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NUTRITIONAL AND ANTI-NUTRITIONAL COMPONENTS OF SOME UNCONVENTIONAL FEEDS

Mohamad Rateb Al-Masri[*]

Department of Agriculture, Animal Production Division, Atomic Energy Commission of Syria, P. O. Box 6091, Damascus, Syria

Abstract: Animal feeding in the arid and semi-arid regions during the dry season is largely dependent on cereal crop by-products and herbaceous plants, which provide poor feed and have low nutritive value. Research is directed towards the possibility of using on-farm produced feeds as feed supplements to meet some nutrient requirements of ruminants. Nutritive and anti-nutrient contents in leaves of some tree species (*Melia azesarach, Pinus halepansis*, *Eucaliptus camaldulensis, Acacia ampliceps*, *Elaeagnus angustifolia, Casuarina equisetifolia, Sesbania aculeate, Schinus molle, Olea europea*) and agricultural by-products were determined. The crude protein values ranged from 43 to 234 g/kg DM, with the leaves of *E. angustifolia* having the highest value and sunflower seed shells having the lowest value. Crushed date palm kernels had high ($P < 0.05$) contents (g/kg DM) of total carbohydrates (878), cellulose (441) and hemicellulose (280) and low contents of lignin (25), and could therefore be used as an energy-rich feed supplement for ruminants. The highest values (41–84 g/kg DM) of tannins were noted in the tree leaves of *C. equistifolia*, *A. ambiceps*, *E. camaldulensis*, *S. molle*, *S. aculeate* and *P. halepansis*. Nitrogen solubility in the leaves of the studied tree species was negatively correlated with total phenols and tannins. The leaves of the studied tree species (with the exception of *P. halepansis*), olive cake pulp, olive tree pruning branches and leaves of olive oil extraction are suitable as protein feed supplements for ruminants in arid and semi-arid regions.

Key words: carbohydrate, fiber, nutrient, residue, tannin, tree leaves.

Introduction

The dry season in the arid and semi-arid areas is the most challenging limitation, characterized by insufficient and poor-quality feed (Babayemi, 2007). The ruminants in these areas depend mainly on cereal crop residues and annual herbaceous plants containing lower amounts of proteins and digestible organic

[*]Corresponding author: e-mail: ascientific38@aec.org.sy

matter and a higher proportion of lingo-cellulosic material, so that high levels of ruminant production are not always possible (Al-Masri, 2004 and 2005).

Tree leaves have been used as protein and mineral supplements to the low-quality roughages in the tropics during the dry periods (Kumara Mahipala et al., 2009; Khan and Habib, 2012; Habib et al., 2013). Leaves of shrubs and trees provide the required “bypass” protein and some addition compounds (glucose, propionate) which decrease enteric methane production, enhance propionic acid production from the feed consumed and hence the glucose supply to the animal, and therefore increase the animal productivity (Preston et al., 2021).

Both the cultivation of olive trees and the olive oil industry generate huge amounts of olive by-products, consisting mainly of pruning residues, leaves, stones, pulp, olive cake, and water waste (Molina-Alcaide and Yáňez-Ruiz, 2008). The recycling of these wastes is of great importance as their storage causes serious environmental, social and economic problems. An alternative utilization of olive leaves and olive tree by-products would be to use them as roughage feeds for ruminants and would have the potential for alleviating some of the feed shortages and nutritional deficiencies that occur during the dry season (Fayed et al., 2009).

The chemical composition of unconventional feeds intended for feeding is closely related to their feeding value. Some feeds contain anti-nutrient components (particularly tannins) which may bind to the protein, thus making the protein inaccessible to the rumen microbes (Getachew et al., 2000). However, the leaves of some tree species containing high amounts of tannins can be used as a feed additive in ruminant diets to decrease the enteric methane production (Kamalak and Ozkan, 2021).

