DIGESTIBLE VALUE OF TWO RABBIT FEEDSTUFFS IN TWO CLIMATIC ENVIRONMENTS

Alagón G.[1], Arce O.N.[2], Martínez-Paredes E.[3],Ródenas L.[3], Pascual J.J.[3], Cervera C.[3]

[1]Facultad de Agronomía y Zootecnia, Universidad Nacional de San Antonio Abad del Cusco. Perú.
[2]Facultad de Ciencias Agrarias y Veterinarias, Universidad Técnica de Oruro. Bolivia.
[3]Instituto de Ciencia y Tecnología Animal, UniversitatPolitècnica de València, Camino de Vera, 14, Valencia 46071, Spain.
[*]Corresponding author:jupascu@dca.upv.es

ABSTRACT

A digestibility trial was performed with 72 rabbits 35 days old in order to determine the digestible energy (DE) and digestible protein (DP)content of dried distillers grains with solubles (DDGS) and beet pulp, using the substitution methodology and calculation procedures. Half of rabbits were housed in a conventional farm (CF) with temperatures ranged from 18 to 20 ºC and half in a climatic chamber (CC) set up to perform a daily sigmoid curve with a temperature ranging from 25 to 36ºC. Animals submitted to heat challenge showed significantly lower daily feed intake(–20%) and increased apparent digestible coefficients for main nutrients increased (from 2 to 7 points of percentage) in comparison to those kept in normal conditions, and independently of the diet. As heat stress had a similar effect on the different diets, digestible values for the feedstuffs calculated by substitution were less affected by the climatic environment, being the DE values of 11.6 and 11.7 MJ/kg of dry matter (DM) for DDGS and 15.0 and 14.2 MJ/kg DM for beet pulp at the CC and CF housing, respectively. The DP values obtained for the DDGS were 177 and 165 g/kg DM at the CC and CF housing, and 67 and 45 g/kg DM for beet pulp. Only the DP value of beet pulp significantly increased in heat stress conditions (+49%; $P<0.05$) due to the low crude protein content of this feedstuff, butit should have lowrelevanceat feed formulation level.

Keywords: Rabbit, digestibility, heat stress, DDGS, beet pulp

INTRODUCTION

Ambient temperature isone of the variables that affect most nutrition, because directly influence the energy equilibrium of the animal, changing the flow of heat between animal and environment (Cervera and Fernández-Carmona, 2010).Depression in feed intake and the increase in water consumption are the most important reactions to heat exposure. At 30ºC rabbits consume only 60-70% of that recorded at 20ºC, and at 35ºC daily feed intake (DFI) decreased by 28-17%. On the contrary the water requirements increase by 50% as temperature rose from 18 to 38ºC.

Although noeverybody agree, it is generally accepted that a reduction in intake occurs at 25°C, and perhaps above 22°C (Casamassima *et al*., 1988; Fernández Carmona *et al*., 1994a), and certainly impaired growth is assured around 30°C. Ogunjimi *et al.* (2008) showed that there is high correlation between both rabbit weight gain or feed efficiency and thermal comfort level of the habitat.

A reduction of 25% in feed intake, comparable with the percentage observed in hot climates, should be balanced by about the same increment on dietary nutrients content. However, in order to formulate these diets, the digestible values of feedstuffs in these environmental conditions are needed. There is little information about whether climate could affect digestible energy (DE) value of feedstuffs, in addition to its influence on composition. Sanz*et al.* (1973) reported that increasing the temperature to 34°C adversely affected the coefficient of digestibility of a restricted-fed and balanced diet, but other studies (Kasa*et al*., 1989) have failed to detect any significant change.
The present work attends to evaluate the evolution of DE and digestible protein (DP) values of two common feedstuffs under both thermoneutral zone and heat stress conditions.

MATERIALS AND METHODS

A control diet (C) for growing rabbits were formulated according to recommendations of de Blas and Mateos (2010), and 20% of this diet were replaced by dried distillers grains with solubles (DDGS) or beet pulp (DD and BP diets, respectively).

A digestibility trial were performed with 72 rabbits 35 days old (24 rabbit/diet) following the EGRAN guidelines (Perez *et al.*, 1995) in order to obtain the DE and DP values for growing rabbits of DDGS and beet pulp, two feedstuffs with high fibrous contents and medium and low protein content, respectively, using the substitution methodology and calculation procedures (Villamide *et al.*, 2001). Half of rabbits were housed in a conventional farm (CF) with temperatures ranging from 18 to 20 ºC, and half in a climatic chamber (CC) set up to perform a daily sigmoid curve with a temperature ranging from 25 to 36ºC (see description at García-Diego *et al.*, 2011).

