The Eurasia Proceedings of Health, Environment and Life Sciences (EPHELS)
ISSN: 2791-8033

The Eurasia Proceedings of Health, Environment and Life Sciences (EPHELS), 2023

Volume 11, Pages 12-18

ICVALS 2023: International Conference on Veterinary, Agriculture and Life Sciences

# Determining Nutritive Value of Dry Ash Leaves (*Fraxinus Angustifolia*) Harvested in Fall via the Regression Method for Growing Rabbits

**Farid Djellal**
Université Ferhat Abbas

**Azeddine Mouhous**
Université M. Mammeri

**Hocine Guermah**
Université Mohammed Boudiaf

**Si Ammar Kadi**
Université M. Mammeri

**Abstract**: Shortage acute and high price of animal proteins can be mitigated by sustainable farming of small, very prolific animal species with a short production cycle and valuing non-competitive foods on the resources and space reserved for human food. The rabbit (*Oryctolagus cuniculus*) combines all these assets. Ash leaves are little or not known nutritionally, nutritive value information relating them is very fragmentary and relates specifically to small ruminant herbivores.Therefore, the present work aim is to determine the nutritional value of oxyphylle dry ash leaves(*Fraxinus angustifolia*), distributed with increasing rates incorporation in pelleted food for growing rabbits. The nutritive value of Ash leaves collected in fall, dried under shade conditions and distributed for growing rabbits. We compared diets containing an increasing incorporation of Ash (*Fraxinus angustifolia*) leaves (0 to 40%) in substitution to a basal mixture. The crude protein (CP) concentration of Ash leaves was 10.9 % dry matter (DM), while neutral detergent fibre (NDF) and acid detergent fibre were 30.5 and 19.9%, respectively. A basal diet was formulated (32.51% NDF and 18.2% CP, on DM basis) and pelleted. Two others diets were obtained through substitution of 20 and 40% of basal diet by Ash leaves. Faecal digestibility was measured between 45 and 49 d of age on 12 young rabbits per diet, fed ad libitum since weaning (35 d, 802±197 g). The substitution of 40% of basal diet by Ash leaves didn't reduce the digestibility of organic matter, however digestibility of crude proteins, energy and NDF were reduced from 76 to 70%, 71 to 67% and 34 to 32, ($P < 0.01$), respectively. The digestible energy obtained by regression for shade-dried Ash leaves was 8.67±0.47MJ/kg DM, and the digestible protein content of Ash leaves was 71.55±7.3 g/kg DM.

**Keywords:** Dry ash leaves (*Fraxinus angustifolia*), Diet, Nutritive value, Growth rabbit, Fall

## Introduction

Overall, acute shortage and animal proteins high price can be alleviated by small breeding sustainable, very prolific animal species with a short production cycle and valorizing non-competitive feeds on resources and space reserved for human food (Pothin et al., 2017). Concretely, the rabbit (Oryctolagus cuniculus) brings together all these assets. However, feeds lack affects negatively rabbit productivity and stimulates nutritionist's curiosity to seek and find new alternative and unconventional sources that are cheap and locally available.
Fodder trees and shrubs are important sources t fed small ruminants (Papachristou and Platis (1999); El hasan et al., 2000; Khanal & Subba (2001); Dini-Papanastasi et al., 2005; Pereira et al., 2008 ; Ahmed et al., 2015 and Kholif et al., 2015 & 2016), however the use available shrubs and trees remains a relatively little explored

