

## Meat production on savannah-like grasslands (*dehesas*) in semi-arid zones of the province of Salamanca

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### Abstract

Two savannah-like grassland systems (*dehesas*) in the province of Salamanca (Spain), developed on decomposing slate and granite soils and used for extensive meat production, were examined over a period of three years to determine the stocking rate they could support, their indices of pasture utilization, and the metabolisable energy necessary for meat production. The effective stocking rates were 0.36 and 0.30 cows ha<sup>-1</sup> year<sup>-1</sup> on the slate and granite systems respectively. The energy provided by supplementary feed was the 34% of the annual nutritional requirements of the herds, but reached more than 60% in the months of greatest need. Pasture utilization was 40% on the slate soil and 38% on the granite soil. The live weight obtained per reproductive cow was between 128 and 217 kg, equivalent to a weight per hectare of 57-90 kg year<sup>-1</sup>, of which 85% corresponded to calf production. The mean metabolisable energy required for producing one kilogram of meat (live weight) was 361 MJ on the slate soil and 369 MJ on the granite soil (range 215-499 MJ), depending on the year.

**Key words:** stocking rate, pasture utilization, energy-meat production ratio in savannah-like (*dehesa*) systems.

### Resumen

#### Producción de carne en sistemas adehesados en zonas semiáridas de la provincia de Salamanca

En dos sistemas adehesados ubicados en suelos de descomposición de pizarras y granitos, dedicados a producción de carne en extensivo, situados en la provincia de Salamanca, se estimó mediante un estudio de tres años de duración la carga ganadera que soportan, el índice de utilización del pasto y la energía metabolizable necesaria para la producción de carne. La carga ganadera real fue de 0,36 y 0,30 vacas ha<sup>-1</sup> año<sup>-1</sup> en pizarras y granitos, respectivamente. El aporte energético medio de la suplementación fue el 34% de las necesidades nutritivas anuales del rebaño, llegando a más del 60% en los meses más deficitarios; la utilización del pasto ofertado fue del 40 y 38%; por vaca reproductora se obtuvieron entre 128 y 217 kg de peso vivo, equivalente a un peso por hectárea entre 57 y 90 kg año<sup>-1</sup>, de los que el 85% corresponde a la producción de terneros. Para producir 1 kg de carne (peso vivo) fue necesario ofertar una cantidad media de energía metabolizable de 361 y 369 MJ en pizarras y granitos, respectivamente, con un rango entre 215 y 499 MJ. Estas oscilaciones dependen fundamentalmente del año y del sistema.

**Palabras clave:** carga ganadera, índice de utilización del pasto, relación producción-energía en sistemas de dehesa.

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### Introduction

In a previous paper (Martín Polo *et al.*, 2003), estimations were reported regarding the amounts of available energy and protein in two savannah-like systems (*dehesas*) – one developed on decomposing slate soil, the other on decomposing granite soil, both typical of stock raising land in the province of Salamanca, Spain. Semi-arid conditions, such as those reigning in this

part of the country, limit production. Feed supplementation periods therefore usually last longer than six months, although the greater part (80%) of the available feed is pasture. Prieto (1992) indicates that pasture utilisation is the main economic forte of the *dehesa*, and that pasture resources over the year condition stock raising production costs.

The extensive animal production systems of the Extremaduran *dehesas* (central southwestern Spain) support cattle stocking rates of 0.28 cows ha<sup>-1</sup>, and an estimated total stocking rate of 0.37 animals ha<sup>-1</sup> (Escribano *et al.*, 2001). In their structural characterisation of

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*dehesa* ecosystems in areas grazed by native *Avileña*, *Morucha* and *Retinta* cattle, Milán *et al.* (2001) estimated total stocking rates of  $0.5 \pm 0.1$ ,  $0.9 \pm 0.1$ , and  $0.4 \pm 0.0$  animals  $\text{ha}^{-1}$  of usable area (UA) respectively, 93%, 93% and 80% of which corresponded to cattle. Colson and Chatellier (1996) indicate the mean European stocking rate to be 1.45 cows  $\text{ha}^{-1}$ , with important differences between the northern and southern countries.

