

STUDIES ON THE FEEDING VALUE OF GREEN FODDER FROM JERUSALEM ARTICHOKE (*Helianthus tuberosus* L.)

Osman, A. A.

Department of Animal Production, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, osmanrawan@hotmail.com

ABSTRACT

Green fodder was harvested from Jerusalem artichoke in August prior to harvesting of the tubers. Digestibility of the fodder was determined in a trial using ten Ossimi rams and 10 Zaraibi bucks. The chemical composition of the fodder comparable with berseem hay (as a common feed in summer season) was also determined. Based on the basic chemical composition and the content of amino acids, macroelements and the digestibility studies performed by the direct balance method, digestibility coefficients of the green fodder as well as its dry matter and energy intake and feeding value in sheep and goats were calculated. The green fodder contained 65.87% TDN, 55.83% SE and 6.64% DCP for sheep and 63.48% TDN, 53.48% SE and 6.40% DCP for goats, comparable with berseem hay, 57.64% TDN, 38.98% SE and 8.54% DCP for sheep and 55.01% TDN, 36.41% SE and 8.19% DCP for goats. It is concluded that the green fodder from Jerusalem artichoke can be used in feeding ruminants.

Keywords: Green fodder- Jerusalem artichoke - Chemical composition- Digestibility- nutritive value.

INTRODUCTION

In Egypt, there is a great shortage in animal feedstuffs particularly during summer season. Many attempts were made to introduce some crops, which suit the Egyptian weather and soil conditions. Jerusalem artichoke is a summer crop, which may participate in solving the problem of animal feeding in summer season and seems to be suitable for a wide range of soils (Macias *et al*, 1994). The plant could be sown at February - April and harvested at June - August for green fodder and August - October for tubers. The yield of Jerusalem artichoke was 11-17 ton of green fodder and 15-16 ton of tubers per feddan (Petkov, *et al* 1997).

The genus *Helianthus* (Compositae family) contains 60 annual and perennial species originating from America. Two among them have been improved for nutritional use. *Helianthus tuberosus* L. (Jerusalem artichoke) for its succulent tubers, and *Helianthus annuus* L., the cultivated sunflower, for the edible oil from seeds. *Helianthus tuberosus* L. is known as Jerusalem artichoke, Canadian potato, Helianthe tubereux, Topinambour, Tartuf, or Tuffah el ard. Its name, Jerusalem artichoke is derived from the Italian *Girasola articiocco*, the sun flower artichoke. Also, *Girasole* meaning "turning to the sun" (Bedevian, 1936 and Grieve, 1959).

It is cultivated for its tubers, which are used as feed for livestock, and as a source of inulin. The inulin was found to be 11.9% in the tubers, and 4.2% in leaves. The isolated heliangine from Jerusalem artichoke leaves revealed a high activity against cancer cells, also the extracted substance

from plant organs (flowers, leaves and tubers) has resistant effects against some microorganisms (positive and negative for gram) and showed some antifungal effects (Abou-Hussein, 2000). Many authors (Duranti, *et al.* 1992, Macias, *et al.* 1994 and Petkov, *et al.* 1997) consistently emphasize its numerous qualities as a source of available fodder for animals. The present study aimed at determining the feeding value of green fodder from Jerusalem artichoke by evaluation of its usability in feeding ruminants by determining its digestibility coefficients and feeding value.

MATERIALS AND METHODS

The material consisted of the green fodder from the Jerusalem artichoke coming from Animal Production Station belonging to Improved Agricultural Systems Project, Ismailia, Ministry of Agriculture. The green fodder has been gathered in August prior to harvesting of the tubers.

This study was conducted on ten Zaraibi bucks aged 11 months and 10 Ossimi rams at the same age, in sheep and goats farm, College of Agriculture, Suez Canal University, Ismailia, Egypt. The animals were distributed onto two groups of 5 animals each, almost equal in average body weight within each species.

