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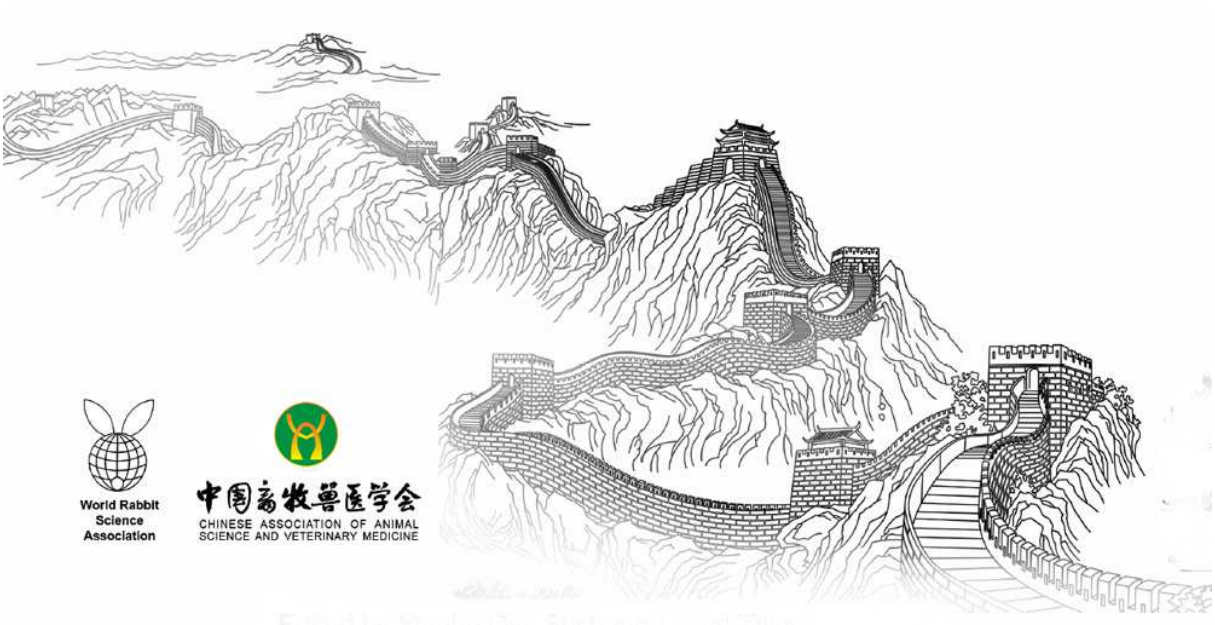

NUTRITIVE VALUE OF CRUDE OLIVE CAKE (*OLEA EUROPAEA* L.) FOR GROWING RABBIT

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ABSTRACT

The nutritive value of sun-dried crude olive cake (COC) for growing rabbit was studied by comparing 3 diets containing increasing incorporation level of COC (0, 10 and 20%) in substitution to basal diet. Three groups of 12 rabbits (individually caged) were fed *ad libitum* the three diets. The faecal digestibility of the diets was measured between 42 and 46 days of age. Chemical analyses were conducted at INRA Toulouse (UMR 1388 GenPhySe, France). The average chemical composition shows that COC is a fibre source since it contains (%DM) 70.7% of NDF, 53.0% of ADF and 24.2% of ADL. The substitution of 20% of basal diet by crude olive cake reduced the digestibility of organic matter, crude protein and NDF from 67.8 to 55.6%, 80.3 to 76.4%, 31.5 to 19.9% (P<0.001) respectively. The digestible energy (DE) content of the crude olive cake estimated by regression was 3.24±0.41MJ DE/kg DM, corresponding to an energy digestibility of 14%. Protein digestibility of crude olive cake was estimated at 43.6%, corresponding to a digestible crude protein concentration of 27.9±4.2 g DP/kg DM. Crude olive cake could be considered as a moderate source of nutrients for growing rabbit but a good fibre source.

Key words: Olive cake, nutritive value, digestibility, rabbit.