Holechek (1988) estimated stocking rate as a function of the forage produced and utilised, bearing in mind the ingestion of the animals involved, the slope, distance to water, and the effects of life on the open range.

The present work estimated the current, theoretical and effective stocking rates, pasture utilisation, and meat production per reproductive cow per hectare and year for two *dehesa* systems of the province of Salamanca, one developed on decomposing slate soil, the other on decomposing granite soil, taking into account the energy requirements and productivity of each.

## Material and Methods

### Animal production monitoring

The two *dehesa* systems (A = slate-derived soil, B = granite-derived soil) examined were used exclusively for the production of beef from native cattle (*Morucha* cow x *Charolais* bull crosses). Monthly stock censuses were taken, the weight of the «type» animal determined, and every two months the weight of 20 representative animals of the herd recorded. Since these animals are not easy to handle, visual weight estimations were made and the results contrasted with the true weights recorded for the eight most manageable adult cows.

The meat produced was considered to be the live weight of calves weaned at 6-7 months, the live weight of old animals, and that of stud bulls.

In 1989, no winter data were taken since work did not begin until the end of May. Data for the yearly census for this year were provided by the stock raiser.

### Estimation of herd energy needs

The maintenance ration of a typical cow (MRC) was considered to be that which covered the metabo-

lisable energy needs for the mean live weight of mother cows (MAFF, 1987). This was used as a unit of reference. The equivalents for herd animals, according to Bellido *et al.* (1986) are: 1.4 (i.e., 1.4 × maintenance ration of a mother cow) for lactating cows, 1.3 for cows in the last three months of gestation, 1.0 for non-pregnant cows (i.e., non-gestating or in the first six months of gestation), 1.5 × an activity factor (AF) of 1.15 for adult bulls, 1.25 × 1.15 AF for two year-old bulls, 0.9 for one year old cattle, 1.1 for two year-old females, and 0.9 for calves aged 4-7 months. Animal walking costs and the energy cost of life on the open range were taken into account, which amount to 30% of general maintenance needs according to Marchi (1978) but 20% on the Extremaduran *dehesas* according to Bellido *et al.* (1986). In this work, the figure of 20% was assumed because of the similarity between the *dehesas* of Extremadura and Salamanca. Since data on milk production in *Morucha* cows were lacking, those for Extremaduran *Retinta* cows living under similar conditions were used (1,130 kg over seven months of lactation) (Bellido, 1983).

### Determination of the stocking rate

Based on the work of Bellido *et al.* (1986), three types of stocking rate were considered:

— The current stocking rate (CSR): the result of dividing the total number of maintenance rations over one year required by the herd (MRCT) by the number of maintenance rations per year (i.e., 365) needed by the type animal (i.e., the MRC), and by the available pasture area (APA, ha), identified and estimated from aerial photographs:  $\text{CSR} = \text{MRCT} / (\text{MRC} \times 365 \times \text{APA})$ .

— The theoretical stocking rate (TSR): this depends on feed availability at times of maximum production (spring pasture, autumn pasture, and acorn harvest) and assumes that full use is made of all resources. The TSR is estimated by dividing the total amount of metabolisable energy provided by the system in the form of pasture and acorns (TME) by the metabolisable energy of one maintenance ration for a type animal (MERT), the number of maintenance rations per year (365), and the APA:  $\text{TSR} = \text{TME} / (\text{MERT} \times 365 \times \text{UA})$ .

— The effective stocking rate (ESR) is that which the pasture can truly support. To calculate this, the total energy needs of the herd ( $\text{MRCT} \times \text{MERT}$ ) are subtrac-

ted from 95% of the energy provided by supplementation (EPS) [there is a 5% loss according to Gaillard (1989)], and the difference divided by the MERT, 365, and the APA:  $ESR = (MRCT \times MERT - EPS \times 0.95) / (MERT \times 365 \times APA)$ .

