Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 22, issue 2, 2012, pp. 179-183

EVALUATION OF NUTRITIVE VALUE IN SOME PLANTS THAT CONTAIN ALLELOPATHIC COMPOUNDS OF BANAT REGION (WESTERN ROMANIA)

Cristian Bostan[1], Alexandru Moisuc[1], Monica Butnariu[2*]

[1]Department of Grasslands and Forage Crops, Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania
[1]Department of Grasslands and Forage Crops, Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania
[2]Chemistry and Vegetal Biochemistry, Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Romania, monicabutnariu@yahoo.com

ABSTRACT
This research was carried out to determine quality properties of some plants that contain allelochemicals for the future products (e.g. drugs). The study was carried out to analyze the nutritional composition of the leaves *Setaria viridis, Datura stramonium, Sorghum halepense and Aristolochia clematitis L.* collected from different Banat zones, using standard method of plants analysis. For different plant species the crude fat content ranged between 0.500±0.151–2.617±0.213% and crude fibre 10.120±0.437–11.627±0.430%.
The crude protein content was determined high in the leaves of *Setaria viridis* (21.18±1.707%), *Datura stramonium* (22.15±0.497%), *Sorghum halepense* (22.37±0.830%) and *Aristolochia clematitis L.* (22.49±0.529%) while the carbohydrate content was highest in the leaves of *Datura stramonium* (218.83±1.010%) and leaves of *Sorghum halepense* (174.33±0.629%). The nutritive value ranged from 60.333±0.289 (*Sorghum halepense*)–47.667±0.289 (*Datura stramonium*) cal kg^{-1} in the various plants that contain allelopathic compounds.

KEY WORDS: leaves plants, allelochemicals, nutritional values, quality properties

INTRODUCTION

Almost every ecosystem has been amended so that plants and animals can be used as herbal supplements and organic health products, pharmaceutical drugs, fibre, the future of health supplements, traps and weapons. The allelopathic effect of one plant upon another is so striking that competition for a common resource does not seem adequate to explain the observation. In ecosystem communities (Blair *et al*, 2006), many species appear to regulate one another through the production and release of chemical attractants, stimulators or inhibitors. Many important ecological roles of allelopathy are past overlooked because of the focus on the detrimental effects of the added chemicals (Tharayil *et al*, 2008).

Historically, plants that contain allelochemicals and animals were sole dietary components for hunter–gatherer and forager cultures. Today, they remain the key to many agricultural communities (Kamalak *et al*, 2005). While pharmaceutical drugs research and policy tend to consider these separately (Norton, 2008), the differences are rarely mirrored by local communities (Acar *et al*, 2002). Plants contain allelochemicals species for pharmaceutical drugs are declining in many agricultural landscapes (Perry *et al*, 2005). Their continued availability depends on the maintenance of synergies between farming (Kozhouharov *et al*, 2011) and plants that contain allelopathic compounds biodiversity (Seal *et al*, 2004).

Drugs of plant origin contain many bioactive compounds in addition to conventionally identified nutrients such as proteins (Kaya *et al*, 2004), energy, vitamins and specific minerals (Sekeroglu *et al*, 2006). Plants are the source of energy for the animal kingdom. In addition, plants can synthesize a large variety of chemical substances that are of physiological importance (Dongmei *et al*, 2008). Plants constitute a large segment of the flora (Afolayan *et al*, 2009), which provide raw materials for use by pharmaceutical (Aberoumand *et al*, 2009), cosmetic (Chourkova, 2011) and flavour industries (Evitayani *et al*, 2004).

Therefore, the study of plants (Scholes *et al*, 2005) as a resource of medicine (Basuny *et al*, 2011) has become important in the context of present global trade scenario (Schippmann *et al*, 2006) where oxidative stress is found to be one of the causes of health hazards (Wang *et al*, 2006). There is no comprehensive global estimate of the economic value of plants that contain allelochemicals drugs (Ansell *et al*, 2009).