INTRODUCTION

The rabbit is an herbivore able to optimize fibrous raw material. Moreover, fibre intake is necessary to prevent digestive disorders for rabbit. Indeed, ADF contributions of 18% and contributions in ADL>5% are recommended (Gidenne, 2015). In Algeria, in order to comply with these recommendations, the imported dehydrated alfalfa is used as the primary source of fibre in feed formulation for rabbits, which makes it more expensive.

Olive cake (*Olea europaea* L.), a solid by-product of olive oil extraction composed of a mixture of skins, pulp, woody endocarps, seeds and which represents 35 % of the weight of olives pressed (Dal Bosco et al., 2007) is available locally in large quantities. The amounts used as a fuel are low and olive cake is usually deposited around the oil mills or thrown into rivers. According to Rupić et al. (1999), due to the long period required for its degradation, olive cakes present an environmental pollution source. Olive cake can be used in animal feed (Heuzé et al., 2014). However, it contains high amounts of crude fibre (220 to 350g / kg), which can limit its use in the chicken or pork, but may be beneficial in ruminant and rabbits (Rupić et al., 1999). Indeed, several studies (Fernandez-Caramona et al., 1996; Chaabane et al., 1997; Kadi et al., 2004; Carraro et al., 2005; Dal Bosco et al., 2010) report the use of olive cake in rabbit's diet. In those studies, the incorporation of this by-product in rabbit feed does not affect their health or performance. Furthermore, the olive cake is a potentially useful source of indigestible fibre in growing rabbits to prevent digestive problems by allowing a better balance between the different fibre fractions of the feed (Carraro et al., 2005).

There are 3 different types of olive cake according to the oil extraction method used: crude olive cake obtained from traditional oil mills which use hydraulic press system and the woven mats, the exhausted olive oil cake obtained after extracting oil from the crude olive cake, and the residue derived

from modern mills using a continuous string extraction process (Chaabane et al., 1997). There is very little data on the nutritional value of olive cake and application as feed for rabbits. The aim of this study is to determine the nutritive value of sun dried crude olive cake for growing rabbits.

MATERIALS AND METHODS

Animals and experimental design

36 rabbits of Algeria white local population were used to assess the nutritive value of crude olive cake. The trial was conducted during the month of May 2015, in a private rabbit breeding unit located in Tizi-Ouzou area (Algeria). Chemical analyses were conducted at INRA laboratories in Toulouse (UMR 1388 GenPhySe, France). The crude olive cake was provided by a traditional oil mill located in Tizi-Ouzou area and sun dried. A basal mixture that contained dehydrated alfalfa, soya bean meal, wheat bran and barley as main ingredients was formulated to fit the nutritional requirement of the growing rabbit according to the recommendations of De Blas and Mateos (2010).

Three experimental diets containing an increasing incorporation rate of crude olive cake were prepared by substituting the basal diet, without minerals and premix, with 0, 10 or 20% of crude olive cake (COC0, COC10 and COC20). Mineral and premix were added to all diets at fixed amount of 2%. The mixture was then pelleted. Dietary ingredients and chemical composition are shown in table 1.

Table 1. Ingredients and chemical composition of diets and of sun-dried crude olive cake (COC)

Ingredient %as fed	COC0	COC10	COC20	COC
Olive Cake	-	10.0	20.0	
Alfalfa	37.2	33.4	29.6	
Barley	8.8	7.9	7.0	
Soybean meal	9.8	8.8	7.8	
Wheat bran	42.1	37.8	33.5	
Premix	2.0	2.0	2.0	
Chemical composition, g/kg DM				
Dry matter	883	884	891	874
Crude ash	87	87	82	26
Crude protein (N×6.25)	191	182	166	64
Ether extract	-	-	-	82
Crude fibre	-	-	-	455
Neutral detergent fibre	337	373	414	707
Acid detergent fibre	173	202	236	530
Acid detergent lignin	44	60	80	242
Gross energy, Kcal/kg	4375	4428	4519	5335

Rabbits were weaned at 35 d of age (mean weight: 702±38g), allotted into three groups (12 per diet) according to weaning weight. They are placed in individual wire mesh cages. The cages were equipped with wire net under the floor to collect the hard faeces individually and totally. Each group received one of the experimental diets. Throughout the experimental period, the animals had free access to feed and water. After a 7 d adaptation period, faeces were collected from 42 to 46 d of age according to the European reference method described by Perez *et al.* (1995) and stored daily in polyethylene bags at –20ºC until chemical analysis. At the end of the experimental period, faeces excreted by each rabbit during the 4 d of collect are pooled, dried and stored for later chemical analysis.