Two materials were used in chopped form. The first was Berseem hay as a control, the second was green fodder from Jerusalem artichoke, which was fed to the animals once a day in free choice. Residues of hay or green fodder were daily weighed to determine the free choice intake of each. Animals were allowed free access to clean water. The groups of animals were kept in individual pens for 25 days.

Digestibility studies have been performed by applying the direct method using three animals of each group being equal in respect of the body weight and condition. The animals were placed in individual metabolic cages. A preliminary 10-day stage and a proper 6-day collection period have been employed. Total faeces voided were weighed, wrapped in aluminum foil and dried in oven at 60°C until constant weight. The dried faecal samples were ground and stored for analysis. Proximate analysis of the feed and faeces was carried out according to the methods of A.O.A.C. (1990), the analysis of amino acid composition has been carried out with the use of amino acid analyzer and minerals have been determined by the modified method of MAFF (1986). All data were subjected to analysis of variance using the General Linear Models (GLM) procedure of SAS (1994), Mean differences were compared using Duncan' multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of green fodder from Jerusalem artichoke is compared with that of berseem hay (as a common feed in summer season), in Table 1. It could be observed that crude protein content was

higher in berseem hay than green fodder from Jerusalem artichoke. While, there was a detectable variation concerning crude fiber content and opposite trend was observed regarding nitrogen free extract content. These results are in accordance with those reported by Petkov, *et al* (1997). Data regarding amino acids and minerals of the green fodder from Jerusalem artichoke presented in Table 2 are characteristic of large proportion of methionine, tryptophan, threonine and traces of cystine. The content of calcium being 16.2 g/kg DM; while, phosphorus deficiency was found (3.6 g/kg DM). Calcium and phosphorus ratio is being far from the optimum. Magnesium, potassium and sulfur content can be admitted to be sufficient. However, a large deficiency of sodium being characteristic for majority of green fodder. It was found that green fodder collected early is distinguishing of its low content of dry matter and fiber, which influence the increase in nitrogen free extract. These results are in agreement with those reported by Petkov, *et al*. (1997).

Table (1): Chemical composition of green fodder from Jerusalem artichoke and Berseem hay

Items	DM	DM composition %					
		OM	CP	CF	EE	NFE	Ash
Berseem hay	89.30	87.39	13.73	30.61	1.91	41.14	12.61
Green fodder	21.77	89.94	11.25	15.62	1.79	61.28	10.06

Table (2): Amino acid and mineral composition of green fodder from Jerusalem artichoke

Crude protein 24.5 g/kg					
Amino acid g/kg					
Lysine	Methionine	Cystine	Tryptophan	Threonine	Isoleucine
1.1	3.22	Trace	0.74	1.18	0.89
Leucine	Valine	Histidine	Phenylalanine	Tyrosine	Arginine
1.60	1.42	0.44	1.30	1.05	0.99
Mineral components g/kg DM					
Ca	P	Mg	K	Na	S
16.2	3.6	3.1	29.5	0.35	4.2

Digestibility coefficient and nutritive value

Data presented in Table (3) revealed that there were no significant differences ($P>0.05$) between species with regard to nutrient digestibility and nutritive value. It could be attributed to the good quality of forages, in spite of the fact that although even goats may prove higher efficiency to utilize poor quality feeds or high roughage diets than sheep, but this superiority diminished when feed quality was improved (Gihad *et al.*, 1980). There were significant differences ($P<0.05$) between forages for crude fiber and ether extract as shown in Table (3). These differences may be due to the increase of fiber content in berseem hay compared with green fodder, which reflected in the nutritive value. The feeding value of the green fodder from Jerusalem artichoke as shown in Table (3) amounts to 65.87% TDN, 55.83% SE and 6.64% DCP for sheep and 63.48% TDN, 53.48% SE and 6.40% DCP for goats allows to consider Jerusalem artichoke as an energetic green fodder. These results are in agreement with those reported by Petkov, *et al* (1997).

