Kableshkov” University of Transport, Sofia (Bulgaria)
- Prof. Vasil Zecev PhD, College of tourism, Blagoevgrad (Bulgaria)
- Prof. Venus Del Rosario PhD, Arab Open University (Philippines)
- Prof. Yuri Doroshenko PhD, Dean, Faculty of Economics and Management, Belgorod (Russian Federation)
- Prof. Zlatko Pejkov, PhD, Faculty of Agricultural Sciences, UKIM, Skopje (Macedonia)
- Prof. Zivota Radosavljevik PhD, Dean, Faculty FORCUP, Union University, Belgrade (Serbia)
- Prof. Zorka Jugovic PhD, High health – sanitary school for professional studies, Belgrade (Serbia)

REVIEW PROCEDURE AND REVIEW BOARD

Each paper is reviewed by the editor and, if it is judged suitable for this publication, it is then sent to two referees for double blind peer review.

The editorial review board is consisted of 45 members, full professors in the fields 1) Natural and mathematical sciences, 2) Technical and technological sciences, 3) Medical sciences and Health, 4) Biotechnical sciences, 5) Social sciences, and 6) Humanities from all the Balkan countries and the region.

CONTENTS

ANALYSIS OF <i>RL</i> -CIRCUIT SUPPLIED BY VOLTAGE WITH SINUS OR SQUARE WAVEFORM	607
Goce Stefanov.....	607
Vasilija Šarac	607
FUNCTIONAL DEPENDENCE OF LASER POWER AND LAYUP SPEED FOR AUTOMATIC FIBRE PLACEMENT TEMPERATURE CONTROL	613
Dijana Cvetkoska.....	613
Filip Kochoski	613
ANALYSIS OF THERMAL PHENOMENA IN MILLING PROCESS	621
Anđelija Mitrović	621
Maja Radović.....	621
THE POSSIBILITY OF USING SOLAR ENERGY ON THE TERRITORY OF THE CITY OF LESKOVAC	629
Miodrag Šmelcerović	629
Oliver Dimitrijević	629
CONTENT OF TOTAL NITROGEN AND PROTEINS FROM ALFALFA (<i>Medicago sativa</i> L.) COLLECTED IN THREE SLOPES.....	635
Valentina Butleska Gjoroska	635
Liljana Koleva Gudeva.....	635
Lenka Cvetanovska.....	635
INFLUENCE OF EXTRACT <i>Cannabis sativa</i> L. ON LIPID PEROXIDATION ACTIVITY <i>Sorghum halepense</i> (L.) Pers.....	641
Konstantinović Bojan	641
Šućur Jovana.....	641
Kojić Mirjana.....	641
Samardžić Nataša	641
Vidović Senka.....	641
Koren Anamarija	641
Vladić Jelena.....	641
Gavarić Aleksandra	641
Popov Milena.....	641
CHARACTERIZATION OF DRINKING WATER SPRINGS FOR THE CITY OF SKOPJE.....	645
Erhan Mustafa.....	645
Katerina Atkovska	645
Flakrim Aliu	645
Stefan Kuvendziev.....	645
Mirko Marinkovski.....	645
Ana Tomova	645
Kiril Lisichkov.....	645
IMPACT OF HYDROPOWER PLANT ON CLIMATE CHANGE	651
Miodrag Šmelcerović	651
TRADITIONAL MACEDONIAN SAUSAGES WITH STARTER CULTURES	657
Aleksandra Silovska Nikolova	657
Zlatko Pejkovski	657
Daniela Belichovska	657
Katerina Belichovska.....	657

