DRIED CHICORY PULP AS FIBRE SOURCE IN FATTENING RABBIT DIETS

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ABSTRACT

One-hundred-ninety-two hybrid weanlings of 32 days were fed one of 4 iso-energetic (9.65 MJ/kg) and iso-nitrogeneous (16.4% CP) diets: a low dietary digestible fibre content (Control diet), a high digestible fibre diet (Beet pulp diet) and 2 diets with chicory pulp (CP). Chicory pulp was introduced (10 and 20%) in the fattening diet mainly at the expense of beet pulp, as an alternative source of soluble fibre. Each dietary treatment consisted of 12 replicates of 4 rabbits. Weight gain was high (average of 54g/day) and comparable for the CP diets, control and the beet pulp diet. However, feed conversion ratio was improved with the diet containing 20% chicory pulp compared to the control diet. Mortality was low and not influenced by the dietary treatment. It is concluded that chicory pulp is a good alternative digestible fibre source in balanced diets for rabbits and can be used at least till 20%.

Key words: rabbit, chicory pulp, digestible fiber, dietary inclusion.

INTRODUCTION

It is already long-time known that fibre supply plays a major role in the prevention of digestive troubles (Lebas, 1980). However, due to better analytical methods to estimate fibre fractions and intensive research, the role of the different fractions is now much better defined (Gidenne, 2003; Gidenne *et al.* 2010).

The low digested fibres (lignin and cellulose) play a key role in the digesta retention time (Gidenne and Perez, 1994) while the more digestible fibres (hemicellulose and pectins) enhance caecal microbial activity and increase the caecal acidity (Garcia *et al*., 2002; Gidenne *et al.*, 2004). Recently, it has been shown that the role of type of fibre could also be related to its solubilization and a good balance between insoluble fibre and soluble fibre favours intestinal health (Nicodemus *et al.*, 2006; Gómez-Conde *et al*., 2007; Gómez-Conde *et al*., 2009).

In rabbit diets, main used sources of digestible or soluble fibres are beet pulp, apple or citrus pulp. An alternative source could be chicory pulp known for its high content of inulin and pectin (minimum 7% and 27%, respectively, Socode 2011). Chicory pulp is the dried and ground product obtained after partial extraction of inulin by diffusion of the chicory root shreds. Chicory pulp contains on average 87% DM, 8.8% CP, 32.0% NDF, 24.0% ADF and 2.0% ADL (Socode, 2011).

The aim of our work was to evaluate the effect of increasing levels of chicory pulp as source of digestible or soluble fibre in fattening rabbit diets and its effect on slaughter yield. Chicory pulp was introduced iso-energetic and iso-nitrogeneous in the diet at the expense of beet pulp and compared with a diet with a low level of digestible fibre. Only the first results of this study with chicory pulp will be reported.

MATERIALS AND METHODS

Animals and experimental design

The trial was executed in the autumn of 2009 during the stay of H. Guermah at the Institute for Agricultural and Fisheries Research in Melle (Belgium).

Four isoenergetic and isonitrogeneous diets were formulated using the EGRAN tables (Maertens *et al.*, 2002). However, a value of 11.3 MJ digestible energy was assumed for beet pulp based on a recent work of Gidenne *et al.* (2007). The energy value of chicory pulp was estimated to be in the same range as beet pulp. Diets were formulated to have an energy content of 9.65 MJ/kg and a crude protein content of 15.70%. The composition of the feed is presented in Table 1. No growth promoter was added to the experimental diets.

As negative control diet (NC), a diet with quite low digestible fibre content (16.4%) was used without beet or chicory pulp. The positive control diet (PC) contained 13.5% beet pulp in order to obtain a 30% higher digestible fibre content. Chicory pulp was introduced at 10% (CP10) and 20 % (CP20), mainly replacing beet pulp. In this way a diet with intermediary digestible fibre (18.7%) and a diet with the same digestible fibre as the PC diet were obtained. All diets were prepared and pelleted (3 mm diameter and 0.8 cm long) at the ILVO-Animal Science feed mill. They were fed always *ad libitum* throughout the 5 weeks experimental period.

Two hundred Hycole hybrid weanlings of 28-29 days were purchased from a commercial French rabbitry. They were obtained from the cross between the female parent line and the XXL male line of Hycole. After an adaptation period of 4 days at the Institute, during which they were fed *ad libitum* a standard weaning diet, 192 rabbits were selected for the trial.

Table 1: Dietary composition of experimental diets

Ingredients	NC	PC	CP10	CP20
Wheat shorts	27.10	25.10	25.10	25.10
Alfalafa meal 17	32.30	29.00	28.00	24.00
Wheat	15.40	6.00	10.00	3.00
Palm cake	4.00	4.00	4.00	3.50
Sunflower meal 27	8.00	10.00	10.00	12.00
Beet pulp	0.00	13.50	0.00	0.00
Chicory pulp	0.00	0.00	10.00	20.00
Flax chaff	7.25	6.50	6.90	6.40
Cane molasses	3.00	3.00	3.00	3.00
$CaCO_3$	0.10	0.10	0.10	0.10
NaCl	0.10	0.10	0.10	0.10
Vit. + min. mix	2.50	2.50	2.50	2.50
Methionine	0.095	0.090	0.120	0.120
Lysine	0.190	0.150	0.185	0.170

Experimental rabbits of 32 days were housed per 4 in wire flat-deck cages measuring 45 cm x 70 cm and with a height of 50 cm. Each cage was equipped with a feeder (2 feeding-places) and a nipple drinker. Rabbits were uniquely identified with ear tags and randomised taking into account their weight in order to have approximately the same start weight/cage. Rabbits weight gain and feed consumption were determined on a weekly basis per cage during 5 weeks. At 70 days of age, 10 rabbits per diet were randomly selected and slaughtered following standardized procedures (Blasco and Ouhayoun, 1996).