The objectives of the present work were to evaluate leaves of some tree species (*Melia azesarach, Pinus* halepansis, *Eucaliptus camaldulensis, Acacia ampliceps*, *Elaeagnus angustifolia, Casuarina equisetifolia, Sesbania aculeate, Schinus molle,* and *Olea europea*), some agricultural by-products (leaves of olive oil extraction, olive cake, olive cake pulp, olive cake wood, crushed date palm kernels, peanut shells, and sunflower seed shells) and olive tree pruning branches in terms of their chemical composition, nitrogen solubility, cell wall constituents and anti-nutrient components. In addition, the relationship between the anti-nutrient components, the cell-wall constituents, the crude protein, the total carbohydrates and the nitrogen solubility was investigated.

Material and Methods

Tested plant materials

Nine tree species which are tolerant to the harsh environmental conditions (drought and salinity) (*M. azesarach, P. halepansis, E. camaldulensis, A. ampliceps*, *E. angustifolia, C. equisetifolia, S. aculeate, S. molle,* and *O. europea*), grown at the Der Al-Hajar research station about 30 km southeast of Damascus in the arid steppe region, were selected. The leaf samples of each species with 4 replicates (*n* = 4) (3 trees each) were collected randomly and manually at the vegetative stage (green leaves) (except for *M. azesarach*, at dormant stage; fall leaves) from different parts of the tree.

Seven agricultural by-products (leaves of olive oil extraction, olive cake, olive cake pulp, olive cake wood, crushed date palm kernels, peanut shells, and sunflower seed shells) were studied. Olive oil extraction leaves and olive cake were collected from 4 local factories (*n* = 4) (8 kg each). The samples of olive cake were screened using a 2.5-mm sieve to obtain olive cake pulp, and the remaining part was designated as olive cake wood. Crushed (< 3 mm) date palm kernels, peanut shells and sunflower seed shells were collected with 4 replicates (*n* = 4) (1 kg each).

The branches (stems with leaves) of the olive trees were hand-cut in the routine pruning season at a distance of 50 cm from the tip. The olive tree pruning branches were collected with 4 replicates (*n* = 4) (3 trees each).

All the collected materials were dried at room temperature (20–25 ^{o}C) for one week, ground to pass through a 1-mm sieve, and stored frozen at -20 ^{o}C in sealed nylon bags for later analyses.

Determination of components

Standard methods as described in AOAC (1990) were used for determination of dry matter (DM), ash, ether extract (EE) and crude protein (CP). Nitrogen (N) concentration was measured by the Kjeldahl method, and CP concentration was calculated as N% x 6.25. Organic matter (OM) was calculated as: OM = DM – ash. Cell-wall constituents (neutral-detergent fiber, NDF; acid-detergent fiber, ADF and lignin) were analyzed (Van Soest et al., 1991). Both NDF and ADF were not ash corrected. The acid-detergent residue was treated with H_2SO_4 to determine the lignin. Hemicellulose and cellulose were calculated from the differences between NDF and ADF and between ADF and lignin, respectively.

The total carbohydrate (CHO) was calculated according to Yisehak and Janssens (2013) as follows:

Total CHO (%) = 100 - (% CP + % EE + % ash + % lignin).

Buffer soluble nitrogen (BS-N), non-protein nitrogen (BS-NPN) and nitrogen solubility were determined according to Makkar and Becker (1996). Total phenols and tannins were determined by spectrophotometric methods (Makkar et al., 1993).

Statistical analyses

In this experiment, a one-way variance analysis was used to determine the mean differences in nutritive and anti-nutrient contents between the studied unconventional feeds. The data of the chemical measurements were subjected to a one-way analysis of variance (ANOVA) test, using the Statview-IV program (Abacus Concepts, Berkeley, CA, USA). The means were separated using the Fisher's least significant difference test at the 95% confidence level. Correlation coefficients between the studied parameters were calculated.

Results and Discussion

The values of some nutritional components of the experimental unconventional feeds are illustrated in Table 1. The crude protein content ranged from 43 to 234 g/kg DM, with *E. angustifolia* leaves having the highest content.

Table 1. Nutritive components and cell wall constituents of the experimental unconventional feeds (g/kg DM).