subject in rabbit feeding locally. Tree leaves available locally and at low cost are in contrast to commercial feeds sold at high prices and often lacking essential raw materials due to fluctuations in their prices on global market. Algeria, like developing countries, has a weakness in animal proteins due livestock poor performance of, resulting from often irreversible increases prices of conventional raw materials and imported inputs. Thus, new "low-cost" feeds alternatives are being sought to replace conventional commercial concentrate raw materials. In rabbit nutrition there are some 170 plant foods and or by-products, recognized for their nutritional qualities in developing countries, while only 10% of them are introduced into the formulation of granulated rabbit diet (Finzi, 2008). Currently, new feed solutions have even become a *sine qua* non condition for meeting this constantly growing animal proteins demand. And this, can be accomplished by fully exploiting alternative feed resources advantage, such as volunteer herbaceous plants trees and shrubs leaves in rabbit diet (Raharjo et al., 1986; Deshmukh et al., 1993a,b; El-Gendy et al., 1999; Tedonkeng Pamo et al., 2007; Samkol & Lukefahr 2008; Kadi et al., 2011; Akoutey et al., 2012; Zeweil et al., 2013; Abu Hafsa et al., 2014).

Rabbit farming, for its multiple advantages, is becoming increasingly sought after as an alternative source to the deficit and animal proteins diversification in meat market local (Djellal et al., 2006; Kadi et al., 2013). Concretely, rehabilitating the use certain local and unconventional feeds sources can partly improve this food situation. Certain local plants, such as sulla (Abdelguerfi-Berrekia et al., 1991; Kadi et al., 2011) and certain fodder shrubs, were once used as a ruminant basic ration and monogastric herbivores. Such an alternative can improve and promote sustainable crop and livestock production diets.

Ash (Fraxinus ssp.) is fodder tree per excellence in the North Country. Mainly in Kabylia, it is subject of rigorous and regular exploitation. The presence of ash trees in the Kabyle landscape attests to strong link that exists between this tree and agriculture. Indeed, due to energy and nitrogen balance (Jayanegara et al., 2011), ash branches and leaves are widely used as a valuable dietary supplement for ruminants consuming poor basic diets (Pereira *et al.,* 2008). In addition to fodder reserves it constitutes, this tree plays a very important ecological and productive role in protecting land against erosion, produces firewood and cabinetry wood and has great capacity for bioabsorption of heavy metals and aqueous acid solutions (Abbasi et al., 2017).

Little or no ash leaves nutritional information is available, since information relating to their nutritional value is very fragmentary and concerns specifically small ruminant herbivores (Pereira et al., 2008). However, in rabbit feeding, ash leaves (F. angustifolia) are imperfectly known nutritionally, while characteristics knowledge relating to nutritional value (digestibility, nitrogen and energy value, etc.) and ingestibility determine their rational use. Therefore, the present work aim is to determine ash leaves nutritional value harvested in autumn and shade dried, distributed with increasing incorporation rates in pelleted fattening rabbits feed : this is the so-called range substitution method or regression method.

## Method

### Feeds, Animals and Experimental Setup

Ash leaves (*Fraxinus angustifolia*) were harvested fresh in autumn and immediately dried by displaying them in the shade for a week, in Ait Hague village located in Tizi-Ouzou (Kabylia). Then, they were crushed (sieved with a diameter of 3 mm) and transported to SARL "local production" livestock feed manufacturing unit in Algiers, to incorporate them into two experimental granulated feeds. A ash leaves sample was taken at the factory to determine its chemical composition. Ash leaves nutritional value was studied by measuring fecal digestibility of three granulated diets corresponding to a control feed; also called basic diet (FFA0) and two other diets (FFA20 and FFA 40) with an increasing ash leaves incorporation rate (Table 1).

Table 1. Feeds Ingredients experimental (%)

| | Experimental diets | | |
|---|---|---|---|
| Raw materials | FFA0 | FFA20 | FFA40 |
| Basic diet[1] | 97 | 77 | 57 |
| Crushed Ash leaves | 00 | 20 | 40 |
| CMV | 03 | 03 | 03 |
| Total | 100 | 100 | 100 |

[1] Basic diet composition (%) : barley (INRA 84) 12.06, olive cake 12.13, soybean meal 46 ("48"->INRA 190) 10.7 wheat bran (INRA 104) 62, Salt (NaCl) 0.8, CL25 premix rabbit vit+mineraux 0.5 et Calcium carbonate 1.8. Basic diet was formulated to meet nutritional recommendations for growing rabbits (De Blas and Mateos,

2010). This contains barley, olive cake, soybean meal and wheat bran (Table 2). Feeds containing ash leaves were prepared by substituting the basal diet (mineral-free and premix) with 20 or 40% ash leaves. Minerals and premixes were added to three diets a fixed rate of 3%. The ingredients and chemical composition of diets are listed in Table 1. The mixtures were pelleted to 4mm in diameter and 9mm in length using moist heat.