The trial site was equipped with dynamic (over-under pressure) ventilation with 2 air inlets at the door side of each compartment and air extraction at the other side of the room. Throughout the experiment temperature varied between 14 and 20°C and 10h of light was provided by electric bulbs.

Chemical Analyses

Chemical analyses were performed at ILVO Institute on diets and chicory pulp according to the recommendations of EGRAN (2001): DM, Ash, CP (N×6.25) Kjeldahl, gross energy with an adiabatic bomb calorimeter, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) using the Van Soest sequential method.

Statistical Analysis

The data were analysed using a general linear 1-way analysis of variance (ANOVA) (Statistica 9.0, 2010). An LSD multiple range test was used to separate means that were statistically different. The significance level was fixed at 5 %.

RESULTS AND DISCUSSION

The dietary composition fitted well with the intended nutrient composition (Table 2).

Diets had the same protein content (+/- 15.5%), amino acid and quite the same NDF content.

Daily weight gain (DWG) is presented in Table 3. Overall DWG did not differ between dietary treatments but was very high (on average 54 g/day) and after 5 weeks fattening or at 67 days rabbits reached already a weight of 2.7 kg.

Table 2: Nutrient composition of experimental diets (g/100g)

	NC	PC	CP10	CP20
Digestible fibre*	16.4	21.2	18.7	21.0
Crude protein	15.5	15.6	15.3	15.4
EE	3.3	3.0	3.2	3.3
Lysine [1]	0.75	0.74	0.75	0.75
Meth. + Cystine[1]	0.59	0.59	0.60	0.59
Crude fibre	16.7	17.7	17.1	17.5
NDF	34.9	34.2	33.7	33.9
ADF	18.8	20.2	19.8	21.3
ADL	4.4	4.2	4.2	3.8
DE (MJ/kg) [1]	9.60	9.65	9.65	9.65

* Digestible fibre = hemicellulose + water insoluble pectins (Gidenne, 2003)
[1] Calculated values: Maertens *et al.* (2002)

Therefore the trial was ceased 1 week earlier than intended. However, in the first weeks, weanlings on the diet with 20% chicory pulp had a significant ($P<0.05$) higher DWG compared to the control diet. In the following weeks this trend was less clear but rabbits on the 20% CP diet had the highest DWG and by consequence the highest final weight.

Table 3: Daily weight gain (DWG) during the different periods

	NC	PC=BP	CP10	CP20	SEM	P
Initial weight, 32d, g	835	828	844	834	6.5	0.751
Final weight, 67d, g	2698	2717	2752	2742	14.8	0.573
DWG weeks 1 &2, g	58.7^{b}	60.6^{ab}	60.3^{ab}	63.0^{a}	0.5	**0.038**
DWG weeks 3 & 4, g	52.0	50.7	53.5	49.9	0.6	0.167
DWG week 5, g	43.5	45.9	43.2	49.7	0.8	0.226
DWG total period	53.0	53.7	54.2	55.1	0.3	0.289

Dietary effects on feed intake were always very limited (Table 4). For the overall period daily feed intake was between 155.4 g (beet pulp diet) and 157.8 g (control diet). Feed conversion ratio was, however, most favourable when fed the CP 20 diet and significantly ($P<0.05$) improved compared to the control diet. This effect was clear during the first weeks and to a lesser extent also during the 5th

week. Diets with also a high content of digestible fibre (BP and CP 10) had intermediary feed conversion ratios. This indicates that actual table values underestimate the energy value of soluble fibre sources especially those with a high content of pectins (CP 20 diet).

Table 4: Daily feed intake (DFI) during the different periods

	NC	PC=BP	CP10	CP20	SEM	P
DFI weeks 1 &2, g	124	125	127	126	1.1	0.712
DFI weeks 3 & 4, g	177	172	175	173	1.4	0.594
DFI week 5, g	188	184	182	192	1.9	0.569
DFI total period, g	157.8	155.4	157.6	157.6	1.0	0.808

The improved feed conversion ratio (Table 5) with increased levels of digestible fibre are in line with the results obtained by Trocino *et al.* (2010) and Gómez-Conde *et al*. (2009). These last authors found also no effect on DWG but a linear improvement of the FCR with increasing levels of soluble fibre. Data of the soluble fibre content of the experimental diets will be published elsewhere.

Differences between treatments in slaughter yield were small and not significant (results not presented).

Table 5: Feed conversion ratio (FCR) during the different periods

	NC	PC=BP	CP10	CP20	SEM	P
FCR weeks 1 &2	2.11^{b}	2.06^{ab}	2.12^{b}	2.01^{a}	0.02	**0.027**
FCR weeks 3 & 4	3.40	3.39	3.29	3.48	0.01	0.142
FCR week 5	4.40	4.04	4.29	3.85	0.07	0.125
FCR total period	2.98^{b}	2.89^{a}	2.91^{ab}	2.87^{a}	0.01	**0.049**

Mortality was limited (2/48 in the CP 10 and 3/48 in the other treatment) and a positive effect of an increased level of digestible fibre could not be confirmed. Moreover, the autopsies of the died rabbits revealed as main cause pasteurellosis and not intestinal troubles.

CONCLUSION

Chicory pulp can be considered as an alternative digestible fibre source. In a balanced diet, it can be used at least till 20%. A slight positive effect on the feed conversion ratio was obtained, indicating at least an energy value comparable with beet pulp may be assumed.

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