	CP	A	EE	NDF	ADF	L
Leaves of tree species						
M. azedarach (fall)	72.2^{d}	165.3^{a}	42.9^{j}	290.2^{p}	247.2^{m}	85.8^{l}
P. halepansis (fall)	41.7^{n}	95.3^{d}	80.0^{f}	485.4^{g}	454.7^{g}	217.0^{d}
P. halepansis (green)	66.4^{j}	63.1^{g}	72.6^{g}	479.3^{g}	373.5^{i}	134.1^{h}
E. camaldulensis (green)	78.3^{g}	109.5^{c}	78.8^{f}	322.4^{j}	256.2^{lm}	104.8^{p}
A. ambiceps (green)	126.7^{d}	118.8^{b}	19.0^{n}	389.3^{h}	297.0^{j}	118.1^{j}
E. angustifolia (green)	233.5^{a}	78.1^{f}	52.7^{i}	252.3^{l}	180.2^{no}	48.9^{n}
C. equistifolia (green)	124.7^{d}	60.8^{g}	31.1^{l}	519.0^{f}	398.4^{h}	151.6^{g}
S. aculeata (green)	164.0^{b}	113.2^{c}	56.8^{h}	244.9^{l}	172.3^{o}	65.8^{m}
S. molle (green)	136.2^{c}	85.0^{e}	144.3^{a}	293.9^{p}	187.7^{n}	63.6^{m}
O. europea (green)	92.2^{e}	65.2^{g}	33.8^{p}	365.5^{i}	257.6^{l}	126.1^{i}
Agricultural by-products						
Leaves of olive oil extraction	84.2^{f}	90.5^{d}	72.4^{g}	386.7^{h}	281.4^{p}	170.5^{f}
Olive cake	65.7^{j}	40.3^{i}	93.3^{d}	767.2^{c}	605.5^{d}	359.6^{b}
Olive cake pulp	69.5^{i}	42.8^{i}	116.4^{b}	719.0^{e}	579.3^{e}	298.9^{c}
Olive cake wood	59.3^{p}	34.6^{j}	87.1^{e}	803.0^{b}	654.5^{c}	545.1^{a}
Crushed date palm kernels	50.6^{l}	12.4^{l}	104.2^{c}	745.5^{d}	465.6^{f}	24.8^{o}
Peanut shells	51.2^{l}	27.3^{p}	15.8^{o}	880.1^{a}	799.3^{a}	366.0^{b}
Sunflower seed shells	45.4^{m}	29.6^{jp}	42.6^{j}	819.3^{b}	665.3^{b}	203.1^{e}
Tree pruning residues						
Branches of olive trees	77.6^{g}	51.8^{h}	26.9 ^{m}	514.8^{f}	372.7^{i}	129.4^{hi}
SEM	5.69	4.56	4.11	25.1	21.89	15.61
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

DM: dry matter; CP: crude protein; EE: ether extract; A: ash; NDF: neutral-detergent fiber; a,b,c,d…The means in the same column for each parameter with different superscripts are different at P<0.05.

The leaves of *M. azedarach* and *S. molle* had high ($P < 0.05$) concentrations of ash (165 g/kg DM) and ether extract (144 g/kg DM), respectively. The highest ($P < 0.05$) content of NDF was observed in peanut shells, sunflower seed shells and olive cake wood. Olive cake pulp had higher ($P < 0.05$) concentrations of crude protein and ether extract and lower concentrations of NDF, ADF and lignin than olive cake.

The changes in nitrogen forms, nitrogen solubility and anti-nutritional components of the experimental unconventional feeds are illustrated in Table 2. Total nitrogen, BS-N, BS-NBN and N-solubility values were varied between the experimental materials. The highest concentrations of BS-N were observed in the leaves of *M. azedarach*, *E. angustifolia* and *S. aculeate.* N-solubility was highest ($P < 0.05$) in the leaves of *M. azedarach* and *E. angustifolia* compared to the other experimental materials. There were significant variations between the experimental materials in terms of anti-nutritional components.

Table 2. Nitrogen forms, nitrogen solubility and anti-nutritional components of the experimental unconventional feeds (g/kg DM).