Table 2. Chemical composition and estimated nutritional value basal diet

| Nutriment | Feed intake |
|---|---|
| *Chemical composition (%)* | |
| Dry matter | 89,71 |
| Crude ash | 6,96 |
| Crude Protein | 15,85 |
| NDF | 37,31 |
| ADF | 14,96 |
| ADL | 06,20 |
| Lysine | 00,72 |
| Méthionine | 00,24 |
| Total sulfur amino acids | 00,53 |
| *Nutritive value* | |
| Digestible Proteins (%) | 11,82 |
| Digestible Energy (MJ/kg) | 09,64 |

36 rabbits from a local white population (Zerrouki et al., 2008) weaned at age 35 days with (Live weight: 802±197 g) were used to determine nutritional value of ash leaves in a private hutch (temperature: 10 to 25° C and lighting routine from 7:00 a.m. to 7:00 p.m.), located in the Isser region in Boumerdes. The animals were housed in cages 76 × 46 × 30 centimeters (length, width and height) and arranged in a Flat-Deck. They have all been equipped with a system designed to recover all droppings. Three groups of 12 rabbits were formed and assigned to three pelleted diets. The rabbits had free access to feeds and water. After an adaptation period of 12 days, feces (droppings) were collected from 45 to 49 days of age, according to harmonized and standardized European procedure of the EGRAN group (Perez et al., 1995).

**Chemical Analyzes**

Chemical analyzes of diets and ash leaves were carried out at INRA in Toulouse GenPhySE (Genetics, Physiology and Livestock Systems), according to ISO methods, respecting the recommendations proposed by the EGRAN group. (EGRAN, 2001): dry matter (MS; ISO 6496:1999), crude ash (ISO 5984:2002), crude protein (PCF; N×6.25, Dumas method, ISO 16634-2:2009), gross energy (ISO 9831:1998) and also NDF, ADF and ADL via the sequential Van Soest method (ISO 16472:2007 and ISO 13906:2008).

Table 3. Chemical composition of shade-dried ash leaves of and experimental diets (g/kg DM).

| | Ash leaves (*F.angustifolia)* | Expérimental diets | | |
|---|---|---|---|---|
| | | FFA0 | FFA20 | FFA40 |
| Humidy | 09,32 | 12,88 | 05,06 | 05,20 |
| Organic matter | 89,68 | 91.33 | 91,00 | 92,40 |
| Crude ash | 10,19 | 08,67 | 09,00 | 07,60 |
| Crude Protéins (N*6.25) | 10,26 | 18,21 | 18,00 | 16,00 |
| Neutral detergent fibre (NDF) | 30,50 | 32,56 | 30,00 | 28,00 |
| Acid detergent fiber (ADF) | 19,94 | 12,53 | 13,00 | 13,90 |
| Acid detergent lignin 5ADL) | 08,56 | 03,72 | 04,00 | 04,70 |
| Gross Energy (Kcal/kg DM) | 4212 | 4635 | 4301 | 4304 |

**Statistical Analyzes**

The data were analyzed using a completely random system according to the GLM procedure of the SPSS software (Version 26) and as main of source variation the diets type. Comparison of means was carried out using the Tukey test. In addition, the effect of incorporating ash leaves was treated by regression using SAS software. The nutritional value of ash leaves was calculated according to regression method described by Villamide et al. (2001).