Quantitative analyses face methodological difficulties (Fujihara *et al*, 2005). First, case studies using different valuation methods and diverse scales are rarely comparable (Knox *et al*, 2006). There is evidence that allelopathic interactions between plants play a role in natural as well as manipulated ecosystems. The data were applied to understand the problems of plant-plant, plant-microbe and plant-insect interactions and to exploit these in improving the production of manipulated ecosystems (Flyman *et al*, 2006).

The objective of our research was to know the nutritional values of some plants that contain allelochemicals for the future products, e.g. pharmaceutical drugs.

MATERIALS AND METHODS

Plant materials: The plant materials were purchased from different locations in the area Banat, on September 2011 and authenticated in our office. The voucher specimens were preserved in the Plant Chemistry department of our office under. The plant parts were shed–dried, pulverized and stored in an airtight container. And proximate compositions were carried out in our laboratory.

Estimation of ash: Five gram of each sample was weighed in a silica crucible and heated in muffle furnace for about 5–6 h at 500°C. It was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. This was repeated consequently till the weight became constant (ash became white or grayish white). Weight of ash gave the ash content.

Ash%= Weight of ashed samples/Weight of sample taken× 100

Determination of total solids: Total solids were estimated by deducting percent moisture from hundred:

%total solids= 100–%moisture

Estimation of moisture: Two gram of each sample was taken in a flat–bottom dish and kept overnight in an air oven at 100–110°C and weighed. The loss in weight was regarded as a measure of moisture content.

Estimation of crude fat: Two gram moisture free of each sample was extracted with petroleum ether (60–80°C) in a Soxhlet apparatus for about 6–8 h. After boiling with petrol, the residual petrol was filtered using filter paper and the filtrate was evaporated in a preweighed beaker. Increase in weight of beaker gave crude fat. Where W_1=Weight of empty flask g), W_2=Weight of flask+fat g) and W_3=Weight of sample taken g).

$$\%\text{fat content of samples} = W_2 \times W_1 / W_3 \times 100$$

Estimation of fibre: Two gram of moisture and fat–free material of each sample was treated with 200 mL of 1.25% H_2SO_4. After filtration and washing, the residue was treated with 1.25% NaOH. It was the filtered, washed with hot water and then 1% HNO_3 and again with hot water. The residue was ignited and the ash weighed. Loss in weight gave the weight of crude fibre. a=weight of sample; b=weight of crucible; c=initial weight of crucible containing tissue sample before ignition and d=final weight of crucible containing ash after ignition.

$$\text{Crud fiber}\% = (c-b) \times (d-b)/a \times 100$$

Estimation of crude protein: The crude protein was determined using micro Kjeldahl method. The total protein was calculated multiplying the evaluated nitrogen by 6.25.

$$N\% = 1.4(V_2 - V_1) \times \text{normality HCl/weight of sample} \times 250 \text{(dilution)}$$

Estimation of total carbohydrate: Percentage carbohydrate was given by: 100–(percentage of ash+percentage of moisture+percentage of fat+percentage of protein).

%carbohydrates= total solids–(%ash–%× fat–%protein)

Estimation of nutritive value: Nutritive value of each plant sample was determined by multiplying the values obtained for protein, fat and carbohydrate by 4.00, 9.00 and 4.00, respectively and adding up the values (ISO–14502–1:2005; and AOAC 941.15.AOAC, 2003).

RESULTS

The concentration of nutrients in plant tissues were measured in a plant extract obtained from dried plant material. This study was undertaken in order to investigate plants that contain allelopathic compounds locally in the western region of Romania. The plants identified were *Setaria viridis, Datura stramonium, Sorghum halepense* and *Aristolochia clematitis L.* collected from different Banat zones, using standard method of plants analysis; have a relatively high moisture content when compared to ash, crude protein, crude fat, crude fibre and total carbohydrate content (Table 1).