DYNAMICS OF THE FILLING MASS AND pH IN DURABLE SAUSAGES DURING RIPENING	663
Kujtim Elmazi.....	663
Mitre Stojanovski	663
Elena Joshevska.....	663
Biljana Trajkovska.....	663
Nesim Seferi	663
MODERN CATTLE SLAUGHTERING TECHNOLOGY AND ITS MEAT QUALITY	667
Vlora Rama.....	667
Elena Joshevska.....	667
Vesna Karapetkovska Hristova.....	667
BIOCENOTIC HETEROGENEITY IN ANTHROPOZOONOSIS FOR EGGS - TRIMODULATE ECOTECHNICAL AGROCENOSIS FOR EFFECTIVE USE OF MANURE	673
Veselin Kirov.....	673
Alexander Tchoukanov.....	673
BIOCENOTIC HETEROGENEITY IN ANTHROPOZOONOSIS FOR EGGS - ECOTECHNOLOGICAL CHAINS OF DETRITY TYPE FOR THE LIMITING OF LINEARITY OF TECHNOLOGIES	681
Veselin Kirov.....	681
Alexander Tchoukanov.....	681
SURVEY OF ECOLOGICAL COMPETENCE OF STUDENTS WITH REGARD TO FOOD AS A RESOURCE AND WASTE	689
Borislava Todorova	689
Margarita Panayotova.....	689
IMPACT OF TECTODYNAMIC AND MORPHODYNAMIC FACTORS ON THE SUSTAINABLE DEVELOPMENT OF THE SHPAT MOUNTAINOUS RIDGE.....	695
Andri Hoxha	695
TERRITORIAL ORGANIZATION, RELEVANT - TYPICAL AND TOURIST REGIONAL SPACE SPACES IN THE BLACK RIVER BASIN IN THE REPUBLIC OF NORTH MACEDONIA	701
Cane Koteski.....	701
DEVELOPMENT OF THE COMPOSTING POTENTIAL IN THE REPUBLIC OF MACEDONIA... ..	707
Blagica Cekova.....	707
Viktorija Bezhovska	707
Filip Jovanovski.....	707
Toni Mitrovski.....	707
VITICULTURE AND WINERY IN REPUBLIC OF NORTH MACEDONIA.....	715
Vasko Lazarevski	715
THE CONSEQUENCES OF THE NATO BOMBARDING OF THE REPUBLIC OF SERBIA ON HUMAN HEALTH AND ENVIRONMENT.....	719
Miodrag Šmelcerović	719
Lazar Stošić	719
HEALTH AND SAFETY IN THE MECHANICAL ENGINEERING WORKPLACE.....	725
Anica Milosevic.....	725
Gordana Bogdanovic	725
Masa Milosevic.....	725
WORKS ON STRENGTHENING BRIDGE	731
Naser Morina	731

MONITORING AND QUALITY CONTROL IN THE PRODUCTION OF WORK UNIFORMS FOR FLIGHT ATTENDANTS	737
Sonja Jordeva.....	737
Silvana Zhezhova	737
Sashka Golomeova Longurova.....	737
THE ANALYSIS CONSTRUCTION PREPARATION OF WOMEN’S PANTS AND PROPERTIES WOVEN FABRIC IMPORTANT FOR COMFORT OF CLOTHES	745
Marija Savić.....	745
Danijela Paunović.....	745
Enisa Nokić	745
THE COSTUME OF FOUNDERS OF THE KREPIČEVAC MONASTERY	751
Dragana Frfulanović-Šomodī	751
GUSTAV KLIMT’S CREATIVITY AND ITS IMPACT ON XX CENTURY FASHION	759
Dragana Frfulanović-Šomodī	759
Milena Savić.....	759

CONTENT OF TOTAL NITROGEN AND PROTEINS FROM ALFALFA (*Medicago sativa* L.) COLLECTED IN THREE SLOPES

Valentina Butleska GjoroskaFaculty of Agriculture, Goce Delcev University - Shtip, Krste Misirkov Str., No 10-A, 2000 Shtip, Republic of North Macedonia, tina_valentina2@yahoo.com**Liljana Koleva Gudeva**Faculty of Agriculture, Goce Delcev University - Shtip, Krste Misirkov Str., No 10-A, 2000 Shtip, Republic of North Macedonia, liljana.gudeva@ugd.edu.mk**Lenka Cvetanovska**Faculty of Natural Science and Mathematics, Arhimedova Str., No 3, 1000 Skopje, Ss. Cyril and Methodius University of Skopje, Republic of North Macedonia, lenka@pmf.ukim.mk