## Results and Discussion

Research work on use dry or moist ash leaves in feeding rabbit is not available either in the ingredient tables (INRA, 2004), not in those updated by Lebas (2004), although chemical composition and nutritional value are available in some small ruminants (Perioro et al., 2008). Shade-dried ash leaves have a moderate concentration of crude proteins, i.e. 119 g/kg DM. This content is close to that reported by Jayanegara et al. (2011) about common ash leaves (Fraxinus excelsior) and variant from 14.1 for the first year of harvest to 12.1 g/kg DM just for the following harvest. It is close to that determined by Cazzato et al. (1994), 109 g/kg DM. However, it is lower than the crude protein concentration of plant Pueraria phaseoloides flowers, which is a legume naturally occurring everywhere in tropical and humid regions, ranging from 176 to 230 g/kg DM (Hiep & Man, 2008; Djago et al., 2010; Akoutey et al., 2012). While the average concentrations of NDF and ADF ash leaves in autumn are 305 and 199 g/kg DM, respectively. This NDF content is close to that ash common leaves (Fraxinus exscelsior) reported by Cazzato et al. (1994) and which is equal to 290 g/kg DM. On the other hand, ADF concentration of ashleaves emerging in autumn is much lower than that flowering Pueraria phaseoloides plant reported by Akoutey et al. (2012): 344 versus 199 g/kg DM.

The energy digestibility coefficient only decreased by approximately 4 points compared to the control diet (Table 4). As a result, the digestible energy (DE) content of the experimental diets decreased with the ash leaves incorporation from 13.71 to 11.99 MJ/kg DM (Table 5). When we extrapolated to 100% (using linear backtracking), the predicted digestible energy content of shade-dried ash leaves is 10.64 MJ ED/kg DM for a 0-40% range incorporation In comparison with "Alfalfa Meal 12" (7.5 MJ/kg DM; Maertens et al., 2002), the DE content of ash leaves is 41% higher. The apparent crude protein (CP) digestibility coefficient decreases linearly and abruptly from 76 (FFA0) to 69% (FFA40) with an incorporation rate of 40% ash leaves (Table 5). As a result, the experimental diets digestible protein (DP) decreased from 138 to 111 g PD/kg DM with ash leaves incorporation. When we extrapolated to 100% (using linear backtracking), the DP content was estimated to be 65.9 g/kg DM in 0-40% incorporation range of ash leaves. On the other hand, this content is higher in 0-20% incorporation rate, predicted at 112.7 g/kg DM. This value is higher than that Alfalfa "12" and which is 78 g/kg DM according to Maertens et al. (2002). Overall, nutritive value of ash leaves, shade-dried and pelleted, is acceptable for growing rabbits, compared to other leguminous plants such as alfalfa, sulla (*Hedysarum fluxiosum*). This is partially explained by the average growth achieved by rabbits during trial period with two rate incorporation into the experimental diets FFA20 and FFA40 (Table 4).

Table 4**.** Effect of ash leaves dietary level on feed consumption and rabbit growth during the two periods of the trial.

| | Experimentals diets | | | ES | p |
|---|---|---|---|---|---|
| | FA0 | FA20 | FA40 | | |
| n | 12 | 12 | 12 | | - |
| Weight live at 35 j (g) | 837.14 | 803.12 | 759.16 | 43 | 0.794 |
| Weight live at $45^2$ j (g) | 1117.14 | 1195.62 | 1119.16 | 50 | 0.772 |
| Weight live at 49 j (g) | 1253.57 | 1333.75 | 1239.16 | 51.7 | 0.734 |
| Consumption 35-45j (g) | 76.78 | 68.00 | 77.50 | 0.4 | 0.611 |
| Consumption 45-49j (g) | 85.71 | 97.03 | 99.58 | 1.1 | 0.417 |
| Consumption 35-49j (g) | 79.34 | 76.30 | 83.83 | 1.4 | 0.758 |
| Gain de poids 35-45 d (g/j) | 36.16 | 39.25 | 36.00 | 1.6 | 0.586 |
| Weight Gain 45-49 d (g/j) | 34.10 | 34.53 | 30.00 | 1.6 | 0.472 |
| Weight Gain 35-49 d (g/j) | 36.06 | 37.90 | 34.26 | 2.6 | 0.487 |

ES: standard error, $45^2$ d: start digestibility test (Collection period).