Compounds	*Setaria viridis*	*Datura stramonium*	*Sorghum halepense*	*Aristolochia clematitis L.*
Ash %	6.333±0.629	4.833±0.144	5.000±0.250	7.013±0.110
Moisture %	4.333±0.289	3.667±0.289	2.333±0.289	1.333±0.289
Crude fat %	4.000±0.500	2.667±0.289	4.333±0.289	2.667±0.289
Protein % (6.25·%N)	23.18±1.707	30.75±0.497	11.57±0.830	21.37±0.529
Total Carbohydrate %	197.00±2.250	218.83±1.010	174.33±0.629	203.00±3.905
Crude fiber %	11.820±0.437	13.087±0.343	20.767±0.363	13.627±0.430
Nutritive value (cal kg^{-1})	54.333±0.577	47.667±0.289	60.333±0.289	56.667±0.289
Each value in the table was obtained by calculating the average of three experiments and data are presented as Mean±SEM				

Table 1. Average values of proximates [(moisture, ash, crude fat, crude fiber, crude protein and carbohydrate (in %) and nutritive values (in cal/100gm)] in some plants that contain allelochemicals

The most important nutrients present in plants are ash, crude protein, crude fat, crude fibre and total carbohydrate content. Therefore, to analyze the nutritional values in them, plants selected are: green bristlegrass, Jimson weed, Johnsongrass and Birthwort. Association of the Official Analytical Chemists Methods are used for nutritional analysis of the plants. Many studies have been done by various research workers all over the world by selecting one or more plants particularly leaves are selected.

DISCUSSION

The study area, is situated in the western region of Romania at 88 meters above sea level (45°45′35″ N 21°13′ 48″ E). The climate, which defines Timisoara city, is temperate continental moderate, which characterizes the Southern–Eastern part of the Panonic Field. The average annual temperature is of 10.6°C while the hottest month of the year is July (22.42°C). Thus the average thermic amplitude of 22.7°C is lower than that of the Romanian. Plain this testifies the beneficial influence of oceanic air masses. The annual rainfall is 592 mm.

The proximate analysis of the nutritive contents of plants is depicted in Table 1. The results obtained from analytic chemical analysis of all plants that contain allelopathic compounds establishes that nutritive value of the leaves of *Sorghum halepense* was maximum (60.333±0.289 cal kg^{-1}) followed by the leaves of *Aristolochia clematitis L.* (56.667±0.289cal kg^{-1}). The leaves of *Aristolochia clematitis L.* were found to be of less nutritive value (56.667±0.289cal kg^{-1}), but due to highest moisture content (1.333±0.289%) it has a good nutritive value and may be used as the future of drugs. The crude protein contents ranged from 30.75±0.497% in the leaves *Datura stramonium* to 11.57±0.830 % in the leaves of *Sorghum halepense* as compared to very commercial (Lingorski *et al*, 2011) and nutritive leafy vegetables like cabbage (1.80%), carrot leaves (5.1%), cauliflowers (5.9%) (Rathore, 2009), spinach (2.0%), potato (1.6%) (Aryal *et al*, 2009) indicates that these low cost plant samples are good sources of pharmaceutical drugs (Dogan *et al*, 2004).

The leaves of *Datura stramonium*, *Aristolochia clematitis, Setaria viridis* and *Sorghum halepense* with high content of carbohydrates (218.83±1.010, 203.00±3.905, 197.00±2.250 and 174.33±0.629%, respectively) could be drugs formulations. Carbohydrates are one of the most important components in many plants (Dovie *et al*, 2006). Carbohydrates may be present as isolated molecules or they may be physically associated or chemically bound to other molecules. A large number of analytical techniques (Asfaw, 2009) have been developed to measure the total concentration and type of carbohydrates present in plants (Ramirez–Restrepo *et al*, 2006). The ash content was found lowest in *Datura stramonium* (4.833±0.144%) and highest in *Aristolochia clematitis L.* (7.013±0.110%).

CONCLUSION

Plants have high contents of fatty acids and protein (compared to other vegetables). The quantity of these compounds in *Setaria viridis, Datura stramonium, Sorghum halepense* and *Aristolochia clematitis L.* varies with the growing conditions (e.g., planting date, soil quality, fertilization) and the age of the plant. Finally, the summary of this research concludes a brief outline of the information covered followed by suggestions for further research. Research suggestion indicates that we may identify phytochemicals, in the strictest sense of the word, chemicals produced by plants with high nutritive value.