	Total N	BS-N	BS-NPN	N-solubility (%)	% NPN	Total phenols	Total tannins
Leaves of tree species							
M. azedarach (fall)	11.5^{d}	6.15^{b}	5.89^{b}	53.3^{a}	51.1^{a}	41.7^{j}	15.6^{hi}
P. halepansis (fall)	6.67^{n}	1.72^{g}	1.44^{j}	25.8^{d}	21.6^{d}	43.2^{j}	23.4^{g}
P. halepansis (green)	10.6^{j}	1.73^{g}	1.45^{j}	16.4^{g}	13.7^{g}	90.0^{f}	49.3^{e}
E. camaldulensis (green)	12.5^{g}	1.15^{p}	1.10^{l}	9.17^{j}	8.8^{j}	104.8^{d}	75.1^{c}
A. ambiceps (green)	20.3^{d}	1.60^{h}	1.56^{i}	7.90^{p}	7.7^{p}	122.4^{a}	58.0^{d}
E. angustifolia (green)	37.4^{a}	16.6^{a}	4.57^{d}	44.4^{b}	12.3^{h}	38.5^{p}	15.6^{hi}
C. equistifolia (green)	19.9^{d}	3.30^{d}	3.24^{e}	16.5^{g}	16.3^{f}	106.6^{c}	83.7^{a}
S. aculeata (green)	26.2^{b}	5.24^{c}	4.88^{c}	20.0^{f}	18.6^{e}	112.6^{b}	81.0^{b}
S. molle (green)	21.8^{c}	2.26^{e}	2.23^{f}	10.4^{i}	10.2^{i}	96.5e	41.2^{f}
O. europea (green)	14.8^{e}	1.36^{i}	0.89^{m}	9.23^{j}	6.0^{l}	75.4^{g}	15.9^{hi}
Agricultural by-products							
Leaves of olive oil extraction	13.5^{f}	1.74^{g}	0.84^{n}	12.9^{h}	6.3^{l}	55.1^{i}	14.9^{i}
Olive cake	10.5^{j}	0.70^{l}	0.54^{o}	6.66^{l}	5.1^{m}	6.8^{no}	0.67^{l}
Olive cake pulp	11.1^{i}	0.59^{m}	0.49^{p}	5.32^{m}	4.4^{n}	8.0^{n}	0.22^{l}
Olive cake wood	9.49^{p}	0.44^{p}	0.30^{q}	4.58^{n}	3.2^{o}	6.4^{o}	0.78^{l}
Crushed date palm kernels	8.10^{l}	1.27^{j}	1.27^{p}	16.9^{g}	15.8^{f}	30.2^{l}	12.8^{j}
Peanut shells	8.19^{l}	1.90^{f}	1.85^{g}	23.2^{e}	22.7^{c}	10.4^{m}	5.5^{p}
Sunflower seed shells	7.26^{m}	1.93^{f}	1.69^{h}	26.6^{c}	23.4^{b}	4.7^{p}	0.27^{l}
Tree pruning residues							
Branches of olive trees	12.4^{g}	1.12^{p}	10.73^{a}	9.05^{j}	5.9^{l}	57.1^{h}	17.0^{h}
SEM	0.91	0.43	0.43	1.53	1.31	4.76	3.33
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

BS-N: buffer soluble nitrogen; BS-NPN: buffer soluble non-protein nitrogen SEM: standard error of the means $^{a,b,c,d...}$The means in the same column for each parameter with different superscripts are different at P<0.05.

Total phenols were highest in the leaves of *A. ambiceps* ($P < 0.05$) and lowest in sunflower seed shells, peanut shells and olive cake. The changes in the cellulose, hemicelluloses, organic matter and total carbohydrate of the experimental unconventional feeds are shown in Table 3. Total carbohydrate concentrations were highest ($P < 0.05$) in crushed date palm kernels, olive tree pruning branches and olive leaves (757–878 g/kg DM) and lowest in olive cake wood (340 g/kg DM). Olive cake pulp had a higher level of total carbohydrate content than the olive cake.

Table 3. Changes in hemicellulose (HC), cellulose (CL), organic matter (OM) and total carbohydrate (CHO) of the experimental unconventional feeds (g/kg DM).