Abstract: Alfalfa (*Medicago sativa* L.) leaves and stems contain different proteins and nitrogen concentration in different stages of growth. The objective of this study is to determine the dynamic of nutrient accumulation of total nitrogen and proteins in leaves and stems. The experiment was conducted in three slopes, on three regions in the Republic of North Macedonia (Tetovo, Skopje and Ovche Pole). Chemical analysis of total nitrogen and proteins were obtained from first, second and third slope. Modern techniques have been used for analyzing the protein activity of plant material in multiple measuring points. Significant differences are found in the production of total nitrogen and proteins between the locations in Tetovo region on one side, and Skopje and Ovche Pole on the other side. It shows that Tetovo region has better conditions for producing alfalfa protein. Alfalfa is a culture that is rich in high nitrogen and protein content in the Tetovo region, which is correlated with the amino acid composition, resulting in a high biological value. Therefore, alfalfa is the dominant forage crop and active diet culture with high applicability to the bio-diet. Proteins are the most abundant biomolecules in plants and other organisms. Protein macromolecules make up half of the dry matter in the plant cell. The plant cell contains many different proteins with a specific function. Proteins contain the most important property - biological specificity, so the individuality of each organism is conditioned by the type of protein it is made of. Proteins have a specific structure that is found in their biological activity. Proteins are the most important components in the plant cell. Nitrogen is one of the many compounds important for plant life processes and its role in physiological processes in plants is quite large. The needs of certain plants for nitrogen are different. Nitrogen in plants is important in the composition of proteins, nucleic acids, coenzymes, alkaloids, some pigments and other compounds. Accordingly, the nitrogen in plants exists as non-protein and protein nitrogen, found in the protein component. It can only enter the plant cell if it is reduced to ammonia. This scientific research paper provides a comprehensive analysis of the nitrogen and protein composition of alfalfa grown in the Skopje, Tetovo and Ovche Pole region. The results of this research, represent the first full and complete overview of alfalfa (*Medicago sativa* L.), with its protein composition, which would be of great importance for the further cultivation of this forage crop. Scientific evidence has shown that the Tetovo region has a higher advantage over the Skopje and Ovche Pole region in terms of nitrogen and protein content, which are crucial nutrients in forage crops.

Keywords: Kjeldhal method, Skopje, Tetovo and Ovche Pole region, forage.

1. INTRODUCTION

Alfalfa (*Medicago sativa* L.) is one of the oldest forage plants and, because it is perennial, shows high yields with a high quality. It can regenerate rapidly and provides five to six crops during a vegetation season. According to biomass dynamics and nutritional value, alfalfa is one of the most important forage crops in the world due to its high quality, yield and adaptability to different climatic conditions (Gashaw and Harmoniz 2015). Alfalfa has a high concentration of protein with a favourable amino acid composition, resulting in a high biological value. It also contains high amounts of important vitamins, carbohydrates, saponins and mineral elements, especially calcium. In addition, important chemical elements and other active components, essential for the growth and development of animals, are present in alfalfa (Hao et al., 2008). Alfalfa adds nitrogen to the soil and improves the soil fertility (Arshad et al., 2016). All the most important biochemical and assimilation processes relate to phosphorus availability. In the old alfalfa stands the phosphorus availability becomes lower and, consequently, alfalfa forage yield decreases extensively (Madani et al., 2014). In this sense, alfalfa is a dominant fodder culture and an active dietary culture with high applicability in bio-nutrition. Alfalfa is an important livestock feed grown worldwide. The

United States is the fourth largest producer of alfalfa behind corn, wheat and soybeans of all cultivars (Fernandez-Cornejo et al., 2016). Alfalfa is used as a perennial culture continuously for 4-5 years, providing four to five slopes per year. In temperate regions, slopes should be taken every 4-6 weeks. Alfalfa plays an important role in crop rotation and provides large quantities of organic matter to the soil, thereby improving the physical, chemical and microbiological properties of the soil as well as the soil structure. As a nitrogen-fixing plant it enriches the soil with readily available nitrogen, which makes alfalfa an excellent pre-culture for numerous cereals, industrial and horticultural crops. Unlike most other fodder legumes, alfalfa is usually grown in pure monocultures, although it can be mixed with other legumes and grasses.

The constant chemical composition of alfalfa, which could also be maintained by the application of organic acids, enabled the yield of alfalfa to be increased (Ke et al., 2017).

Alfalfa makes an ideal protein supplement. The proteins in alfalfa are highly digestible and available in the rumen to feed the rumen microbes. Because of this, it stimulates digestion of the fiber in both alfalfa and the low-quality forage. This stimulation of digestion also increases intake of the low-quality forage, and as result improves the total digested nutrients that the domestic animals receives (Koleva Gudeva, 2010).

In Macedonia, this crop is grown on an area of 19,000 ha, with an average yield of 6-6.5 t/ha (Илиевски, 2013).