The pasture utilisation index (PUI) is the relationship between the energy actually used by the cattle and that which is available:  $PUI = (MRCT \times MERT - EPS \times 0.95) / (TME \times 100)$  (expressed as a percentage).

## Results and Discussion

### Changes in energy needs

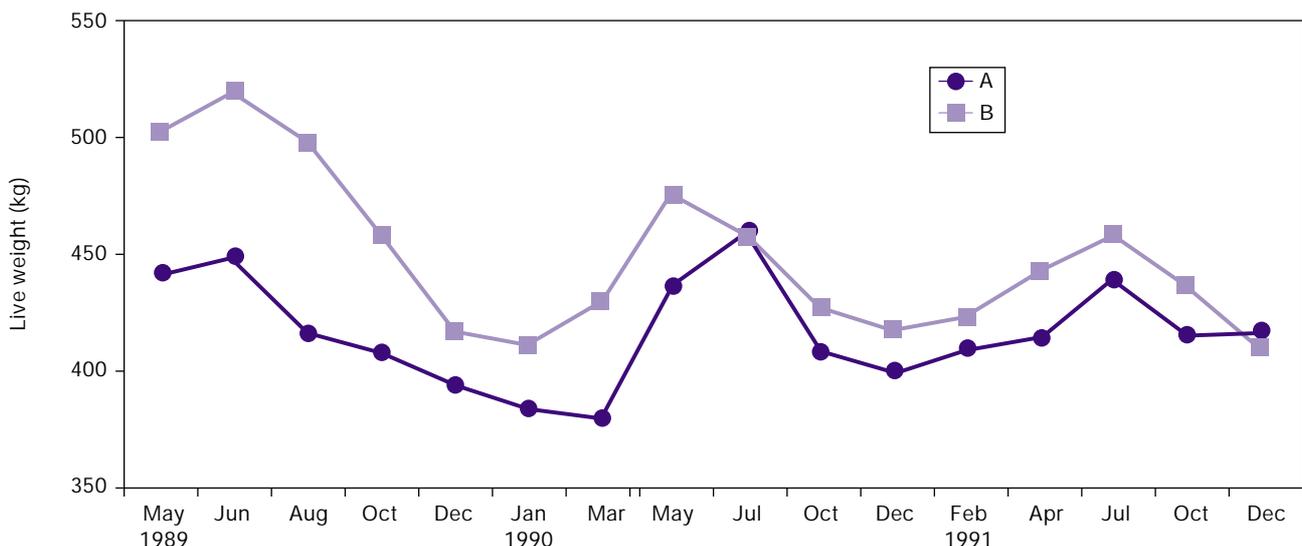
Figure 1 shows the changes in adult cow live weight. The coefficient of variation, which is always below 15%, is relatively low and quite acceptable for a field study. It also shows that the herds were homogeneous. The live weight of animals in system A showed a spring maximum when the available pasture was at its peak (mean of  $448 \pm 8.5$  kg), and a winter's end minimum ( $388 \pm 9.0$  kg). System B animals showed a similar trend ( $482 \pm 11.7$  kg in spring,  $409 \pm 2.3$  kg at the end of winter). Weight losses were therefore 13.2 and 15.2%, respectively. According to Agabriel and Petit (1986) total winter weight loss should not surpass 8-9% by the time the cattle can graze once more, since this would increase the interval between births and reduce the production of milk.

Table 1 shows the nutritional needs of the herd. For the whole years of 1990 and 1991, supplementation reached 33.0% and 34.6% of the needs of the system A herd, and 31.6% and 36.5% of the system B herd. At certain moments (October and November of 1989) it actually reached as much as 63.7% and 63.3% of the two herds' needs respectively. Bearing in mind that weather conditions during the study period were worse than normal, and that these annual values do not exceed 50%, the systems can be characterised as 'extensive'. Calvo *et al.* (1997), who studied sheep raising on the Extremaduran *dehesas*, reported supplementation to reach 13.3% of total flock needs. Campos *et al.* (1996) reported general supplementation needs of 34.3% for Salamanca, 23.1% for the Alentejo (Portugal), and 46.7% for Badajoz.