	HC	CL	OM	CHO
Leaves of tree species				
M. azedarach (fall)	43.0^{p}	161.4^{f}	722.6^{l}	760.1^{d}
P. halepansis (fall)	30.8^{p}	237.7^{d}	828.7^{i}	648.3^{i}
P. halepansis (green)	105.8^{fg}	239.4^{d}	852.3^{h}	756.3^{d}
E. camaldulensis (green)	66.2^{j}	151.4^{f}	799.5^{j}	728.7^{ef}
A. ambiceps (green)	92.3^{hg}	178.9^{e}	776.4^{p}	734.6^{e}
E. angustifolia (green)	72.1^{ij}	131.3^{g}	822.5^{i}	697.1^{g}
C. equistifolia (green)	120.1^{e}	246.8^{d}	861.0^{fg}	716.7^{f}
S. aculeata (green)	72.7^{ij}	106.5^{i}	779.7^{p}	720.1^{f}
S. molle (green)	106.2^{efg}	124.2^{gh}	881.6^{de}	673.0^{h}
O. europea (green)	107.9^{ef}	131.5^{g}	865.1^{f}	757.5^{d}
Agricultural by-products				
Leaves of olive oil extraction	105.4^{fg}	110.9^{hi}	856.4^{gh}	638.5^{i}
Olive cake	161.6^{b}	245.9^{d}	912.8^{b}	339.8^{l}
Olive cake pulp	139.7^{d}	280.4^{c}	887.1^{d}	547.9^{j}
Olive cake wood	148.5^{bcd}	109.4^{i}	903.5^{c}	339.8^{l}
Crushed date palm kernels	279.9^{a}	440.7^{b}	922.4^{a}	877.9^{a}
Peanut shells	80.8^{hi}	433.3^{b}	880.8^{de}	641.0^{i}
Sunflower seed shells	154.0^{bc}	462.3^{a}	881.6^{de}	776.7^{l}
Tree pruning residues				
Branches of olive trees	142.1^{cd}	243.3^{d}	876.8^{e}	791.2^{b}
SEM	6.56	13.47	6.11	14.32
P-value	<0.0001	<0.0001	<0.0001	<0.0001

SEM: standard error of the means. [a,b,c,d...]The means in the same column for each parameter with different superscripts are different at $P<0.05$.

The results indicated that crude protein, total carbohydrates, total phenols, buffer-soluble nitrogen and tannins were negatively correlated with cell wall constituents (NDF, ADF, lignin) (Table 4). Nitrogen solubility in the leaves of the experimental tree species was negatively correlated with total phenols ($r = -0.80$; $P < 0.001$) and tannins ($r = -0.54$; $P < 0.001$) (Figures 1 and 2).

Table 4. The correlation coefficients between the cell wall constituents and nutritional and anti-nutritional components of the experimental unconventional feeds.

	CP	CHO	BS-N	TP	TT
NDF	- 0.66***	- 0.37**	- 0.48***	- 0.74***	- 0.58***
ADF	- 0.66***	- 0.44**	- 0.45***	- 0.74***	- 0.56***
Lignin	- 0.47***	- 0.86***	- 0.40***	- 0.61***	- 0.48***

CP: crude protein; CHO: total carbohydrates; BS-N: buffer soluble nitrogen; TP: total phenols; TT: total tannins; NDF: neutral-detergent fiber; ADF: acid-detergent fiber. ***P*<0.01, ****P*<0.001.

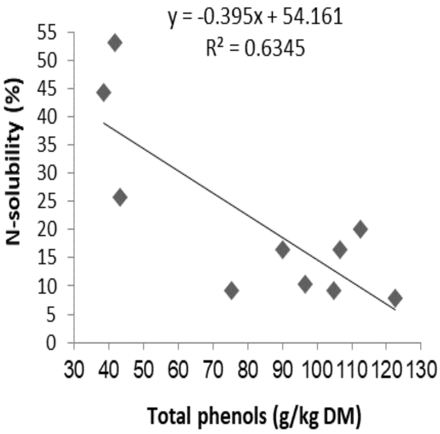

Figure 1. Relationship between N-solubility and total phenols of the leaves of experimental tree species

