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A note on the chemical composition of rape seed hulls and their feeding value for ruminants

Th. Keller, W. Kracht, S. Dänicke and H. Jeroch

Institute of Animal Nutrition,
Faculty of Agriculture, Martin-Luther-University Halle-Wittenberg
Emil-Abderhalden-Street 25 b, D-06108 Halle/Saale, Germany

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ABSTRACT

The digestibility of crude nutrients and fibre fractions and metabolizable energy of rape seed hulls obtained in a process of pealing before oil extraction was evaluated by difference method in combination with dehydrated lucerne on six adult wethers.

Rape seed hulls inclusion significantly lowered the digestibility of CP and ADF and significantly increased the digestibility of crude fat of the whole ration in comparison with dehydrated lucerne fed alone. The relatively high metabolizable energy content of the rape seed hulls of about 9.2 MJ ME/kg DM were based mainly on its high crude fat content. It seems that the restricted utilization of rape seed hulls is possible in ruminant nutrition.

KEY WORDS: rape seed, hulls, chemical composition, nutritive value, ruminants

INTRODUCTION

In recent years rape has been widely grown for oil production in Europe (FAO, 1994). About 12-16% of the weight of the rape seed grain are hulls (Henkel and Mosenthin, 1989). According to a new technology it is intended to peal the rape seeds in the oil mill before or after oil extraction. The aim of pealing before the oil extraction is to improve oil quality, i.e. get a lighter coulour of oil and pealing after oil extraction is applied with the aim to increase the feeding value of rapeseed meal. It was slown that digestibility of rations with rapeseed meal by swine (Bayley and Hill, 1975; Bourdon et al., 1982) and by poultry (Leslie et al., 1973; Jones and Sibbald, 1979) increased as the amount of rape seed

hulls was decreased. In the process of dehulling the substantial proportion of hulls is removed, and as a fibre content in this fraction is very high it might be used only in ruminant nutrition. Little work has been published on the nutritional value of the hulls when fed to ruminants till now.

MATERIAL AND METHODS

Rape seed hulls

The rape seeds used for dehulling was a black seed of 00-quality (erucic acid free, low glucosinolate variety). The dehulling was done before extraction process with a method developed by the Fa. SKET Magdeburg GmbH. The rape seed grains were conditioned, elastic deformation in a roller slot followed, the hulls cracked and there were separated by electro-separation. The fraction of rape seed hulls (RH) was not further extracted.

Animal studies

The estimation of digestibility coefficients of crude nutrients and fibre fractions and calculation of energy content of rape seed hulls (RH) was done by difference method. The group A obtained dehydrated lucerne supplemented with vitamin-mineral mixture as only feed. In the ration of group B 15.6% lucerne was substituted on DM basis by rape seed hulls. Each digestibility trial was conducted with six adult wethers (according to Schiemann, 1981). The animals weighed about 80 kg and were housed separately in metabolism cages in an experimental hsouse. Food was given in two equal meals each day at 07.00 and 14.00 h. The total feed ration of about 1200 g dry matter (DM) plus vitamin-mineral supplementation was adequate for maintenance. Water was offered *ad libitum*. After the adaptation to the rations (7 days) and a preliminary period of 7 days the excreta were collected every morning for another 7 days. An aliquote proportion (15%) was stored at $+3^0$C without addition of a preservative for laboratory analysis. Feed refusals were collected at 07.00h each day, weighed and included in the daily ration on DM basis.

Analysis

Crude protein was determined in the homogenized fresh excreta, the other crude nutrients, ash and fibre components (Goering and van Soest, 1970) were analyzed according to standard laboratory methods (VDLUFA, 1988) in excreta dried in 65^0C for 24 h.

Gross energy of rape seed hulls was determined by adiabatic bomb calorimetry. The contents of metabolizable energy (ME) and net energy for lactation (NEL) were calculated with according to of the following equations:

ME (MJ) = 0.0312 x g digestible crude fat + 0.0136 x g digestible crude fibre + + 0.0147 x g (digestible organic matter – digestible crude fat – – digestible crude fibre) + 0.00234 x g crude protein (GfE, 1995)

and

NEL (MJ) = 0.6 x (1 + 0.004 x [q – 57] x ME (q = metabolizable energy/gross energy) (GEH, 1986).