The chemical analyses of dry matter (DM), crude protein (CP), ash, acid detergent fiber (ADF) and lignin (ADL) followed the AOAC metodhs (934.01, 976.05, 942.05 and 973.18, respectively; AOAC, 2000). Neutral detergent fibre (NDF) was analysed by the method described by Mertens (2002), and the gross energy (GE) was determined in adiabatic bomb as recommended by EGRAN (2001).

Data of the apparent digestible coefficients (d) of DM, organic matter (OM), CP, GE, NDF and ADF, as well as the DFI and DP and DE values of DDGS and beet pulp were analyzed using the GLM procedure of SAS software (SAS Institute, 2009),in a model including as fixed effects the feedstuff (DDGS and BP), the housing (CF and CC) and their interaction.

RESULTS AND DISCUSSION

Table 1 summarizes the apparent digestible coefficients for main nutrients, DFI during the digestibility trail as well as the DP and DE values obtained for both feedstuffs.

The environmental conditions affected all the apparent digestibility coefficients. Animals submitted to the heat challenge showed a significantly lower DFI with every diets (on av. –20%; P<0.0001), while their main apparent digestible coefficients increased (from 2 to 7 points of percentage; P<0.05) in comparison to those obtained for animals kept under normal conditions.

Table 1. Daily intake of feed (DFI), apparent digestible coefficients of dry matter (DMd), crude protein (CPd), gross energy (GEd), neutral detergent fibre (NDFd),acid detergent fibre (ADFd), hemicellulose[1] and cellulose[2]of diets (C,DD and BP),as well as digestible protein (DP) and digestible energy (DE) values of feedstuffs (DDGS and beet pulp).

	Climatic chamber			*Conventional farm*				P value
Variable	C	DD	BP	C	DD	BP	SE	Housing
DFI (g DM/d)	107	106	96	137	139	120	5.81	0.0001
DMd (%)	60.9	59.7	65.1	57.9	58.0	61.6	0.62	0.0001
CPd (%)	74.9	74.0	75.8	71.0	69.7	68.9	1.03	0.0001
GEd (%)	60.5	60.2	64.9	57.6	58.0	61.6	0.63	0.0001
NDFd (%)	27.1	26.9	34.6	24.0	25.8	31.2	1.02	0.004
ADFd (%)	11.1	13.3	23.1	9.2	12.9	18.7	1.20	0.024
Hemicellulose (%)	44.7	40.5	48.4	40.4	38.8	46.3	1.30	0.014
Cellulose (%)	15.0	17.6	28.4	13.7	17.9	24.8	1.29	0.159
	DDGS	*Beet pulp*		*DDGS*	*Beet pulp*			
DP (g/kg DM)	177	67		165	45		7.80	0.031
DE (MJ/kg DM)	11.6	15.0		11.7	14.2		0.64	0.588

[1] Hemicellulose as NDF-ADF; [2] Cellulose as ADF-ADL.

As recently reviewed by Cervera and Fernandez-Carmona (2010), high temperatures usually depress the DFI of rabbits and consequently increase the apparent digestible coefficients of main nutrients. A

decrease in the amount of feed eaten normally leads to a slower rate of passage, being the digesta exposed to the action of digestive enzymes for a larger period, increasing digestibility of nutrients. Heat challenge done in the present work lead rabbits to reduce 20% of their voluntary feed intake, being highly affected the digestibility of the main nutrients (between 2 to 5 points of percentage).
The digestibility coefficient for the cellulose seems to be apparently unaffected by the environmental temperature both in C and DD diets, but increased 3 point of percentage in BP diets. This discordant response is difficult to be explained from our results. In any case, Gidenne *et al.* (2002) described how fibrolitic activity of rabbit caecum bacteria was not affected by intake reduction, suggesting that digestibility of some cell-wall constituents could be not substrate-dependent.

Heat stress had a similar effect on all diets, and then the digestible values of feedstuff calculated by substitution were less affected by the climatic environment. Only the DP value of beet pulp increased significantly in heat stress conditions (+49%), but it seem to be due to the low crude protein content of this feedstuff and it will have a low repercussion in diet formulation.

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