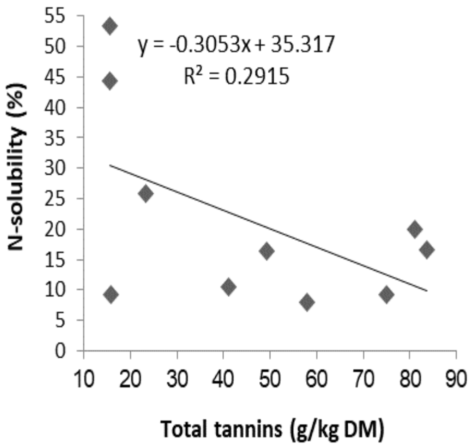

Figure 2. Relationship between N-solubility and total tannins of the leaves of experimental tree species

The crude protein concentration in the experimental leaves of *Acacia ambiceps* (127 g/kg DM) was comparable to that reported by Azim et al. (2011) for *A. nitotic* (118 g/kg DM). However, the crude protein concentrations (72 g/kg DM) in the experimental fall leaves of *Melia azesarach* were lower than those reported by the previous referent for green leaves of *M. azedarach* (141 g/kg DM). The content of crude protein of *M. azedarach* can be misleading, because up to 51% of this fraction can consist of non-protein nitrogen. Parissi et al. (2005) showed that the crude protein content of some browse species (*Medicago arborea*, *Arbutus andrachne* and *Gleditsia triacanthos*) decreased with maturation. Narvaez et al. (2010) showed that the crude protein content of 11 California browse species decreased from spring to fall. El-Waziry (2007) and Sallam et al. (2008) reported that the crude protein contents of trefoil hay and alfalfa hay, commonly used as livestock feed, were 145 and 182 g/kg DM, respectively. The minimum crude protein level of 80 g/kg DM is required for rumen microbial function (Norton, 2003). Therefore, the experimental un-conventional feeds (except for olive cake, olive cake wood, crushed date palm kernel, peanut shells, sunflower seed shells and leaves of *P. halepansis*) appear to be a good protein source for ruminants.

Lignin contents were highest in peanut shells, olive cake and olive cake wood, and lowest in crushed date palm, leaves of *E. angustifolia*, *S. aculeate* and *S. molle.* Alonso-Diaz et al. (2009) indicated that NDF concentrations in tree leaves of *Lysiloma latisiliquum*, *Acacia pennatula* and *Piscidia piscpula* were negatively correlated with dry matter digestibly. However, Jung et al. (1997) and Moore and Jung (2001) reported that the lignin concentration of forages was negatively related to the extent of digestion. This inhibition likely results from a reduction in the microbial growth rate and microbial enzyme activity in the rumen (McSweeny et al., 2001).

The rates of nitrogen solubility were highest in the leaves of *M. azedarach* and *E. angustifolia* (44–53%), intermediate in *S. aculeate* leaves, sunflower seed shells, peanut shells and the fallen leaves of *P. halepansis* (20–26%) and lowest in remnant materials (5–17%). Hussain et al. (2001) reported that BS-N rates ranged between 25 and 40% of the total nitrogen in the leaves of some *Sesbania* species. Al-Masri (2013) reported that the BS-N and BS-NPN values were negatively correlated with crude fiber and NDF concentrations (r = -0.87) of some range plants.

The concentrations of total phenols (122 g/kg DM) and total tannins (58 g/kg DM) in the experimental leaves of *A. ambiceps* were analogous or comparable to those (122 and 89 g/kg DM, respectively) reported for *Hippophae rhamnoides* by Singh et al. (2005). Pritchard et al. (1988) reported that the low intake and feed value of *Acacia aneura* leaves were related to the content of condensed tannins, which bound with the proteins in the leaves. Rubanza et al. (2005) indicated that the concentrations of condensed tannins varied between the *Acacia* species (*A. angustissima, A. drepanolobium, A. nilotica, A. polyacantha, A. tortilis, A. Senegal*) and ranged from 53 to 98 g/kg DM. Abdulrazak et al. (2000) reported that the total phenol and tannin contents in the leaves of some *Acacia* trees were negatively correlated with crude protein (r = -0.90, P < 0.01) and positively correlated with acid-detergent fiber contents (r = 0.67, P < 0.05). Getachew et al. (2002) indicated that plants containing total tannin and phenol levels up to 20 and 40 g/kg DM, respectively, do not precipitate protein and, therefore, probably do not affect ruminant productivity.