The fatty acids were determinated as methylesters with gas chromatograph HP 5890 II GC (with FFAP capillar column of 30 m length, diameter 0.53 mm, detection with flame ionisation detector and integration on HP 3396). The carrier gas used was helium. The content of glucosinolates was determined with high pressure liquid chromatography (EG, 1990).

Statistical analysis

Statistical analysis was performed by means of analysis of variance (acc. to Rasch et al., 1978) using the procedure of Statistica for Windows (Release 4.5, StatSoft Corp., 1992). Means of the energy content of rations and feedstuffs were compared using the Tukey-Test.

RESULTS AND DISCUSSION

Chemical composition

The crude nutrient and fibre contents of RH and dehydrated lucerne are shown in Table 1. Rape seed hulls contained about 15% crude protein and about 15% crude fat per kg DM. That is comparable with that reported by other workers (Table 1) and is a result of an incomplete separation from the seed embryo during dehulling process. The crude protein and fat content in RH was notably lower and crude fibre higher than in rape seeds (which contained about 24% crude protein, 45% crude fat and 7% crude fibre). However, soyabean hulls normally have higher fibre content as the rape seed hulls. There is no explanation for the high ADF value of rape seed hulls which nearly equaled to NDF content.

The dehydrated lucerne was relatively high in fibre and low in crude protein, as it was harvested in a later growth stage. Quality of dehydrated lucerne was good according a sensoric evaluation, there were no visible traces of heat damage.

TABLE 1

Crude nutrient and fibre content (g/kg DM) of rape seed hulls (experimental and from literature) in comparison with soyabean hulls and dehydrated lucerne

	Rape seed hulls	Dehydrated lucerne	Rape seed hulls[1]	Rape seed hulls[2]	Rape seed hulls[3]	Sayabean hulls[4]
	Experimental		From literature			
Organic matter	943	905	962	n.d.	959	956
Crude protein	147	162	153	239	154	99
Crude fat	143	23	106	72	130	10
Crude fibre	227	343	397	189	n.d.	420
N-free extractives	426	377	n.d.	436	n.d.	427
NDF	535	483	712	503	658	670
ADF	526	393	599	392	467	512
Hemicellulose	9	90	n.d.	n.d.	n.d.	500
ADL	263	92	165	n.d.	n.d.	157
Cellulose	263	301	n.d.	n.d.	n.d.	13

[1] – Bell and Shires (1982)
[2] – Chibowska et al. (1994)
[3] – McKinnon et al. (1995)
[4] – Mitaru et al. (1984)
n.d. – not determinated

The fatty acid composition of fat extracted from rape seed hulls was similar to that composition of rape seed oil, with a high proportion of unsaturated fatty acids (Table 2).

The content of glucosinolates was 4.2 μM/g fat-free DM. That is in comparision to rape seed (Bille et al., 1983 - 17 - 22 μM/g fat-free DM; Kallweit, 1989 - 31 [10-134] μM/g fat-free DM) relatively low. But it is known that the glucosinolates are mainly found in the seeds (Bertram et al., 1986).

TABLE 2

Fatty acid composition of oil from rape seed hulls, % of fat, as methylester

C 16:0	5.16
C 18:0	1.76
C 18:1	53.27
C 18:2	18.28
C 18:3	6.69
C 20:0	0.57
C 20:1	1.02
C 22:1	0.16

Apparent digestibility and metabolizable energy content

The addition of rape seed hulls did not lowered significantly the digestibility of organic matter, but significantly lowered ($P \leqslant 0.05$) the digestibility of crude protein and ADF of the whole ration (Table 3). However, the apparent digestibility of crude fat, that is found only in a small amount in lucerne, substantially increased. The low fibre digestibility was surely resulting from the high content of lignin of about 260 g/kg DM of the rape seed hulls (Table 1). It should be taken into consideration that some insignificant effects found might be a result of a low amount of hulls in the ration. However, similar results were reported by McKinnon et al. (1995) who fed higher rations of rape seed hulls to growing lambs. The low digestibility of crude protein of rape seed hulls was also concluded by Finlayson (1974) based on in vitro experiments and are in agreement with the findings of Lessire et al. (1993) who fed rape seed hulls to adult cocks.