Chemical Analyses

Chemical analyses were performed at INRA Toulouse (UMR 1388 GenPhySe, France). Humidity, crude ash, crude protein (N x 6.25, Dumas method, Leco apparatus), energy (adiabatic calorimeter Parr), crude and Van Soest fibre (NDF, ADF and ADL) were measured on diets, faeces (7 per group) and on the crude olive cake according to EGRAN harmonised procedures (EGRAN, 2001).

Statistical Analysis

Data were analysed as a completely randomised design with type of diet as the main source of variation by using the GLM procedure of SAS software (OnlineDoc®, SAS Inst., Cary, NC). Means comparisons were performed by Scheffe test. In addition, the effect of crude olive cake incorporation was analysed with the REG procedure from SAS. The nutritive value of crude olive cake was calculated according to the regression method described by Villamide *et al.* (2001).

RESULTS AND DISCUSSION

According to their chemical composition (Table 1), crude olive cake can be considered as a source of fibre due to its high fibre contents. Indeed, COC contain a low amounts of crude protein (6.4%) close to that reported by Kadi (2015): 4.2%, but low than the values reported by Fernandez –Caramona *et al.* (1996) and Chaabane *et al.* (1997) that were respectively 10% and 8.7%. COC contain a large amount of crude fibre (45%) that was similar to that reported by Chaabane et al. (1997): 48%, Heuzé et al. (2014): 38% and Kadi (2015): 52%, but higher than that reported by Fernandez –Caramona *et al.* 1996): 26%. The ADL value obtained is closed to the average value reported by Heuzé *et al.* (2014): 27%, but low than that reported by Kadi (2015): 32%. Moreover, the COC presents a high fat content (8.2%) close to the values reported by Fernandez–Caramona et al. (1996), Chaabane et al. (1997) and Heuzé et al. (2014). However, it was higher than that reported by Kadi (2015): 4.4%. For the ash content, the value of 2.6% obtained is low. The variation in the chemical composition of the crude olive cake can be explained by several factors such as the characteristics of the olive, the climate and the manufacturing process (De Blas *et al.*, 2015) and the oil extraction degree, year and geographical origin of the olive (Mioč *et al.*, 2007).

The increasing level of COC led to the significant ($P< 0.001$) decrease of the energy digestibility: from 66.6 (COC0) to 54.3 (COC20) (Table 2). Using the calculation procedure proposed by Villamide et al. (2001), the DE of the sun-dried crude olive cake reached a value of 3.24±0.41MJ DE/kg DM. The equation obtained by regression method to predict the digestible energy is: DE (MJ/kg) =-19.457COC (%) +2584.5; $R^2 = 0.99$ and COC= crude olive cake. The theoretical value of 3.24±0.41 MJ DE/kg DM is lower than the value of 7.1±0.72 MJ DE/kg DM measured on crude olive cake by Fernandez-Caramona *et al.* (1996).