### Determination of the stocking rate

The census data of Table 2 were taken into account in order to express the total needs of the herds in terms of MRC.

The Table 2 shows that live weight remains practically constant over the study period in system A, but drops by 7.4% in system B. The mean number of calves born per reproductive cow was 0.77 in both systems, slightly greater than the 0.7 reported by Elena *et al.* (1986) for the Extremaduran *dehesa*. Table 2 shows the CSR, TSR and ESR and PUI values. CSR



**Figure 1.** Changes in mean live weight of the «type» animal (adult cow) over 1989, 1990 and 1991 in the slate-derived (A) and granite-derived (B) systems.

**Table 1.** Maintenance rations per mother cow (MRC) and totals for the herd (MRCT), stocking rates and pasture utilisation indices (PUI)

System	Year	APA	MERT	MRC	MRCT	CSR	TSR	ESR	PUI (%)
A	1989	489	12.82	534	141,358	0.54	—	—	—
	1990	489	13.08	501	136,136	0.56	0.96	0.37	38.5
	1991	489	13.20	541	142,756	0.54	0.84	0.35	41.7
B	1989	362	16.68	544	81,413	0.41	—	—	—
	1990	362	14.33	530	86,211	0.45	0.74	0.32	43.2
	1991	362	13.44	508	79,388	0.43	0.85	0.28	32.9

APA: area of pasture available (ha). MERT: metabolisable energy of one maintenance ration for a typical animal (MJ day<sup>-1</sup>). CSR: current stocking rate (cows ha<sup>-1</sup> year<sup>-1</sup>). TSR: theoretical stocking rate (cows ha<sup>-1</sup> year<sup>-1</sup>). ESR: effective stocking rate (cows ha<sup>-1</sup> year<sup>-1</sup>).

and ESR showed little variation over the study period, e.g., mean CSR values were  $0.55 \pm 0.02$  and  $0.43 \pm 0.01$  in systems A and B respectively, and mean ESR was  $0.36 \pm 0.01$  and  $0.30 \pm 0.02$  cows ha<sup>-1</sup> year<sup>-1</sup> respectively. These values are higher than the 0.25 and 0.13 obtained respectively by Elena *et al.* (1986) and Miguel *et al.* (1989) for the Extremaduran *dehesa*. Milan *et al.* (2001) report a mean stocking rate for the Salamanca *dehesa* of  $0.9 \pm 0.1$  cows ha<sup>-1</sup> and  $0.4 \pm 0.0$  for that of Extremadura.

Coates and Mannelje (1990) determined an ESR of 0.17 cows ha<sup>-1</sup> year<sup>-1</sup> for natural pasture in Australia, and up to 0.68 for a combination of natural and sown pastures. The stocking rates of the present study are therefore high for semi-arid *dehesa* systems, but below the maximum 1.4 cows ha<sup>-1</sup> demanded by the EU for extensification aid (BOE, 2000).

With respect to TSR, mean values of  $0.90 \pm 0.04$  and  $0.80 \pm 0.05$  cows ha<sup>-1</sup> year<sup>-1</sup> were obtained for systems A and B; system A would therefore appear to be more productive.

The two systems had more or less the same PUI: 40% for A and 38% for B, values recommended by

Holecheck (1988) for arid (rainfall approx. 400 mm year<sup>-1</sup>) areas. Winder *et al.* (2000), who studied arid areas (mean rainfall 235 mm year<sup>-1</sup>) stocked at 0.025 and 0.36 cows ha<sup>-1</sup> year<sup>-1</sup>, and with a dry matter production of 530-930 kg ha<sup>-1</sup> year<sup>-1</sup>, estimated pasture utilisations of 32% and 42% respectively. These values are high for the stocking rates but not so high with respect to production. For sheep grazing on the Extremaduran *dehesa*, Calvo *et al.* (1997) report a pasture utilisation of 61.7%. This figure is influenced by the stocking rate, supplementation, and the production of dry matter each year. It is also influenced by the natural degradation of pasture production, which, although it depends on the year, is more constant and beyond the control of the stock raiser. No data are available on this.