The results indicated that crushed date palm kernels had high contents of total carbohydrates, cellulose and hemicellulose and low contents of lignin. Therefore, it could be used as an energy-rich feed supplement for ruminants. Olive cake wood had high concentrations of lignin and low concentrations of total carbohydrates and therefore could not be used as a feed source. Al-Masri (2003) indicated that removing the wood from olive cake to obtain olive cake pulp improved organic matter digestibility and metabolizable energy. Our results indicated that removing the wood from olive cake to obtain olive cake pulp increased the crude protein, total carbohydrates and cellulose and decreased the cell wall constituents, and therefore olive cake pulp could be used as a feed source. Further work is required to study *in-vivo* palatability and growth performance of the experimental unconventional feeds.

Conclusion

Based on the results of this research it can be concluded that:

Crushed date palm kernels had high contents of total carbohydrates, cellulose and hemicellulose and low contents of lignin, and therefore, it could be used as an energy-rich feed supplement for ruminants.

Removing the wood from the olive cake to obtain the olive cake pulp increased the crude protein, total carbohydrates and cellulose and decreased the cell wall constituents.

Nitrogen solubility in the leaves of the studied tree species was negatively correlated with total phenols and tannins.

Leaves of the studied tree species (with the exception of *P. halepansis*), olive cake pulp, olive tree pruning branches and leaves of olive oil extraction are suitable as protein feed supplements for ruminants in arid and semi-arid regions.

In-vivo palatability and growth studies for the experimental unconventional feeds are necessary to complete the experiments and confirm the results.

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NUTRITIVNE I ANTINUTRITIVNE KOMPONENTE NEKIH NEKONVENCIONALNIH HRANIVA

Mohamad Rateb Al-Masri*

Department of Agriculture, Animal Production Division, Atomic Energy Commission of Syria, P. O. Box 6091, Damascus, Syria

R e z i m e

Ishrana životinja u sušnim i polusušnim regionima tokom sušne sezone u velikoj meri zavisi od nusproizvoda žitarica kao i krmnog bilja, koje obezbeđuje lošu stočnu hranu, niske hranljive vrednosti. Istraživanja su usmerena ka mogućnosti korišćenja hraniva proizvedenih na gazdinstvu u vidu dodatne ishrane, kako bi bile podmirene hranidbene potrebe preživara. Utvrđen je sadržaj nutritivnih i antinutritivnih sastojaka u lišću nekih drvenastih vrsta (*Melia azesarach, Pinus halepansis*, *Eucaliptus camaldulensis, Acacia ampliceps*, *Elaeagnus angustifolia, Casuarina equisetifolia, Sesbania aculeate, Schinus molle, Olea europea*) i sporednih poljoprivrednih proizvoda. Vrednosti za sadržaj sirovih proteina kretale su se od 43 do 234 g/kg SM, pri čemu su listovi *E. angustifolia* imali najvišu vrednost, a ljuske semena suncokreta najnižu vrednost. Drobljene koštice urmine palme odlikovale su se (P < 0,05) sadržajem (g/kg SM) ukupnih ugljenih hidrata (878), celuloze (441) i hemiceluloze (280), a niskim sadržajem lignina (25), pa su se stoga mogle koristiti kao energetski bogat dodatak ishrani preživara. Najviše vrednosti (41–84 g/kg SM) tanina su zabeležene u lišću drvenastih vrsta *C. equistifolia*, *A. ambiceps*, *E. camaldulensis*, *S. molle*, *S. aculeate* i *P. halepansis*. Rastvorljivost azota iz lišća ispitivanih drvenastih vrsta bila je u negativnoj korelaciji sa ukupnim fenolima i taninima. Lišće ispitivanih drvenastih vrsta (sa izuzetkom *P. halepansis*), pulpa maslinove pogače, grančice-ostaci od orezivanja maslina, kao i lišća, nakon ekstrakcije maslinovog ulja, pogodni su kao proteinski dodaci hranivima za preživare u sušnim i polusušnim regionima.

Ključne reči: ugljeni hidrati, vlakna, hranljive materije, ostaci, tanini, lišće drveća.

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*Autor za kontakt: e-mail: ascientific38@aec.org.sy