The role of alfalfa (*Medicago sativa* L.), as the highest quality forage culture, in the development of agricultural production and the intensification of forage production is due to the ability to ensure high yield, to have the ability to regenerate continuously and to possess high nutritional value (Butleska Gjoroska, et al, 2019).

2. PLANT MATERIAL AND METHODS

2.1. Plant material

Plant material from alfalfa (*Medicago sativa* L.) was collected from three different regions in the territory of the Republic of North Macedonia: Tetovo region, Skopje region and the Ovche Pole region, from 19 different locations in three slopes. The material was collected during the vegetative cycle (from June to August) in 2013. In the first, second and third slope, plants were collected on June 15, July 17 and August 15, respectively (Table 1). Analysis of nitrogen and proteins was conducted on dry plant material using the neutralization method.

Table 1. Description of the locations from the examined locations altitude (m) and latitude ($^{\circ}$ N) and longitude ($^{\circ}$ E) with the dates of first, second and third slope

No.	Location	Region	Altitude (m)	Latitude ($^{\circ}$ N)	Longitude ($^{\circ}$ E)	First slope (date)	Second slope (date)	Third slope (date)
1.	Bogovinje	Tetovo	531.50	41.9236809	20.9168772	15.06.2013	16.07.2013	17.08.2013
2.	Vrutok	Tetovo	682.41	41.7665300	20.8381550	15.06.2013	16.07.2013	17.08.2013
3.	Dzepchishte	Tetovo	474.48	42.0331690	21.0001650	15.06.2013	16.07.2013	17.08.2013
4.	Galate	Tetovo	600.73	41.8381370	20.8813700	15.06.2013	16.07.2013	17.08.2013
5.	Zelino	Tetovo	1605.94	41.9006530	21.1175770	15.06.2013	16.07.2013	17.08.2013
6.	Pechkovo	Tetovo	991.87	41.7843700	20.8311530	15.06.2013	16.07.2013	17.08.2013
7.	Jegunovce	Tetovo	658.34	42.1245655	21.0875064	15.06.2013	16.07.2013	17.08.2013
8.	Avtokomanda	Skopje	246.68	42.0006868	21.4536642	16.06.2013	17.07.2013	18.08.2013
9.	Sopishte	Skopje	1017.16	41.8638490	21.3083500	16.06.2013	17.07.2013	18.08.2013
10.	Drachevo	Skopje	264.41	41.9352675	21.5098515	16.06.2013	17.07.2013	18.08.2013
11.	Saraj	Skopje	424.88	42.0017493	21.2815977	16.06.2013	17.07.2013	18.08.2013
12.	Radishani	Skopje	392.32	42.0732769	21.4479917	16.06.2013	17.07.2013	18.08.2013
13.	Vlae	Skopje	256.07	42.0072938	21.3801924	16.06.2013	17.07.2013	18.08.2013
14.	Glumovo	Skopje	274.74	41.9817742	21.3103747	16.06.2013	17.07.2013	18.08.2013
15.	Chesinovo	Ovche Pole	294.00	41.8735350	22.2905610	17.06.2013	18.07.2013	19.08.2013
16.	Karbinci	Ovche Pole	342.98	41.7882100	22.2622460	17.06.2013	18.07.2013	19.08.2013
17.	Obleshevo	Ovche Pole	297.63	41.8639320	22.2622460	17.06.2013	18.07.2013	19.08.2013
18.	Lozovo	Ovche Pole	277.86	41.7806752	21.8995629	17.06.2013	18.07.2013	19.08.2013
19.	Mustafino	Ovche Pole	289.18	41.8407190	22.0789350	17.06.2013	18.07.2013	19.08.2013

2.2. Laboratory method

Determination of the total nitrogen content

The Kjeldhal method for nitrogen determination is performed in three steps:

1. *Combustion with a catalyst mixture:* In a dry, clean combustion cell, was placed 1 g of mashed dry plant material and 5 g of catalyst mixture, stirred and added 20ml of concentrated H₂SO₄. The incineration was carried out for 2 hours at 410°C and the procedure was completed by discoloration of the contents in the cell.

