METABOLIZABLE ENERGY CONTENT AND PROTEIN DIGESTIBILITY OF RAPESEED HULLS IN ADULT COCKERELS

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INTRODUCTION

Rapeseed, from *Brassica napus L*, is the most important oilseed crop in France. The production reached more than two millions metric tons in 1990. Nevertheless the use of rapeseed meal is still limited in poultry fed. Two main reasons are responsible for : its glucosinolates content and its low metabolizable energy (ME) value. Glucosinolates or their metabolic derivatives decrease the growth rates of broilers and increase the thyroids and liver sizes (Fenwick and Curtis 1980 ; Fenwick 1982 ; Bell 1984). On the other hand, the low ME of the meal limits its uses in high energy poultry diets. It is especially true for young birds for which the ME content of rapeseed meal is lower than in older birds (Rao and Clandinin 1972 ; March et al. 1973 ; Bayley et al. 1974). The ME content of double zero rapeseed remains lower than that of soyabean meal. This can be explained by its highest content in fibre. Hulls represent approximately 16 % of the seed (Appelquist and Ohlson, 1972). After oil extraction, the meal contains more than 30 % of hulls which are mainly composed of fibre. Moreover hulls contain tannins (Clandinin and Heard 1968 ; Leung et al 1979 ; Mitaru et al. 1982) which may reduce the protein digestibility.

The aim of the present experiment was to determine on adult birds the ME value and the protein digestibility of rapeseed hulls and dehulled rapeseed meal obtained from a new 00 cultivar.

MATERIAL AND METHODS

The rapeseed cultivar used in this study (Tapidor) is a new french double zero cultivar. Hulls were obtained by an air classification technique and dehulled seeds were processed using hexane extraction. Rapeseed hulls and rapeseed meal were subjected to chemical analyses : dry matter, nitrogen, lipids, crude fibre, water insoluble cell walls : WICW (Carré and Brillouet 1989) and ashes.

Metabolizable energy and protein digestibility content of hulls were determined using two basal diets (table 1) supplemented with increasing levels of hulls : 0, 5 10, 15 and 20 % (table 2). The first basal diet is mainly composed of corn, wheat and soyabean meal, the second one is composed of 75 % of the first one and 25 % of dehulled rapeseed meal. Hulls were introduced at the expense of the non rapeseed meal fraction of both diets.

The experimental diets were fed ad libitum to adult cockerels and a total excreta collection method was employed for the digestibility trial. After 3 days of adaptation to the experimental diets the birds were starved for 24 hrs, then fed ad libitum on one of the experimental diets for 2 days and finally fasted for 24 hrs. Excreta voided during the last 72 hrs were collected are freeze-dried. Sample of diets and excreta were analyzed for their gross energy content. True protein content in excreta was determined using the method of Terpstra and de Hart (1974). ME and protein digestibility values were calculated for each experimental diet. The ME and protein digestibility values of the hulls were calculated by linear regression.

RESULTS AND DISCUSSION

1. Composition of rapeseed fractions

Analyses indicate (table 3) that dehulling the seed before oil extraction leads to a meal which contains large amounts of crude protein (44.3 %) and low levels of crude fibre (8 %) and WICW (23.5 %). On the other hand hulls contain large amounts of crude fibre (26 %) and WICW (74.5 %) but low levels of crude proteins (14.16 %). Hulls contains more lipids (ether extract) than the dehulled rapeseed meal (8.33 vs 0.72 % respectively). These results are in good agreement with most of previous studies (Bell and Shires 1982 ; Leslie et al. 1973 ; Sarwar et al. 1981) even if some discrepancies are observed. These discrepancies are mainly due to the technique used for dehulling the seed : laboratory or industrial procedures, and to the amount of fine of endosperm and cotyledons origin.

2. Metabolizable energy and protein digestibility

ME and protein digestibility values of the experimental diets are shown on table 4. The relationships between ME or digestibility values of the diets and the percentage of hulls in the diet are given figure 1.

ME and apparent protein digestibility values of dehulled meal can be calculated from diets 1 and 6 which contain 0 and 25 % of the meal respectively. The obtained values reach 2134 Kcal/kg DM and 77.7 %. Previous studies (Bayley and Hill 1975 ; Lessire 1985 ; Seth and Clandinin 1973) mentioned ME values greater than 2000 Kcal/kg for dehulled meal and proteins of rapeseed meal are known to be less digestible than those of soyabean meal (Picard and Darcy–Vrillon 1985).