Table2. Effect of COC dietary incorporation level on faecal digestibility and nutritive value of experimental diets in growing rabbits

	Experimental diets			SE	P
	COC0	COC10	COC20		
Digestibility coefficients (%)					
Dry matter$^{\mu}$	68.4^{a}	62.7^{b}	57.3^{c}	0.46	<.0001
Organic matter$^{\mu}$	67.8^{a}	61.4^{b}	55.6^{c}	0.51	<.0001
Energy$^{\mu}$	66.6^{a}	60.1^{b}	54.3^{c}	0.56	<.0001
Crude protein$^{\mu}$	80.3^{a}	78.2^{ab}	76.4^{b}	0.58	0.0008
Neutral detergent fibre	31.5^{a}	24.2^{b}	19.9^{b}	1.39	<.0001
Acid detergent fibre	22.4^{a}	13.0^{b}	10.2^{b}	2.05	<.0001
Dietary nutritive value					
DP (g/kg raw basis)	136 ^{a}	126^{ab}	113 ^{b}	0.94	0.0008
DE (MJ/kg raw basis)	10.77 ^{a}	9.85^{b}	9.15 ^{c}	0.09	<.0001

n=7, DP: digestible crude protein, DE: digestible energy, $^{\mu}$: significant linear effect ($P<0.05$) , Mean values in the same raw with a different superscript differ, $P<0.05$.

The digestibility coefficient for crude protein decreased from 80.3 (COC0) to 76.4 (COC20). The equation obtained by regression method to predict the digestible protein is DP (g/kg) = -1.1467COC (%) + 137.14; $R^2 = 0.99$. The predicted digestible protein concentration was 27.9±4.2 g DP/kg DM, which correspond to a crude protein digestibility of 43.6%. This value is much higher than the 9.7±4.3g DP/kg DM obtained by Fernandez-Caramona *et al.* (1996) for the same by-product by direct method. Moreover, crude protein digestibility obtained in our essay is close to the value of 49.3% obtained by De Blas *et al.* (2015) for crude olive cake partially destoned and using the *in-vitro*

method. This variability in nutritive value can be related as mentioned by Perez *et al.* (1995) to the methodology of measurements used.

CONCLUSIONS

The nutritive value of sun-dried crude olive cake *Olea europaea* L. was characterised by an energetic concentration of 3.24±0.41 MJ DE/kg DM and protein concentration of 27.9 ±4.2 g DP/kg DM. Therefore, crude olive cake could be considered as a moderate source of nutrients for growing rabbit but a good fibre source and a very interesting lignin source (71% of NDF, 53% of ADF and 24% of ADL). Further experiments are needed to determine the optimum inclusion rate of crude olive cake in growing rabbit diets without changes in performances or digestive health.

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Aim of the work

This work aimed to asses the nutritive value of sun-dried crude olive cake (*Olea europaea* l.) for growing rabbit .

Material and Methods

➢ The crude olive cake was provided by a traditional oil mill located in Tizi-Ouzou area (Algeria) and sun dried.

➢ Three experimental diets containing an increasing incorporation rate of crude olive cake were prepared by substituting the basal diet, without minerals and premix, with 0, 10 or 20% of crude olive cake (COC0, COC10 and COC20) and have been distributed to 36 rabbit of Algerian white local population divided on three groups of twelve.

➢ The digestible trial has been achieved following the European reference method described by Perez et al. (1995).

➢ The chemical analyses were performed on diets, faeces and crude olive cake according to EGRAN harmonised procedures (EGRAN, 2001).

➢ The nutritive value of crude olive cake was calculated according to the regression method described by Villamide et al. (2001).

Results

Chemical composition (g/kg DM) of sun-dried crude olive cake (COC)

DM	Crude ash	CP (N×6.25)	EE	CF	NDF	ADF	ADL	Grosse Energy (Kcal/kg)
874	26	64	82	455	707	530	242	5335

Effect of COC dietary incorporation level on faecal digestibility and nutritive value of experimental diets in growing rabbits

	Experimental diets			SE	P
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n=7, DP: digestible crude protein, DE: digestible energy, $^{\mu}$: significant linear effect (P<0.05) , Mean values in the same raw with a different superscript differ, P<0.05.

Conclusion

➢ The sun-dried crude olive cake *Olea europaea* L. was characterised by an energetic concentration of **3.24±0.41 MJ DE/kg DM** and protein concentration of **27.9 ±4.2 g DP/kg DM**.

➢ Crude olive cake could be considered as a moderate source of nutrients for growing rabbit but a **good fibre source** and a very interesting lignin source.