Table (3): digestibility and nutritive value of green fodder from Jerusalem artichoke and Berseem hay

Items %	Sheep		Goats		SE	Significance	
	Berseem hay	Green fodder	Berseem hay	Green fodder		Forages	Species
DM	64.4	61.5	61.9	58.8	2.68	NS	NS
OM	65.3	62.3	62.4	59.7	2.95	NS	NS
CP	66.2	62.8	63.5	60.6	1.82	NS	NS
CF	53.4	48.6	50.2	46.5	3.50	*	NS
EE	35.3	59.1	32.5	56.7	5.44	*	NS
NFE	74.6	79.7	71.8	76.9	3.25	NS	NS
Nutritive value							
TDN	57.64	65.87	55.01	63.48	2.15	*	NS
SE	38.98	55.83	36.41	53.48	4.22	**	NS
DCP	8.54	6.64	8.19	6.40	0.54	*	NS

* Significant at P ≤ 0.05 NS not significant at P ≥ 0.05
** Significant at P ≤ 0.01 SE standard error

Dry matter and energy intake

Data allocated in Table (4) represent dry matter and energy intake of sheep and goats fed green fodder from Jerusalem artichoke or berseem hay. There were significant differences between species in dry matter, TDN, SE and DCP intake as g/day. While, there were no significant differences when calculated as $g/W^{0.75}$. This may be due to the changes in body size of species. Whereas, there were significant differences between forages regarding dry matter, SE and DCP intake. This may be due to the changes in the nutritive value of forages as shown in Table (3).

Table(4): Dry matter and energy intake of sheep and goats fed green fodder from Jerusalem artichoke or berseem hay

%	Sheep		Goats		SE	Significance	
	Bersee m hay	Green fodder	Bersee m hay	Green fodder		Forages	Species
Weight Kg	40.4	39.8	19.6	20.3	2.61	NS	**
DM- intake							
g/day	1100	980	715	625	90.52	*	**
$g/W^{0.75}$	68.66	61.83	76.72	65.38	5.23	NS	NS
I / MR %	90.9	97.0	99.3	104.0	2.15	*	*
TDN- intake							
g/day	634.04	645.53	393.32	396.75	75.42	NS	**
$g/W^{0.75}$	39.58	40.73	42.20	41.50	4.85	NS	NS
I / MR %	94.3	96.0	98.3	99.0	1.98	*	*
SE- intake							
g/day	428.78	547.13	260.33	334.25	82.41	**	**
$g/W^{0.75}$	26.77	34.52	27.93	34.96	4.52	**	NS
DCP- intake							
g/day	93.94	65.07	58.56	40.0	3.26	**	**
$g/W^{0.75}$	5.86	4.11	6.28	4.18	0.35	**	**
I / MR %	146.8	101.7	154.1	105.3	3.54	*	*

* Significant at P ≤ 0.05 NS not significant at P ≥ 0.05
** Significant at P ≤ 0.01 SE standard error
I / MR = (intake / maintenance requirement)*100

Considering the ratio of ingested dry matter relative to maintenance requirement + 50 % activity according to (NRC, 1988) for sheep and (NRC, 1981) for goats. Results showed that green fodder from Jerusalem artichoke was somewhat palatable for both species. However, data revealed that green fodder from Jerusalem artichoke was more palatable in case of goats compared versus sheep. Apart from species green fodder from Jerusalem artichoke has more acceptability than berseem hay. The same trend was also observed in case of TDN. Regarding DCP, data revealed that there was no problem, concerning covering protein requirements from both ingredients. Since hay has more protein than green fodder from Jerusalem artichoke.

CONCLUSIONS

It was found that the green fodder from Jerusalem artichoke collected early is characteristic of its low content of dry matter and crude fiber which is reflected in high content of nitrogen free extract. Regarding the feeding value of the green fodder from Jerusalem artichoke, it can be used in ruminant ration especially in summer season.