2. *Distillation of ammonia and its condensation into boric acid:* After combustion, the contents of the test tube were quantitatively transferred to a Kjeldhal flask (500 ml) by rinsing with 70 ml of distilled water. After that was added 70 ml of 40% NaOH solution to the Kjeldhal flask and the distillation with water vapor started. The steam produced in the flask with the heater passes through the tubes and enters the Kjeldhal flask, boiling the solution, and the separated ammonia is carried to the receiver Erlenmeyer flask (250 ml) in which acid is immersed and 2-3 drops of indicator mixture. Distillation takes about 15-20 minutes, until about 150 ml is collected in the Erlenmeyer flask.

3. *Titration with hydrochloric acid:* The distillate was cooled and titrated with 0.1 N HCl solution was conducted, when changing the distillate color from blue to discoloration.

The calculation is as follows: from the amount of bound HCl the total nitrogen content is calculated. 10 ml of 0.1N HCl binds 0.00142 g of nitrogen the calculation was made by the following formula:

$$\text{Total N \%} = \frac{a \times \text{FHCl} \times 0.00142 \times 100}{b \times (100 - W)}$$

where:

a - spent ml of 0.1N HCl;

FHCL - solution factor of HCl;

b - measured quantity of dry plant material (g);

0.00142 g of nitrogen correspond to 1 ml of 0.1 N HCl;

W - the sum of the percentage of water content in the sample.

Determination of proteins

The method of determination of proteins is according to the Mohr method and is performed in 4 steps.

1. *Protein separation from other nitrogen compounds:* The first step in determining the protein content of alfalfa using the Mohr method is to separate the protein from the other nitrogenous compounds. This was done by precipitation with a solution of 0.5% acetic acid solution, with aim to remove polypeptides, amides, alkaloids, nitrates and other amino compounds.

2. 3. and 4 the step. The next three steps are the same as the method for determining total nitrogen.

The calculation is as follows: From the amount of bound HCl the protein nitrogen content is calculated. 10 ml of 0.1N HCl binds 0.00142 g of nitrogen. The calculation is carried out using the same formula that calculates the percentage of nitrogen. Protein in alfalfa, as in many other plant crops, has an average of 16% nitrogen, so multiplying the value of protein nitrogen by a factor of 6.25%, the amount of protein is obtained.

$$\text{Protein \%} = \text{total protein N \%} \times 6.25$$

2.3. Statistical data processing

The data were analysed (XLSTAT 2014) via one-way variance analysis (ANOVA) to determine the significant differences ($p < 0.05$ and $p < 0.01$) between the mean values of the samples. Subsequently, the results were post-hoc analysed using Duncan's multiple ranking test to determine statistically significant differences in the contents of total nitrogen and proteins among the three slopes.

3. RESULTS AND DISCUSSION

3.1. Total nitrogen

The average values for total nitrogen at the examined locations, on the level of the regions, in all slopes, at the Republic of North Macedonia, expressed as a percentage is shown in figure 1.

In all slopes separately and in all slopes together, the highest content of total nitrogen in the examined locations was measured in the Tetovo region, at the Dzepchishte location. The smallest content in the first and in the second slope was in Ovche Pole, Mustafino location and in the third slope and in all slopes together, the lowest content was measured at Skopje region, in Drachevo location.