It appears that these ash leaves are well balanced in essential amino acids since their PD content is moderate. What is already reported by Gidenne et al. (2015) for certain raw materials used in feeding growing rabbits achieving weight increases. Therefore, it would be convenient to obtain ash leaves with a higher protein content, taking care to carry out pruning in smart or planters depending on the shape and age of the ash and Preferably use leaves from young branches a few years old. Presumably, tree leaves nutrient content is related to age of the tissues that form leaves and stems of plants that have never been used before (Tsiouvaras & Nastis, 1990; Cazzato et al., 1995; Jayanegara et al., 2011).

Hiep & Homme (2008) showed that *Pueraria phaseoloides* whole plant can be introduced in a rate of 20 to 40% as a source of fiber in rations of growing rabbits. Also, Nieves et al. (2004) recommends a incorporation rate of *Leucaena leucocephala* green leaves into fattening rabbit diets ranging from 24 to 40%. However, no rate of

incorporation of ash leaves under all its forms have not been previously decided for growing rabbits. Precisely, the present study demonstrates that ash leaves, harvested in autumn, can be incorporated into diets for growing rabbits at a level of 20 to 40% as a fiber and energy source.

Table 5. Effect of ash leaves level incorporation (Fraxinus angustifolia) on apparent digestibility (%) and nutritive value of experimental diets in growing rabbits diet.

| | FFA0 | FFA20 | FFA20 | *SEM* | *P value* |
|---|---|---|---|---|---|
| n. | 12 | 12 | 12 | | |
| Digestibility Coefficient de (%) | | | | | |
| *Dry matte* | 70,5 | 69,6 | 71,0 | 0,74 | > 0.05 |
| *Organic matter* | 70,8 | 69,5 | 71,1 | 0,75 | >0.05 |
| *Crudes proteins* | 76,1 | 74,9 | 69,7 | 1,16 | >0.05 |
| *Gross Energy* | 70,7 | 66,6 | 66,9 | 0,91 | >0.05 |
| *Neutral detergent fibre* | 33,7 | 30,6 | 31,7 | 1,72 | >0.05 |
| *Acid detergent fibre* | 21,1 | 22,5 | 32,5 | 2,10 | >0.05 |
| Nutritive Value | | | | | |
| *Digestible enrrgy (Mj/kg)* | 13,71 | 11,99 | 12,05 | | |
| *Digestible proteins (g/kg)* | 138,6 | 134,8 | 111,5 | | |

## Conclusion

Ash leaves, harvested in autumn, can be considered a good source of energy (8.67 ± 0.47 MJ/Kg DM) and fiber, but a moderate source of digestible protein (71.55 ± 7.3 g PD/kg DM). However, additional trials are necessary to verify growth and health performance using a large number of rabbits, fed with a complete and balanced diet including a high proportion of ash leaves and harvested in autumn.

## Recommendations

Ash leaves, harvested in autumn, can be incorporated into meat rabbit diets. They are an excellent source of energy and fiber, and moderate source protein digestible.

## Scientific Ethics Declaration

Ash leaves, harvested in autumn, can be incorporated into meat rabbit rations. They are an excellent source of energy and fiber, and a moderate source of digestible protein.

## Acknowledgements or Notes

* This article was presented as a poster presentation at International Conference on Veterinary, Agriculture and Life Sciences (www.icvals.net) held in Antalya/Turkey on November 16-19, 2023.

* The authors would like to thank the DJEBALI Family and Yazid LOUCHAMI who placed their hutchs and breeding equipments at their disposal. They also thank Muriel SEGURA and Carol BANNELIER for them assistances in chemical analyzes at the INRA laboratories (Toulouse, France).

## References

Abbasi, H., Pourmajidian; M.R., Hodjati, S.M., Fallah, A., & Nath, S. (2017). Effect of soil-applied lead on mineral contents and biomass in Acer cappadocicum, Fraxinus excelsior and Platycladus orientalis seedlings. *iForest 10,* 722-728.