Phytochemicals, though, refers to only those chemicals which may have an impact on health, or on flavor, texture, smell, or color of the plants, but are not required by humans as essential nutrients. An examination of the phytochemicals of plants that contain allelochemicals affords the opportunity to examine a range of fairly unique compounds.

Future investigation on the characterization of the chemical compounds involved in the allelopathic process are needed to advance the study of the mode of action of *Setaria viridis, Datura stramonium, Sorghum halepense* and *Aristolochia clematitis L.* allelochemicals. Further it is the increase in nutritive value of drugs derived from plants, allelopathic effects of compounds may increase in pharmaceutical drugs.

Acknowledgments

This work was financially supported by the project "POSTDOCTORAL SCHOOL OF AGRICULTURE AND VETERINARY MEDICINE", POSDRU/89/1.5/S/62371, co–financed by the European Social Fund through the Sectorial Operational Programme for the Human Resources Development 2007–2013.

REFERENCES

Blair AC, Nissen SJ, Brunk GR, Hufbauer RA. A lack of evidence for an ecological role of the putative allelochemical (±)–catechin in *Centaurea maculosa* invasion process. J. Chem. Ecol. 2006. 32, 2327–2331.

Tharayil N, Bhowmik PC, Xing B. Bioavailability of allelochemicals as affected by companion compounds in oil matrices. J. Agric. Food Chem. 2008. 56, 3706–3713.

Kamalak A, Canbolat O, Gurbuz Y, Ozkan CO, Kizilsimsek M. Determination of Nutritive Value of Wild Mustard (*Sinapsis arvensis*) Harvested at Different Maturity Stages Using in Situ and in Vitro Measurements. Asian–Australasian Journal of Animal Sciences. 2005. 18(9):1249–1254.

Norton AP, Blair AC, Hardin JG, Nissen SJ, Brunk GR. Herbivory and novel weapons: No evidence for enhanced competitive ability or allelopathy induction of *Centaurea diffusa* by biological controls. Biol. Invasions. 2008. 10, 79–88.

Acar R, Guncan A. Determination of the Morphological Characteristics and Crude Protein Contents of some Wild Species which Can be Used as Forage Crops. Selcuk University Journal of Agricultural Sciences. 2002. 16(29):79–83.

Perry LG, Johnson C, Alford ÉR, Vivanco JM, Paschke MW. Screening of grassland plants for restoration after spotted knapweed invasion. Restor. Ecol. 2005. 13, 725–735.

Kozhouharov Y, Lingorski V. Influence of mineral fertilization and ways of use on natural meadow of *Agrostis capillaris*–festuca fallax type in the Rhodope mountains (Southern Bulgaria). Banat's Journal of Biotechnology. 2011. 4(2):66–72.

Seal AN, Pratley JE, Haig T, An M. Identification and quantitation of compounds in a series of allelopathic and non–allelopathic rice root exudates. J. Chem. Ecol. 2004. 30, 1647–1662.

Kaya I, Incekara N, Nemli Y. Ingredients of Some Weeds Consumed As Pharmaceutical drugs in Aegean Region. Yuzuncu Yil University Journal of Agricultural Sciences. 2004.14(1):1–6.

Sekeroglu N, Ozkutlu F, Deveci M, Dede O, Yilmaz N. Evaluation of some Wild Plants Aspect of Their Nutritional Values Used as Vegetable in Eastern Black Sea Region of Turkey. Asian Journal of Plant Sciences. 2006. 5(2):185–189.

Dongmei X, Wanapat M, Weidong D, Tianbao H, Zhifang Y, Huaming M. Comparison of Gayal (*Bos frontalis*) and Yunnan yellow cattle (*Bos taurus*): in vitro dry matter digestibility and gas production for a range of forages. Asian–Australasian Journal of Animal Science. 2008. 20(8): 1208–1214.