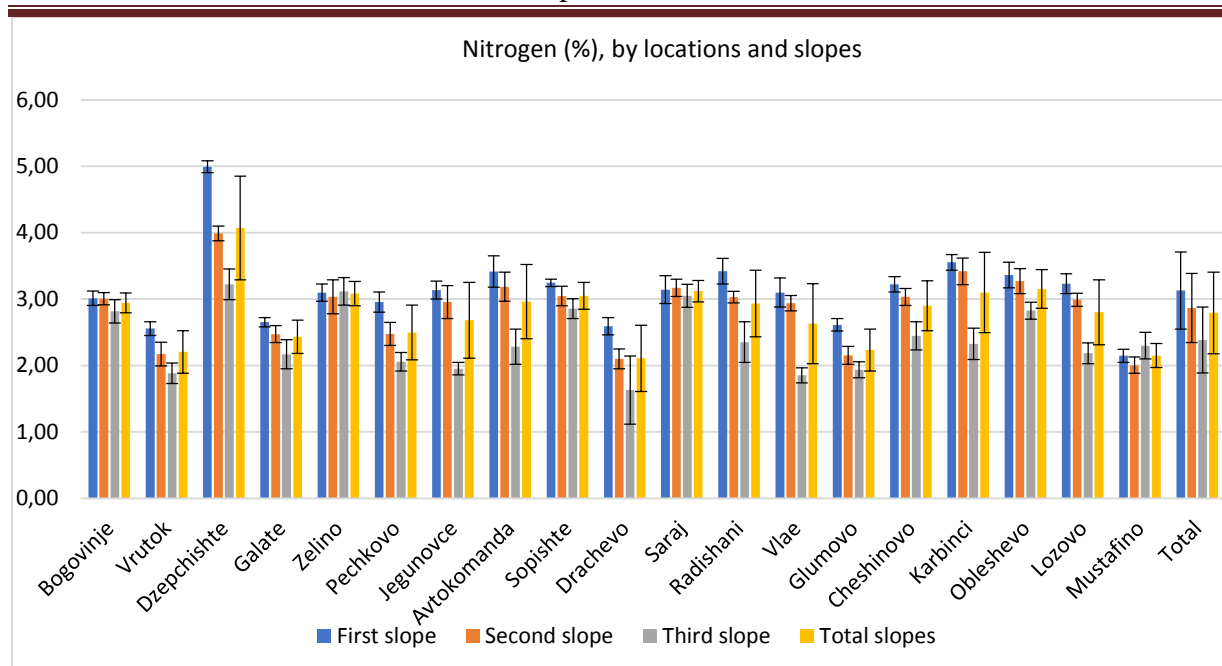


Figure 1. The content of total nitrogen at the examined locations from the three regions, in the three slopes, expressed in percentage (%) of dry plant material

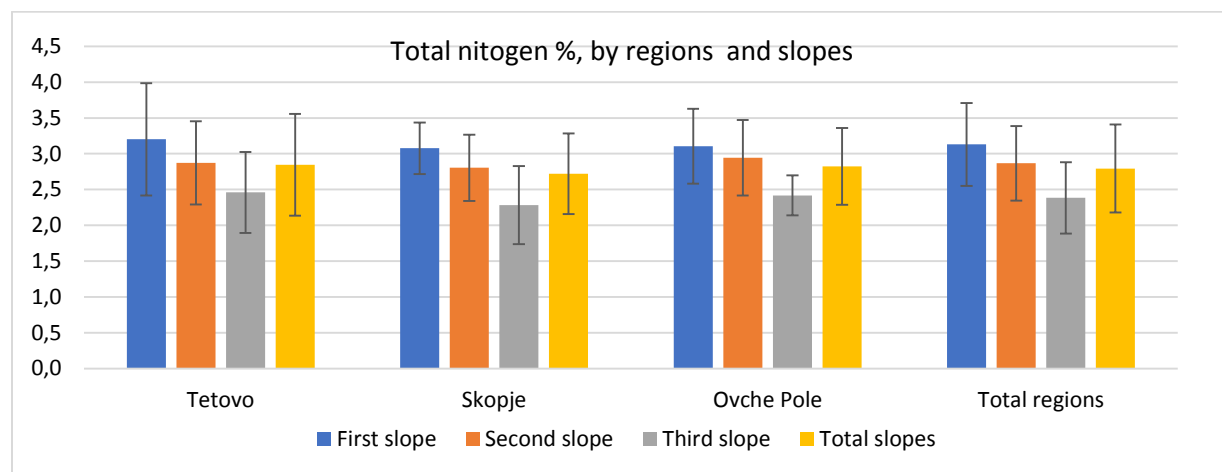


Figure 2. Total nitrogen content at the examined regions, in the three slopes, expressed in (%) of dry plant material

From the results, which are graphically presented (Figure 2), it can be seen that in the first and third slope the highest total nitrogen content was measured in the Tetovo region, and in the second slope and in all three slopes together in the Tetovo region, with the smallest content being measured in the Skopje region. Duncan's test for $p < 0.05$ and $p < 0.01$ showed no significant difference. The mean values of total nitrogen, at the level of the examined regions, in the three examined slopes separately and in the three slopes together, Duncan's test for $p < 0.05$ and $p < 0.01$ showed no significant difference.

3.2. Proteins

The results which are presented in (Figure 3), shows the values of mean protein, expressed as a percentage, at the examined locations in the Republic of North Macedonia, at the region level in all slopes. The highest measured

protein content, in all slopes separately and in all slopes together is in the Tetovo region, at the location Dzepchishte and the smallest in the Ovche Pole region, at the location Mustafino.

