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Effect of extrusion of rapeseed oilmeal on rumen degradability and intestinal digestibility[1]

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ABSTRACT

Effective ruminal protein degradation (EPD) and the intestinal digestibility of undegraded protein (IUPD) of rapeseed oilmeal (RSM) subjected to extrusion at a temperature of 140°C was determined. The protein EPD coefficient of the extruded rapeseed oilmeal (ERSM) was 55.5%, whereas that of the RSM not subjected to extrusion, 79.3%. The intestinal digestibility of rumen-undegraded RSM protein was 55.5%, which was 38.3 percentage points lower than the IUPD of the ERSM. The total tract protein digestibility of both meals was similar. The high IUPD of the ERSM indicates a favourable shift of protein availability from the rumen to further sections of the gastrointestinal tract.

KEY WORDS: rapeseed oilmeal, protein, ruminal degradation, intestinal digestibility

INTRODUCTION

The principal factor limiting the value of extracted rapeseed oilmeal (RSM) in the nutrition of high yielding cows is the excessive sensitivity of nitrogen compounds to ruminal degradation. The degradation coefficient of RSM protein ranges from 62 to 77% (Madsen and Hvelplund, 1985; Żebrowska et al., 1997). Extrusion could be beneficial for feed protein utilization and for this reason the experiment was carried out to determine protein disappearance from the rumen and post-ruminal part of the digestive tract from untreated (RSM) or extruded (ESRM) rapeseed oilmeal.

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MATERIAL AND METHODS

The experiments were conducted on two Jersey heifers of 435 kg body weight fitted with ruminal and duodenal cannulas and fed standard diets. The RSM was extruded at 140°C using a single-worm extruder (Insta-Pro®2000R Company). Crude protein degradation in the rumen was determined by the *in sacco* method described by Kowalski et al. (2001), while the intestinal digestibility of rumen-undegraded protein was assessed using the mobile bag method (Hvelplund and Weisbjerg, 2000). The ruminal degradation constants of crude protein were calculated from the Ørskov and McDonald (1979) equation with the PROC NLIN (SAS, 1996) calculation procedure. The intestinal digestibility of rumen-undegraded dietary protein (IUPD) and the total tract protein digestibility (TTPD) were calculated according to the formulas described by Kowalski et al. (1997).

RESULTS

The experiment *in sacco* confirmed a significant influence of extrusion on the reduction of crude protein losses in the rumen in the particular periods of incubation. Differences between feeds were particularly noticeable between the 4 and 8 h of incubation (Figure 1).

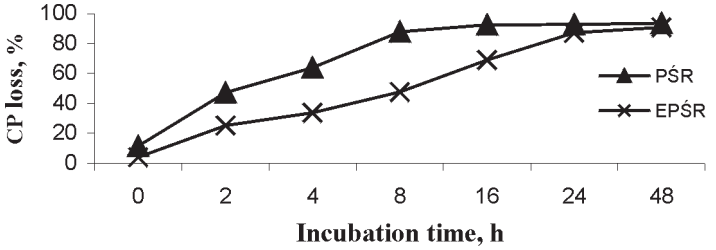

Figure 1. Losses of crude protein (CP) in consecutive hours of incubation ,%

The degradation parameters and EPD coefficients of crude protein presented in Table 1 show a lower constant *a* and higher *b* value for ERSM than for RSM. Moreover, the extrusion process dramatically reduced EPD of rapeseed oilmeal.

The intestinal digestibility of RSM protein undegraded in the rumen was lower than of ERSM protein by about 38 percentage points, but protein digestibility in the total tract (TTPD) was similar for untreated and treated rapeseed oilmeal.

Table 1. Protein degradability parameters (a, b, c), effective ruminal protein degradation (EPD), intestinal digestibility of rumen-undegraded protein (IUPD) and total tract protein digestibility (TTPD) of RSM and ERSM

Degradation constants	RSM	ERSM
A	11.22	9.76
B	82.78	87.04
C	0.28	0.07
EPD	79.25	55.54
IUPD	55.5	93.8
TTPD	96.1	98.1

DISCUSSION

The results of the experiment demonstrated that the extrusion of RSM decreased the susceptibility of its protein to rumen degradability, but the protein undigested in the rumen protein was more intensively digested further in the digestive tract, giving in effect similar values of total-tract protein digestibility. The effect of the distal shift of protein digestion from the rumen is desirable as decomposition of protein in the rumen to ammonia is avoided and amino acids of rumen-undegraded protein can be utilized more effectively by their absorption from the intestine.

The similar loss of RSM and ERSM protein in the rumen after 24 h of incubation could suggest ineffective protection of protein by extrusion, but the calculated retention time of the feed particles in the rumen is shorter, as at the passage rate of k = 0.06 it amounts to only 16 h (Ørskov and Mc Donald, 1979). This is the reason that rumen overpass of protein from ERSM is greater than from RSM. Similar trends following treatment of protein by different physical factors were also reported by other researchers (Tuori, 1992; Aufrère et al., 1998). Cros et al. (1991) also confirmed the effectiveness of the Insta-Pro® method for the protection of protein. The use of a double-worm extruder to protect the protein of whole field beans (Benchaar et al., 1994) and pea (Walhain et al., 1992) also increased the amino acid pool available in the intestines.

CONCLUSIONS

Extrusion of rapeseed oilmeal at 140°C shifts protein digestion from the rumen to the intestines, which can be beneficial for protein utilization.

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STRESZCZENIE

Wpływ ekstruzji poekstrakcyjnej śruty rzepakowej na strawność białka w żwaczu i jelitach

Oznaczono efektywny rozkład białka w żwaczu (EPD) oraz strawność jelitową białka nie strawionego w żwaczu (IUPD) poekstrakcyjnej śruty rzepakowej (RSM) poddanej ekstruzji w temperaturze 140°C. Współczynnik EPD białka ekstruderatu (ERSM) wynosił 55,5%, natomiast śruty nie poddanej ekstruzji 79,3%. Strawność jelitowa (SJ) białka nie ulegającego rozkładowi w żwaczu RSM wynosiła 55,5% i była niższa od SJ ERSM o 38,3 punktu procentowego. Strawność białka obydwóch śrut w całym przewodzie pokarmowym była podobna. Wysoka IUPD białka extrudowanej śruty wskazuje na korzystne przesunięcie dostępności białka ze żwacza do dalszych odcinków przewodu pokarmowego.