Abdelguerfi-Berrekia, R., Abdelguerfi, A., Bounaga N., & Guittonneau G.G. (1991). Répartition des espèces spontanées du genre *Hedysarum L.* en Algérie, en relation avec certains facteurs du milieu. *Fourrages, 126:* 187-207.

Abuhafsa, S.H., Hassan, A.A., Camacho, L.M., & Salem, A.Z.M. (2014). Replacement of berseem hay by Salix tetrasperma on physiological performance of New Zealand White rabbits under subtropical conditions of Egypt. *Trop. Anim. Health Prod., 46,* 1119-1125.

Ahmed, M.H., Elghandour, M.M.Y., Salem, A.Z.M., Zeweil, H.S., Kholif, A.E., Klieve, A.V., & Abdelrassol A.M.A. (2015). Influence of Trichoderma reesei or Saccharomyces cerevisiae on performance, ruminal fermentation, carcass characteristics and blood biochemistry of lambs fed Atriplex nummularia and Acacia saligna mixture. *Livest. Sci., 180,* 90-97.

Akoutey, A., Kpodekon, M.T., Bannelier, C., & Gidenne, T. (2012). Nutritive value of sun-dried *Pueraria phaseoloides* for rabbits under tropical conditions. *World Rabbit Sci., 20,* 209-213.

Cazzato, E., Corleto, A., & Laudadio, V. (1994). Quantitative and qualitative evaluation of tree and scrubby pasture species in southern Italy. In V. *Papanatasis & L. Stringi L. (Eds.), Fodders trees and shrubs. Cahiers Options Mediterranéennes* (pp.129-134). Zaragoza : CIHEAM

De Blas, C., & Mateos, G.G. (2010). Feed formulation. *I*n: C De Blas & J. Wiseman (Eds.), *Nutrition of the rabbit, CABI*, 222-232.

Deahmukh, S.V., Pathak, N.N., Randhe, S.R., & Deahmukh S.S. (1993b). Voluntary intake, digestibility and nutritive value of coastal Bermuda grass (*Cynodon dactylon*) employed as sole feed for rabbits. *World Rabbit Sci., 1,* 109-111.

Deshmukh, S.V., Pathak, N.N., Takalikar, D.A., & Digraska, S.U. (1993a). Nutritional effect of mulberry (*Morus alba*) leaves as sole ration of adult rabbits. *World Rabbit Sci., 1,* 67-69.

Dini-Papanastasi,O., Platis, P.,& Papachristou, T. (2005). Integration of certain promising woody fodder species in the grazing systems of sub-humid Mediterranean areas. *Animal Production and Resources Utilization in the Mediterranean mountain areas. E.A.A.P., Greece, 115,* 99-103.

Djago, A., Kpodekon, M., & Lebas, F. (2010). Le guide pratique de l'éleveur de lapins sous les tropiques. In *Cecuri éd.,2 ème Édition, Abomey-Calavi, Bénin.*

Djellal, F., Mouhous, A., & Kadi, S.A. (2006). Performances de l'élevage fermier du lapin dans la région de Tizi-Ouzou, Algérie. *Livestock Research for Rural Development. 18,* 100.

EGRAN. (2001). Technical note: Attempts to harmonise chemical analyses of feeds and faeces, for rabbit feed evaluation. *World Rabbit Sci., 9,* 57-64.

El Hassan, S., Lahlou, A., Newbold, C., Wallace, R. (2000). Chemical composition and degradation characteristics of foliage of some African multipurpose trees. *Animal Feed Science and Technology 86,* 27-37.

El-Gendy, K.M. (1999). Effect of dietary inclusion of acacia leaves meal (Acacia saligna) on digestibility, growth performance and blood constituents of growing rabbits. *Egyptian J. Rabbit Science, 9,* 271-283.