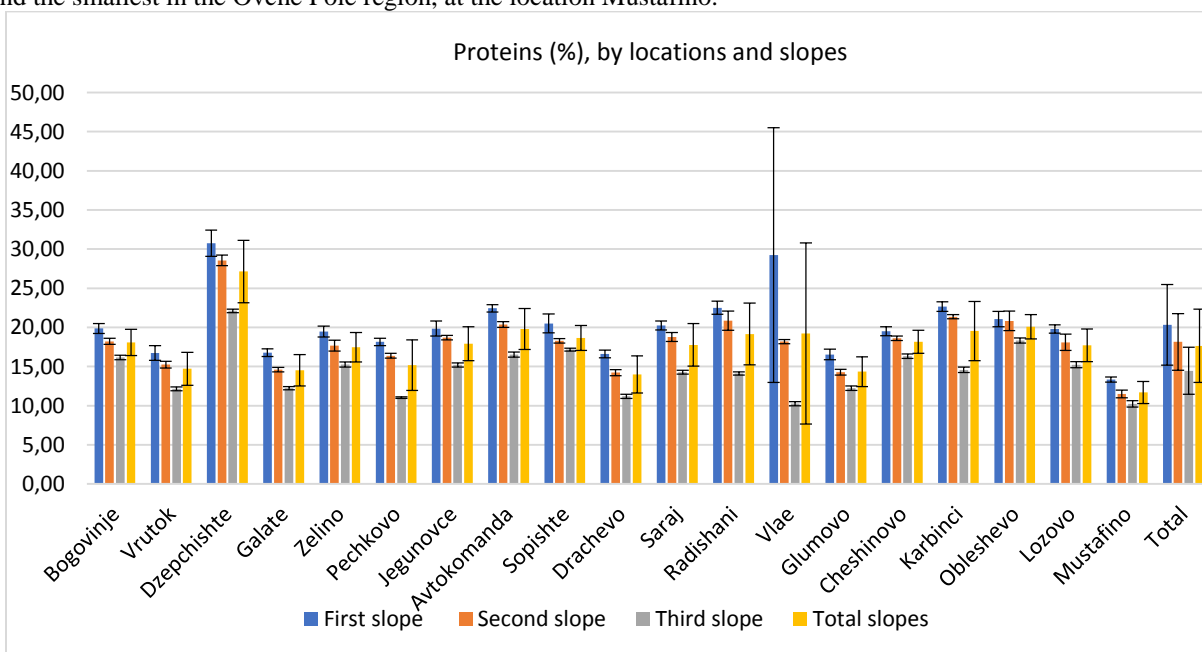


Figure 3. The content of proteins at the examined locations from the three regions, in the three slopes, expressed in percentage (%) of dry plant material

At figure 4 are presented the results for the mean protein values, on the region level, in the three slopes separately and in the three slopes together, with the Duncan test for $p < 0.05$ and $p < 0.01$ showed no significant difference.

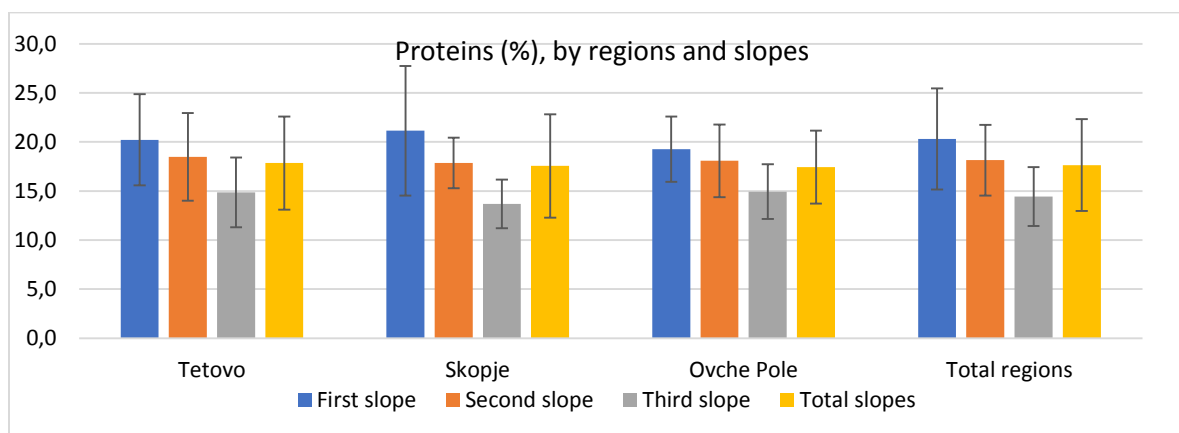


Figure 4. Proteins content at the examined regions, in the three slopes, expressed in (%) of dry plant material