Increasing levels of hulls results in linear decreases of ME and protein digestibility of the diets. The relationships between these parameters and the proportion of hulls (X) in diets 1, 2, 3, 4, 5 with no rapeseed meal added are the following :

$$\text{ME} = 2976.4 - 27.15\ x$$
$$\text{Protein digestibility} = 78.83 - 0.796\ x$$

When the basal diet contains 25 % dehulled rapeseed meal (diets 6, 7, 8, 9, 10) similar decreases are obtained :

$$\text{ME} = 2705.3 - 24.77\ x$$
$$\text{Protein digestibility} = 78.55 - 0.53\ x$$

These equations leads to a ME value which is 297 Kcal/kg DM in diets with no dehulled rapeseed meal added, when rapeseed meal is added, the ME value of the hulls is 554 Kcal. These low values are not different. Similar low values are obtained for protein digestibility (– 0.77 and – 4.3 %), these values are not different from zero.

In the literature few experiments have been done to determine the ME and the digestible protein contents of rapeseed hulls in poultry. Most of them were done using only high hulls fractions (Seth and Clandinin 1973 ; Bayley and Hill 1975) and the incorporation levels used in those experiments were by far greater than those possible in practice with rapeseed meal. Moreover in other species such as mice (Sarwar et al. 1981) hulls reduced the digestibility of protein by more than could be accounted for by simple dietary dilution with the hulls. In the present experiment, we used hulls as pure as possible introduced at low levels in a classical diet or in an other one containing dehulled rapeseed meal. The obtained results show very low ME values of hulls and a linear decrease of protein digestibility of the diet with increasing levels of hulls. The intercepts of the equations which are the values of pure hulls were equal to zero, consequently hull protein are largely indigestible. Therefore, according to the results obtained in our experimental conditions, hulls and tannins had a limited effect as postulated before (Leung et al. 1979) in view of the low chemical extractability of condensed tannins from rapeseed hulls.

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Table 1. Composition of the basal diet (%)

Corn	54.9
Wheat	15.0
Oil	1.4
Soyabean meal	24.7
DL–methionine	0.1
Calcium carbonate	1.42
Dicalcium phosphate	1.38
Salt, minerals and vitamins mixture	1.0

Table 2. Composition of experimental diets (%)

Ingredients	Diet									
	1	2	3	4	5	6	7	8	9	10
Basal diet	100	95	90	85	80	75	70	65	60	55
Dehulled rapeseed meal	–	–	–	–	–	25	25	25	25	25
Rapeseed hulls	–	5	10	15	20	–	5	10	15	20

Table 3. Composition of the rapeseed fractions used
(Dry matter basis)

	Crude protein %	Lipids %	ASH %	Crude fibre %	WICW* %	Gross energy Kcal/kg
Rapeseed hulls	14.16	8.33	5.38	28.0	74.50	4871
Dehulled rapeseed meal	44.30	0.72	10.35	8.0	23.50	4499

* WICW = Water Insoluble Cell Walls

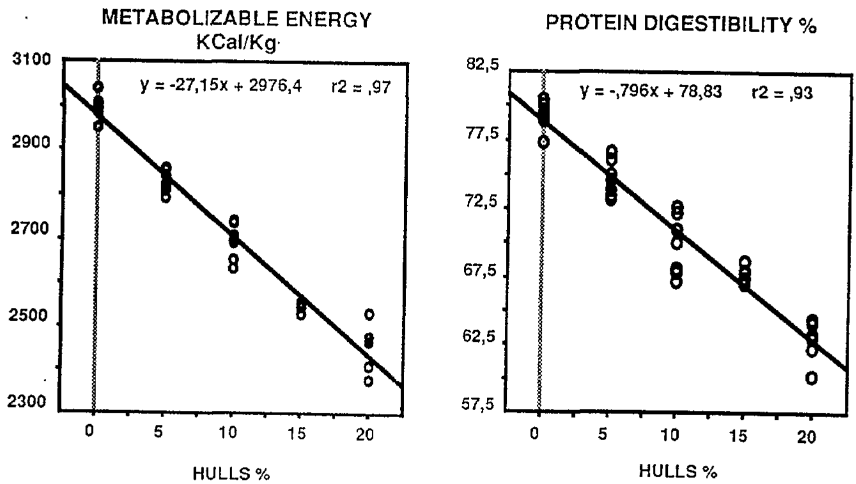
Table 4. Metabolizable energy and protein digestibility vaues of experimental diets

	Diet									
	1	2	3	4	5	6	7	8	9	10
ME Kcal/kg	2998 (6)*	2828 (9)	2695 (19)	2547 (5)	2453 (22)	2738 (13)	2548 (8)	2438 (15)	2343 (12)	2221 (10)
Protein digesti-bility %	79.3 (0.4)	74.7 (0.5)	69.9 (0.8)	67.8 (0.3)	62.9 (0.6)	78.6 (0.3)	75.5 (0.5)	73.5 (0.9)	71.0 (0.9)	67.5 (0.6)

* Standard error of mean

Figure 1: METABOLIZABLE ENERGY AND PROTEIN DIGESTIBILITY VALUES OF RAPESEED HULLS.

I- IN BASAL DIET.



II- IN BASAL DIET SUPPLEMENTED WITH 25% DEHULLED RAPESEED MEAL.