Finzi, A. (2008). Rabbit production development, new strategies to avoid conflict between use of natural resources for food and feed. *In: R. Preston and Nguyen Van Thu (eds.). Proc. of the International Workshop on Organic Rabbit Farming based on Forages. Cantho University, Vietnam, 25-27 November 2008. Available at: http://www.mekarn.org/prorab/Finzi.htm Accessed: September 2012.*

Hiep, N. V., & Man, N.V. (2008). Utilization of tropical kudzu leaves (Pueraria phaseoloides) as a protein source for growing rabbits. Proceedings MEKARN Rabbit Conference: Organic rabbit production from forage. Reg Preston and Nguyen Thu (Eds.). *Cantho University, Vietnam, 25-27* November 2008.

Jayanegara, A., Marquardt, S., Kreuze,r M., & Leiber F. (2011). Nutrient and energy content, *in vitro* ruminal fermentation characteristics and methanogenic potential of alpine forage plant species during early summer. *J. Sci Food Agric., 91,* 1863–1870.

Kadi, S.A. (2012). Alimentation de lapin de chair : Valorisation de sources de fibres disponible en Algérie. *Thèse de doctorat, Université Mouloud Mammeri de Tizi-Ouzou (Algérie), 143 p.*

Kadi, S.A., Djellal F.,& Berchiche, M. (2013). The potential of rabbit meat marketing in Tizi-Ouzou area, Algeria. *Online J. Anim. Feed Res., 3(2),* 96-100.

Kadi, SA., Guermah, H., Bannelier, C., Berchiche, M., & Gidenne T. (2011). Nutritive value of sun-dried Sulla (*Hedysarum flexuosum*), and its effect on performance and carcass characteristics of the growingrabbit. *World Rabbit Sci*., *19,* 151-159.

Khanal, R.C & Subba D.B. (2001). Nutrional evaluation of leaves from major fodder trees cultivated in the hills Nepal. *Animal Feed Science and Technologie 92,* 17-32.

Kholif, A.E., Gouda, G.A., Morsy, T.A, Salem, A.Z.M., Lopez, S., & Kholif, A.M. (2015). Moringa oleifera leaf meal as a protein source in lactating goat's diets: Feed intake, digestibility, ruminal fermentation, milk yield and composition, and its fatty acids profile. *Small Ruminant Res., 129,* 129-137.

Kholif, A.E., Morsy, T.A., Gouda, G.A., Anele, U.Y., & Galyean, M.L. (2016). Effect of feeding diets with processed *Moringa oleifera* meal as protein source in lactating Anglo-Nubian goats. *Anim. Feed Sci. Technol., 217,* 45-55.

Lebas, F. (2004). Reflections on rabbit nutrition with a special emphasis on feed ingredients utilization. In: *Proc. 8 th World Rabbit Congress*, 2004 September, Puebla, Mexico, 686-736.

Maertens, L., Perez, J.M., Villamide, M., Cervera, C., Gidenne, T., & Xiccato, G. (2002). Nutritive value of raw materials for rabbits: EGRAN tables 2002. *World Rabbit Sci., 10:157-166.*

Nieves D., Basilia S., Teran O., Gonzalez C., Ly J. (2004). A note on the chemical composition and feeding characteristics of diets containing Leucaena leucocephala and Arachis pintoi for growing rabbits. *Livest. Res. Rural Develop.16*: Article #99.

Papachristou, T.G., & Platis P.D. (1999). Use of deciduous woody as a diet supplement for goats grazing Mediterranean shrublands during dry season. *Animal feed sciences and technology, 80(3-4)* pp. 267-279.

Pereira, E., Castro, M., & Castro J. (2008). The role of scattered Narrow-leafed ash of lameiro systems on livestock production in Northeast Portugal. *COST E42 "Growing Valuable Broadleaved Tree Species "(ValBro)*. https://bibliotecadigital.ipb.pt/handle/10198/5659.