## Animal production

Table 3 shows that meat production per reproductive cow per ha and year tended to fall after 1989. In this kind of system, the weather conditions of one year

**Table 2.** Mean annual livestock census by system and year

System	Year	Mother	2 years old	1 year old	Bulls	2 years old	1 year old	LW	N	H
A	1989	226	28	19	3	3	4	402	0.80	0.12
	1990	243	19	15	2	3	4	408	0.65	0.30
	1991	236	15	15	2	5	4	412	0.87	0.11
B	1989	126	13	14	4	2	4	461	0.87	0.10
	1990	131	18	30	3	2	4	435	0.78	0.15
	1991	115	18	30	3	1	—	427	0.65	0.25

A: slate-derived system. B: granite-derived system. LW: live weight of «type» animal (adult cow) in kg. N: number of calves per reproductive cow. H: proportion of cows that did not give birth (expressed over 1).

**Table 3.** Meat production per reproductive cow, hectare and year, and MJ of metabolisable energy (ME)

Meat production (kg live weight)	System A			System B		
	1989	1990	1991	1989	1990	1991
Live weight calves	36,200	34,400	26,300	20,470	17,710	17,020
Weight of old animals	7,200	6,450	3,480	3,144	424	6,600
Live weight of bulls	750	1,600	550	—	2,600	1,400
kg calf/cow/year	160	142	111	162	135	148
kg meat/cow/year	195	175	128	187	158	217
kg meat ha <sup>-1</sup> (P+S)	90	87	68	65	57	69
ME (P+S)/kg meat	220	364	499	215	480	412

P + S: pasture and supplementation.

have an effect on events in the next. This is mainly manifested in the number of calves born, which significantly affects total meat production. Some 82% and 87% of meat production in systems A and B respectively corresponded to calf production (although in system B in 1991 this figure fell to 69% as a consequence of an abnormally large number of old animals at the same time as meat production rose with respect to 1990).

Mean values of 138 and 148 kg calf per cow and year were obtained in systems A and B respectively, giving a total production per reproductive cow of 166 and 187 kg respectively, and a mean production per ha of 82 and 64 kg (live weight) respectively [large and significant variations ( $P > 0.05$ ) were seen between years].

Herbel *et al.* (1984) reported 142 kg of calf per reproductive cow per year as a low figure for arid areas of New Mexico. In the same area, Winder *et al.* (2000), with very low stocking rates of 0.025 and 0.036 cows ha<sup>-1</sup>, obtained 178 and 135 kg calf per reproductive cow respectively.

Guimaraes *et al.* (1999) obtained a calf production per ha and year of 25.5 kg, and 109.5 kg cow<sup>-1</sup> year<sup>-1</sup>, when weaning was at 205 days.

The metabolisable energy that must be supplied (as pasture, acorn and supplements) to produce 1 kg of meat (live weight) varies between 220 and 449 MJ in system A and from 215 to 480 MJ in system B. The differences ( $P < 0.05$ ) between years are influenced by the one year phase shift between pasture production and meat production, i.e., in a year of high production there will be more matings and more calves the following year. Calf meat makes up some 85% of total meat production in these systems. In an assay with calves produced by different crosses that received different food rations, Meissner *et*

*al.* (1995) showed it was necessary to offer between 56.0 and 67.9 MJ to increase body weight by 1 kg. In Cantabrian pastures (northern Spain) during the pasture period of March to June, Zea and Diaz (1996) found it was necessary to supply between 87.4 and 98.9 MJ to increase calf weight by 1 kg, depending on pasture availability. Using different forages, McDonald *et al.* (1986), Dumont *et al.* (1989) and Steen (1990) required between 82 and 92 MJ to increase calf weight by 1 kg during fattening. No references on the transformation of metabolisable energy into meat were found for systems similar to those of the present work.