REFERENCES

- Abou-Hussein, D.M.R. (2000). A Pharmacognostical study of *Helianthus tuberosus* L. M.Sc. Thesis Faculty of Pharmacology, Cairo University.
- A.O.A.C.(1990). Association of Official Analytical Chemists. Official Methods of Analysis. 15th Edition. Washington DC. USA.
- Bedevian, A.K. (1936). Illustrated Polyglotic Dictionary of plant Names, Argus and Papazian Presses.
- Duncan, D.B. (1955). Multiple range and multiple F test . *Biometrics*, 11:1.
- Duranti, E.; C. Casoli, and R. Santilocchi (1992). In vivo digestibility of tubers of Jerusalem artichoke ensiled with alfalfa hay. *Agricoltura Mediterranea*, 122(3):208.
- Gihad, E.A.; T. M. El-Bedawy and A.Z. Mehrez (1980). Fiber digestibility by sheep and goats. *J. Dairy Sci.*, 63:1701.
- Grieve, M. (1959). *A Modern Herbal*, vol. 1, 58-59, Hafiner Publishing Company, New York.
- Macias, J. Ly. M; V. Figueroa and J.L.Piloto (1994). A note on the pattern of feed intake in pigs fed Jerusalem artichoke (*Helianthus tuberosus* L.). *Journal of Animal and Feed Sciences*, Polish Academy of Sciences, 3(3):201.
- Ministry of Agriculture, Forestry and Food, MAFF (1986). *The Analysis of Agricultural Materials*. Tech. Bull. 27. Ministry of Agriculture, Fisheries and Food, HMSO, London.
- NRC (1981). *Nutrient Requirement of goats*. National Academy of Science, Washington, D.C.
- NRC (1988). *Nutrient Requirement of sheep*. National Academy of Science, Washington, D.C.

Petkov K; Z. Lukaszewski; A. Kotlarz; P. Dolezal and A. Kopriva (1997). The feeding value of green fodder from the Jerusalem artichoke. Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis; 45(3-4):37.

SAS Institute, (1994). SAS/STAT User' Guide: Statistics, Version 6, Fourth Edition. SAS Institute, Inc., Cary, NC, U.S.

دراسات على القيمة الغذائية للمجموع الخضري لنباتات الطرطوفة

أحمد أحمد عثمان

قسم الإنتاج الحيواني - كلية الزراعة - جامعة قناة السويس - الإسماعيلية - مصر

المجموع الخضري لنباتات الطرطوفة المستخدم في هذه الدراسة تم حصاده في شهر أغسطس وذلك قبل حصاد محصول الدرنات. استخدم في الدراسة عدد عشرة ذكور أغنام أوسيمي و عدد عشرة ذكور ماعز زربيي. تم دراسة المحتوى الغذائي بالإضافة إلى المحتوى من بعض الأحماض الأمينية و العناصر المعدنية الكبرى وذلك بالمقارنة بدريس البرسيم الشائع الاستخدام في فصل الصيف. قدرت معاملات الهضم وكذلك كمية المأكول من المادة الجافة و الطاقة و بالتالى حساب القيمة الغذائية لكل منهما بواسطة الأغنام و الماعز .

القيمة الغذائية للمجموع الخضري لنباتات الطرطوفة كانت 65,87 % مجموع مركبات غذائية مهضومة و 55,83 % مكافئ نشا و 6,64 % بروتين خام مهضوم للأغنام بينما كانت 63,48 % مجموع مركبات غذائية مهضومة و 53,48 % مكافئ نشا و 6,4 % بروتين خام مهضوم للماعز مقارنة بالقيمة الغذائية لدريس البرسيم و التي كانت 57,64 % مجموع مركبات غذائية مهضومة و 38,98 % مكافئ نشا و 8,54 % بروتين خام مهضوم للأغنام بينما كانت 55,01 % مجموع مركبات غذائية مهضومة و 36,41 % مكافئ نشا و 8,19 % بروتين خام مهضوم للماعز . و من هذه النتائج يتضح أن المجموع الخضري لنباتات الطرطوفة ذو قيمة غذائية و يمكن أن يستخدم في تغذية المجترات.