4. CONCLUSION

In all slopes separately and in all slopes together, the highest content of total nitrogen was measured at the Tetovo region and the lowest content in the first and in the second slope was at Ovche Pole. In the third slope and in all slopes together, the lowest content was measured in the Skopje region. Significant differences can also be seen on the level of locations and regions. The mean values of total nitrogen, on the level of the examined regions, in the three examined slopes separately, as well as in the three slopes together, did not show any significant difference. Protein content is indicative of the fact that the Tetovo region has better conditions for protein production in alfalfa. The alfalfa has a high protein concentration in Tetovo region with favorable amino acid composition, resulting in a high biological value. In this sense, alfalfa is the dominant forage crop and active diet culture with high applicability to the bio-diet (Butleska Gjoroska, et al., 2018).

This paper provides a comprehensive analysis of nitrogen and protein composition of alfalfa grown in the Skopje, Tetovo and Ovche Pole region. This analysis is the first full and complete overview on the protein composition of alfalfa in the Republic of North Macedonia. The results will be great importance for further cultivation of this forage crop. Results has shown that the Tetovo region has a higher advantage compared to Skopje and Ovche Pole region in terms of nitrogen and protein content, which are crucial nutrients in forage crops.

REFERENCES

- Arshad, I., Ali, W., Khan, Z.A., Bhayo, W.A. (2016). Effect of Nitrogen and Phosphorus on the Growth and Yield of Alfalfa (*Medicago sativa* L.) under Agro-Climatic Conditions of Tando Adam. *PSM Biol. Res.*, 01(2): 69-73.
- Butleska Gjoroska, V., Krstik, M., Jovanovska Klincarska, I., Cvetanovska, A. Cvetanovska, L. Koleva Gudeva, L. (2018) *Evaluation of total phenols in alfalfa (Medicago sativa L.) collected from different localities in Republic of Macedonia. Journal of Agriculture and Plant Sciences*, 16 (1). pp. 45-54.
- Butleska Gjoroska, V., Krstik, M., Koleva Gudeva, L., Cvetanovska, L. (2019) *Determination of mineral composition in the alfalfa (Medicago sativa L.) collected from different regions in the Republic of North Macedonia. Journal of Agriculture and Plant Sciences*, 17 (1). pp. 57-65.
- Fernandez-Cornejo, J., Wechsler, S. J., and Milkove, D. L. (2016). *The Adoption of Genetically Engineered Alfalfa, Canola and Sugarbeets in the United States*. Washington DC: United States Department of Agriculture, Economic Research Service.
- Gashaw M. and J. Harmoniz. (2015). Review on biomass yield dynamics and nutritional quality of alfalfa (*Medicago sativa*). *Journal Of Harmonized Research in Applied Sciences*. ISSN 2321 – 7456. Vol. 3(4), 241-251.
- Илиевски, М. (2012). *Интегрално производство на индустриски и фуражни култури*. Универзитет „Гоце Делчев” – Штип стр.66.
- НАО, С-с., Wang, L-j., Dong, L., Özkan, N., Wang, D-с. and Mao, Z-h. (2008). Influence of alfalfa powder concentration and granularity on rheological properties of alfalfa-wheat dough, *Journal of Food Engineering*, Vol. 89, pp. 137-41.
- Ke, W.C., Ding, W.R., Xu D.M., Ding, L.M., Zhang P., Li F.D., Guo, X.S. (2017). Effects of addition of malic or citric acids on fermentation quality and chemical characteristics of alfalfa silage. [Volume 100, Issue 11](#), Pages 8958-8966.
- Koleva-Gudeva, L. (2010). *Plant physiology*. Faculty of agriculture, Goce Delcev University- Shtip.
- Madani H., Stoklosa Agnieszka, Zarei J., Usefi Z. (2014). Alfalfa (*Medicago sativa* L.) forage yield responses to triple super phosphate, phosphate solubilizing bacteria and gibberllic acid foliar application. *Scientific Papers. Series Agronomy*. 57:246-249.