In this study, over 4 or even 5 times more energy was required to produce 1 kg of meat than the other systems mentioned above. This might be explained by the following: a) open range grazing in extensive systems increases maintenance requirements by some 20–30% (Marchi, 1978; Bellido *et al.*, 1986); b) since the spring pasture cannot all be utilised at its optimum moment it loses quality due to adverse environmental conditions and trampling; c) there are losses of around 5% in supplementation (Gaillard, 1989); d) some of the available feed is consumed by wild animals; e) in the management of these exploitations a number of unproductive animals have to be maintained every year, such as non-pregnant cows, young animals for eventual breeding, and stud bulls.

As conclusions:

— The mean supplementation requirement was 34% of the needs of the herd in both systems. Despite the adverse conditions of the study period, this figure characterises the systems as extensive.

— The stocking rates supported are high for the type of pasture and the semi-arid nature of the area.

— The PUI for system A (slate-derived soils) was 40%, while that of system B (granite-derived soil) was 38%.

— A calf live weight per reproductive cow of 111-162 kg was achieved, as well as a total live weight of 128-217 kg, corresponding to a production per ha and year of 57-90 kg. Some 85% of total meat production was obtained as calves.

— The mean energy necessary to produce 1 kg of meat (live weight) was 361MJ and 369 MJ for systems A and B respectively.