Perez, J.M., Lebas, F., Gidenne, T., Maertens, L., Xiccato, G., Parigi-Bini, R., Dalle Zotte, A., Cossu, M.E., Carazzolo, A., Villamide, M.J., Carabaño, R., Fraga, M.J., Ramos, M.A., Cervera, C., Blas E., Fernàndez-Carmona, J., Falcao, E Cunha, L., & Bengala Freire, J. (1995). European reference method for in-vivo determination of diet digestibility in rabbits. *World Rabbit Sci., 3: 41-43.*

Pothin, A., Méda, B., & Fortun-Lamothe L. (2017). Alimentations humaine et animale : évaluer la compétition sur les ressources et l'espace. *Douzièmes Journées de la Recherche Avicole et Palmipèdes à Foie Gras, Tours, 05 et 06 avril 2017.*

Raharjo, Y. C., Cheeke, P. R., Patron, N.M., & Supriyati, K. (1986). Evaluation of tropical forages and by-product feeds for rabbit production. I. Nutrient digestibility and effect of heat treatment. *J. Appl. Rabbit. Res., 9,* 56-66.

Samkol, P., & Lukefahr, S.D. (2008). A challenging role of organic rabbit production towards poverty alleviation in South East Asia. *In Proc. 9th World Rabbit Congress, Verona, Italy, 10-13 June 2008,* p.1479-1497.

Tedonkeng Pamo, E., Tendonkeng, F., Boukila, B., Kana, J.R., Fonteh, F.A., & Nanda, A.S. (2007). Nutritive value of some grasses and leguminous tree leaves of the Central region of Africa. *Animal Feed Science and Technology, 135,* 273–282.

Tslouvaras, C., & Nastis A. (1990). Browse production and nutritive value of some fodder shrubs and trees in a semi-arid environment in Greece. *6th meeting FAO on Mediterranean pastures and fodder crops, October 17-19, Bari (Italy), p.*169-172.

Van Soest P.J., Robertson J.B., Lewis B.A. 1991. Methods for dietary fiber, neutral detergent fiber and no starch polysaccharides in relation to animal nutrition. *J. Dairy Sci., 74*, 3583-3597.

Villamide, M.J., Maertens, L., Cervera, C., Perez, J.M., & Xiccato, G. (2001). A critical approach of the calculation procedures to be used in digestibility determination of feed ingredients for rabbits. *World Rabbit Sci., 9,* 19-26.

Zerrouki, N., Hannachi R., Lebas, F., Berchiche, M. (2008). Poductivity of rabbit does of a white population in Algeria. *In Proc.: 9th World Rabbit Congress.*Verona, Italy.

Zeweil, H., Elnagar, S., Zahran, S., Ahmed, M., & El-Gindy, Y. (2013). Pomegranate peel as a natural antioxidant boosts bucks'fertility under Egyptian summer conditions. *World Rabbit Sci., 21: p.33-39.*

## Author Information

**Farid Djellal**
Université Ferhat ABBAS de Sétif-1
Département d'agronomie, FSNV, Université Ferhat Abbas-UFAS-1- UN1901, Sétif, Algeria
Contact e-mail : *fariddjellal@yahoo.com*

**Azeddine Mouhous**
Université Mouloud MAMMERI de Tizi-Ouzou
Faculté des Sciences Biologiques et des Sciences Agronomiques, Université M. MAMMERI, UN1501, Tizi-Ouzou, Algeria

**Hocine Guermah**
Université Mohammed Boudiaf de M'sila
Département d'agronomie, FSNV, Université Mohammed Boudiaf - UN2801, M'Sila, Algeria

**Si Ammar Kadi**
Université Mouloud MAMMERI de Tizi-Ouzou
Faculté des Sciences Biologiques et des Sciences Agronomiques, Université M. MAMMERI, UN1501, Tizi-Ouzou, Algeria

**To cite this article:**

Djellal, F., Mouhous, A., Guermah, H. & Kadi S.A. (2023). Determining nutritive value of dry ash leaves (*Fraxinus angustifolia*) harvested in fall via the regression method for growing rabbits. *The Eurasia Proceedings of Health, Environment and Life Sciences (EPHELS), 11,* 12-18.