The relatively high energy content of the rape seed hulls of about 9.2 MJ ME/kg DM (and 5.6 MJ NEL/kg DM, respectively, Figure 1) significantly increased the energy content of the mixed ration. The energy content of the rape seed hulls is in the range of oat hulls or cotton seed meal (unpealed cotton; DLG, 1991). The content of digestible energy noted by McKinnon et al. (1995) was about 9.3 MJ DE/kg DM. However, energy content of rape seed hulls based mainly on the high crude fat content that may change between 10 -20% of DM depending on the dehulling process and also on the variety (Bell and Shires, 1982). The gross energy content of the rape seed hulls was about 22 MJ/kg DM. It means that this by-product may by alternatively used in a controlled burning process for heat generation.

TABLE 3

Digestibility of crude nutrients and fibre fractions of the rations and the rape seed hulls, %

	Experimental		Calculated
	Group A Dehydrated lucerne	Group Dehydrated lucerne + rape seed hulls	Rape seed hulls
Organic matter	54.2 ± 1.4	53.5 ± 0.8	50.4 ± 7.7
Crude protein	63.9 ± 0.8[c]	56.6 ± 1.1[b]	12.8 ± 7.7[a]
Crude fat	33.9 ± 1.3[a]	60.0 ± 2.3[b]	82.7 ± 4.4[c]
Crude fibre	36.4 ± 1.8[b]	33.2 ± 1.9[b]	10.7 ± 11.7[a]
N-free extractives	67.3 ± 1.8[a]	68.8 ± 0.8[a]	75.8 ± 4.5[b]
NDF	38.6 ± 2.8	38.1 ± 1.6	35.8 ± 9.6
ADF	49.6 ± 2.1[c]	35.8 ± 0.8[b]	20.6 ± 4.3[a]

[1] – a, b, c means ± standard deviation within rows with different letters differ significantly at $P < 0.05$

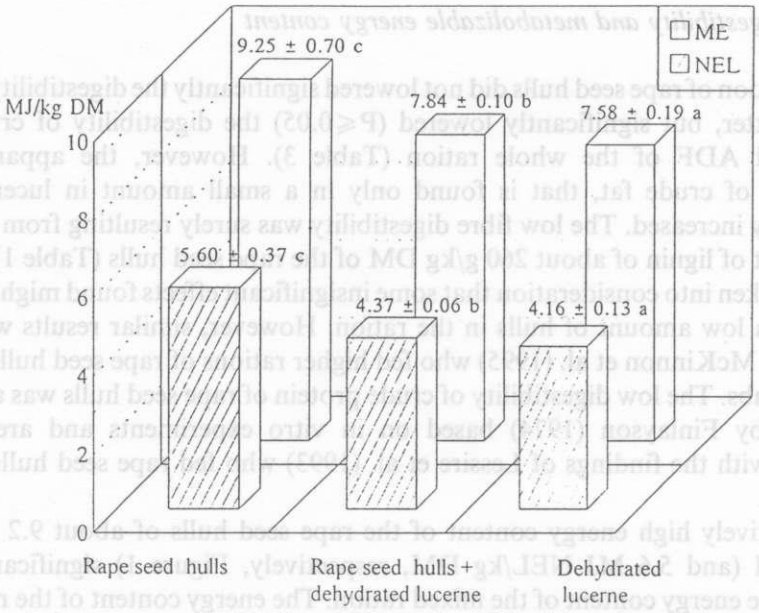

Figure 1. Energy content (MJ NEL and ME ME/kg DM) of the rations and rape seed hulls
a, b, c – means ± standard deviation within rows with different letters differ ($P < 0.05$)

It seems that the utilization of rape seed hulls is possible in ruminant nutrition, however it might be restricted by its high fat content.

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STRESZCZENIE

Skład chemiczny okrywy nasiennej rzepaku i jej wartość odżywcza dla przeżuwaczy

Strawność surowych składników i frakcji włókna oraz energia metaboliczna okrywy nasiennej (łuski) rzepaku otrzymanej w procesie łuszczenia poprzedzającym ekstrakcję oleju zostały oznaczone metodą różnicową, w połączeniu z suszem z lucerny, na sześciu dorosłych skopach. Włączenie łuski rzepaku istotnie obniżyło strawność białka ogólnego i ADF, oraz istotnie podwyższyło strawność tłuszczu dawki w porównaniu z dawką zawierającą wyłącznie susz z lucerny. Stosunkowo wysoka energia metaboliczna łuski rzepakowej (około 9,2 MJME/kg SM) wynikała z dużej zawartości w niej tłuszczu. Wydaje się, że możliwe jest ograniczone stosowanie łuski rzepakowej w żywieniu przeżuwaczy.