## References

- AGABRIEL J., PETIT M., 1986. Peut-on sous alimenter les vaches allaitantes en hiver? Forrages: utilisation, forum Fourrage Auvergne, Ed. INRA. Ceyrat, France pp. 333-338.
- BELLIDO M.M., 1983. Influencia de ciertos factores ambientales sobre la producción de ganado vacuno retinto en la dehesa. Doctoral thesis. Univ Politécnica, Madrid.
- BELLIDO M.M., ESPEJO D.M., PLAZA G.J., LÓPEZ C.T., 1986. Metodología para la determinación de la carga ganadera de pastos extensivos: MAPA. S.I.A. de la Junta de Extremadura, Badajoz, Spain, pp. 1-37.
- BOE (Boletín Oficial del Estado), 2000. Royal Decree 3477/2000, 29<sup>th</sup> December. Ministerio de Agricultura, Pesca y Alimentación. Madrid, Spain.
- CALVO C.J.C., CALVO C.G., VARGAS G.J., APARICIO T.M.A., 1997. Gestión de los recursos de pastoreo y de la suplementación en sistemas adeshados. Proc. of the XXXVII Reunión Científica de S.E.E.P. Sevilla, May, pp 427-432.
- CAMPOS P., APARICIO M.A., CALVO J.C., ESCRIBANO M., PRIETO A., PULIDO F., VARGAS J.D., COHELO I., 1996. Informe científico final del proyecto de investigación «Análisis técnico y económico de los sistemas de dehesas y montados», 1991-1994 (Unión Europea DG VI CT 90-0028). Dirección General de Agricultura. Spain.
- COATES D.B., MANNETJE L.T., 1990. Productivity of cows and calves on native and improved pasture in subcoastal, subtropical Queensland. *Trop Grasslands* 24, 46-54.
- COLSON F., CHATELLIER V., 1996. Les exploitations bovines françaises sont parmi les plus extensives de la Union Européenne. *INRA. Productions Animals* 9(4), 273-284.
- DE MIGUEL J.R., RODRÍGUEZ M.A., GÓMEZ SAL A., 1989. Selección de habitat y distribución territorial de un grupo de vacas en ambiente de dehesa. *Options Méditerranéens-Serie Séminaires* 3, 208-303
- DUMONT L.J.C., LANUZA A.F., ELIZALDE V. H. F., RE-NE A.S., FERRADA N.S., 1989. Utilización de ensilaje de avena cosechada en dos estados fenológicos y respuesta a la suplementación proteica, en vaquillas de lechería. *Agricultura Técnica (Chile)* 49(1), 31-35.
- ELENA R.M., CORNUT E., LÓPEZ MÁRQUEZ J.A., 1986. Estructura del sistema productivo del ecosistema de Dehesa. Encuesta de Extremadura 1980-81. Descripción y análisis mediante el método de ACP. Ed. S.I.A. de Extremadura, Badajoz, Spain, pp. 1-184.
- ESCRIBANO M., RODRÍGUEZ A., MESÍAS F.J., ANARTE J.M., PULIDO. 2001. Relación entre tamaño de la explotación y niveles de cargas ganaderas en sistemas extensivos de producción animal de dehesas. IX Jornadas sobre Producción Animal. ITEA Vol. Extra 22(2), 412-414.
- GAILLARD B., 1989. Forage production in two areas of France. Legumes in farming systems (P. Plancquaert, R. Hagger, eds.). Service Systemes Institut Technique des Cereals et des Fourrages, Varades, France, pp. 105-111.
- GUIMARAES FILHO C.G., SOARES J.G.G., 1999. A physycal model evaluation of a coating buffel grass/leucanea integrated system for cattle production in the semi-arid region. I.-Cowcalf operation. *Pesqui Agropecu Bras* 34(9), 1721-1722.
- HERBEL C.H., WALLACE J.D., FINKNER M.D., ARBROUGH C.C., 1984. Early weaning and part-year confinement of cattle on arid rangeland of the south west. *J Range Manage* 37, 127-130.
- HOLECHECK J.L., 1988. An approach for setting the stocking rate. *Rangelands* 10(1), 10-14.
- MAFF (Ministry of Agriculture Fisheries and Food), 1987. Energy allowances and feeding systems for ruminants. HMSO. London, UK, 85 pp.
- MARCHI A., 1978. El bovino, su adaptación y posibilidades de producción en la región árida central de la República Argentina. *IDIA* 367-372, 116-158. 1991.
- MARTÍN POLO J.L., GARCÍA BELLIDO G.I., SÁNCHEZ RODRÍGUEZ M.E., 2003. Plant production and nutritive quality of savannah-like grassland (dehesas) in semi-arid zones of the province of Salamanca. *Span J Agric Res* 1(4), 41-49.
- McDONALD P., EDWARDS R.A., GREENHALGH J.F.D., 1986. *Nutrición Animal*. Ed. Acribia. Zaragoza, Spain. pp. 300 and 477.
- MEISSNER H.H., SMUTS M., COERTZE R.J., 1995. Characteristics and efficiency of fast growing feedlot steers fed different dietary energy concentrations. *J Anim Sci* 73, 931-936
- MILAN M.J., BARTOLOMÉ J., QUINTANILLA R., GARCÍA-CACHAN M.D., ESPEJO M., HERRAIZ P.L., SÁNCHEZ-RECIO J.M., PIEDRAFITA J., 2001. Caracterización estructural de explotaciones bovinas situadas en ecosistemas de dehesas. IX Jornadas sobre producción animal. ITEA Vol. Extra 22(2), 415-417.
- PRIETO A., 1992. Producción y gestión sustentable de sistemas agrarios adeshados del Centro-Oeste de España. Proc. of the IV Congreso Nacional de Economía,

- Desarrollo Económico y Medio Ambiente. Sevilla, 9-11th December, Ed. Aranzadi, pp. 190-195.
- STEEN R.W.J., 1990. Factors affecting the optimum level and protein content of concentrates for finishing beef cattle. Agricultural Research Institute of Northern Ireland. pp. 129-139.
- WINDER J.A., CALVIN C.B., MILTON T., HOLECHECK J., 2000. Breed and stocking rate effects on Chihuahuan desert cattle production. *J Range Manage* 53, 32-38
- ZEA S.J., DÍAZ D.D., 1996. Utilización de pastos y ensilados en la producción de carne de vacuno. *Pastos XXVI* (2), 129-173.