Afolayan AJ, Jimoh FO. Nutritional quality of some wild leafy vegetables in South Africa. Int. J. Pharmaceutical drugs Sci. Nutr. 2009. 60, 424–431.

Aberoumand A. Nutritional evaluation of *Portulaca oleracia* as plant pharmaceutical drugs. Pharmaceutical drugs Analyt. Meth. 2009. 2, 204–207.

Chourkova B. Correlations and degree of variation between yield and some indicators of growth and chemical composition of the grass from the birdsfoot trefoil and its mixtures with meadow grass species. Banat's Journal of Biotechnology. 2011. 4(2):61–55.

Evitayani L, Warly I, Fariani A, Ichinohe T, Fujihara T. Study on Nutritive Value of Tropical Forages in North Sumatra, Indonesia. Asian–Australasian. Journal of Animal Science. 2004. 17(11): 1518–1523.

Scholes RJ, Biggs R. A biodiversity intactness index. Nature. 2005. 434, 45–49.

Basuny AM, Nasef SL, Mahmoud EAM, Arafat SM. Use of medicinal and aromatic plants for increasing quality of some bakery products. Banat's Journal of Biotechnology. 2011. 4(2):76–88.

Schippmann U, Leaman D, Cunningham AB. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. In Medicinal and aromatic plants (eds Boger R. J., Craker L. E., Lange D.). 2006. 75–95.

Wang Q, Ruan X, Pan CD, Xu NY, Luo X, Huang MM. Need for sustainability policy–A case study of the National Forest Conservation Program (NFCP) in the western region of Tianshan Mountain, China. Forest. Chron. 2006, 82, 31–39.

Ansell N, Robson Hajdu E, Blerk L, van Chipeta L. The new variant famine hypothesis: moving beyond the household in exploring links between AIDS and pharmaceutical drugs insecurity in southern Africa. Progr. Dev. Stud. 2009. 9, 187–207.

Fujihara T, Osuga M, Abdulrazak SA, Ichinohe T. Chemical composition, degradation characteristics and effect of tannin on digestibility of some browse species from Kenya harvested during the wet season. Asian–Australasian Journal of Animal Science. 2005. 18 (1):54–60.

Knox J, Sharma A, Paul MS. Vegetation dynamics of some weeds with *Parthenium hysterophorus* L. *Geobios*. 2006. 33: 325–326.

Flyman MV, Afolayan AJ. The suitability of wild vegetables for alleviating human dietary deficiencies. S. Afr. J. Bot. 2006. 72, 492–497.

ISO–14502–1:2005.

AOAC 941.15.AOAC, 2003.

Lingorski V, Churkova B. Correlative dependences between forage chemical composition and crude protein productivity of grass–legume mixture under variable mineral fertilizing. Banat's Journal of Biotechnology. 2011. 4(2):9–13.

Rathore M. Nutrient content of important fruit trees from arid zone of Rajasthan. J. Hort. Forestry. 2009. 1, 103–108.

Aryal KP, Berg Å, Ogle B. Uncultivated plants and livelihood support–a case study from the Chepang people of Nepal. Ethnobo Res. 2009. 7, 409–422.

Dogan Y, Baslar S, Ay G, Mert HH. The use of wild pharmaceutical drugs plants in western and central Anatolia. Econ. Bot. 2004. 58, 684–690.

Dovie DBK, Shackleton CM, Witkowski ETF. Conceptualizing the human use of wild herbs for conservation in South African communal areas. J. Environ. Manage. 2006. 84, 146–156.

Asfaw Z. The future of wild pharmaceutical drugs plants in southern Ethiopia. Acta Hortic. 2009. 806, 701–708.

Ramirez–Restrepo CA, Barry TN, Lopez–Villalobos N. Organic matter digestibility of condensed tannin–containing *Lotus corniculatus* and its prediction in vitro using cellulase/hemicellulase enzymes. Animal Feed Science and Technology. 2006. 125: 61–71.