Commission on Animal Nutrition **Abstract no 596**
Poster N4.61
chmilis@agro.auth.gr

Cottonseed manufacturing process effect on nutrient digestibility and N balance of sheep rations

D. Liamadis[1], Ef. Lales[1], Ch. Milis[2] and Z. Abas[3]. [1]Aristotle University of Thessaloniki. [2]Ministry of Agriculture. [3]Dimokritio University of Thrace. Greece.

Abstract

The high production of cotton in Greece results in a number of industrial cottonseed by-products that are available, mainly, as feedstuffs in ruminant rations. Nevertheless, in most cases, these by-products have not been nutritionally evaluated enough. Four rations containing one of four cotton seed by-products, whole cotton seed (WCS), cotton seed pellets (PCS), cotton seed meal (CSM) and cotton seed cake (CSC), where fed at four castrated mature rams, in an *in vivo* digestibility trial, using a 4x4 latin square experimental design. The four rations, A) WCS (control), B) PCS, C) CSM and D) CSC, additionally, contained equal amounts of alfalfa hay, and where covering maintenance requirements for energy. Rations A and B had higher ($P<0.05$) DM and OM digestibility compared to rations C and D (61.0; 61.0; 59.1 and 59.4%, for DM and 63.8; 64.1; 62.3 and 62.2%, for OM, respectively), suggesting that WCS and PCS have a superiority compared to CSM or CSC. Significant differences were not revealed on CP digestibility (75.0; 75.4; 75.4 and 74.3%, respectively) nor on Biological Value $(N_{intake}-N_{feacal}-N_{urine})/(N_{intake}-N_{feacal})$ (51.5; 51.0; 49.7 and 42.6%, respectively) or Net Protein Utilization $(N_{intake}-N_{feacal}-N_{urine})/N_{intake}$ (38.6; 38.4; 37.5 and 31.6%, respectively). Former result indicates that manufacturing process doesn't impair CP digestibility and N balance of cottonseed by-products.

Introduction

The high production of cotton in Greece results in a number of industrial cottonseed by-products that are available, mainly, as feedstuffs in ruminant rations. Nevertheless, in most cases, these by-products have not been nutritionally evaluated enough. Whole cottonseed (WCS) is often added to the diets of dairy cows as a source of fat as well as of protein and fiber (Bertrand et al., 1998). A survey of the highest yielding registered Jersey herds in US found that 46% received WCS as a source of added fat (Bertrand and Jenny, 1992). Based on chewing response, WCS appears to be the most effective fiber source from byproduct feeds (Clark and Armentano, 1993; Mooney and Allen, 1997). Nevertheless, WCS can't be stored for a long time, thus manufacturing process aim to solve this problem by reducing humidity (whole cotton seed pellets) or fat content (cotton seed meal, cotton seed cake).

Materials and Methods

Four rations containing one of four cotton seed by-products, whole cotton seed (WCS), cotton seed pellets (PCS), cotton seed meal (CSM) and cotton seed cake (CSC), where fed at four castrated mature rams, in an *in vivo* digestibility trial, using a 4x4 latin square experimental design. The four rations, A) WCS (control), B) PCS, C) CSM and D) CSC, additionally, contained equal amounts of alfalfa hay, and where covering maintenance requirements for energy (Table 1).

chmilis@agro.auth.gr

Table 1. Formulation, and Chemical Analysis of experimental rations

Item	Rations*			
	A WCS	B PCS	C CSM	D CSC
1. Composition (g/kg)				
Alfalfa hay	710	710	710	625
Whole cotton seed	250	-	-	-
Cotton seed pellets	-	250	-	-
Cotton seed meal	-	-	250	-
Cotton seed cake	-	-	-	335
Salt	10	10	10	10
Dicalcium phosphate	15	15	15	15
**Meriden 001	15	15	15	15
Sum	1000	1000	1000	1000
2. Chemical analysis				
Dry matter (DM) (g/kg)	869	870	872	880
Organic matter (g/kg DM)	919	917	916	922
Crude protein (g/kg DM)	208	206	234	215
Ether extract (g/kg DM)	60	55	10	16
Crude fibre (g/kg DM)	220	222	210	215
NFE (g/kg DM)	431	434	462	476

* WCS= whole cotton seed, PCS= cotton seed pellets, CSM= cotton seed meal, CSC= cotton seed cake.

** Meriden 001= premix of vitamins and trace elements.

Results and Discussion

The main difference between these feeds is that WCS and PCS have much higher EE content, which arise their GE content. Instead, CSM and CSC have higher NFE content in comparison with WCS and PCS. Moreover, humidity in PCS is the lowest between these feedstuffs (Table 2).

Table 2. Chemical composition of experimental feedstuffs

	WCS	PCS	CSM	CSC
Dry matter	88.5	91.5	86.3	86.2
Organic matter (% DM)	96.2	87.1	95.1	95.3
Crude protein (% DM)	28.1	27.0	38.2	27.9
Ether extract (% DM)	19.4	18.3	0.4	2.4
Crude fibre (% DM)	27.5	25.5	24.4	29.6
NFE (% DM)	21.2	16.3	32.1	35.9
NDF (% DM)	48.7	45.4	52.0	40.3
ADF (% DM)	35.8	32.1	35.4	29.0
Hemicellulose (% DM)	12.9	13.3	16.6	11.2
Cellulose (% DM)	24.5	21.1	19.7	21.9
Gross energy (kj/g)	21.5	21.1	18.8	20.1

* WCS= whole cotton seed, PCS= cotton seed pellets, CSM= cotton seed meal, CSC= cotton seed cake.

chmilis@agro.auth.gr

Rations A and B had higher (P<0.05) DM and OM digestibility compared to rations C and D, suggesting that WCS and PCS have a superiority compared to CSM or CSC (Table 3). Also, EE digestibility of A and B rations was higher to respective digestibility of C and D rations, indicating WCS and PCS prevail on EE digestibility. Significant differences were not revealed on CP digestibility (Figure 1) nor on Biological Value $(N_{intake}-N_{feacal}-N_{urine})/(N_{intake}-N_{feacal})$ or Net Protein Utilization $(N_{intake}-N_{feacal}-N_{urine})/N_{intake}$ (Figure 2). Former result indicates that manufacturing process doesn't impair CP digestibility and N balance of cottonseed by-products.

Table 3. Nutrient digestibility of experimental diets

Item	Rations*				SEM	P
	A WCS	B PCS	C CSM	D CSC		
Dry Matter (%)	61.0 [a]	61.0 [a]	59.1 [b]	59.4 [b]	1.18	*
Organic Matter (%)	63.8 [a]	64.1 [a]	62.3 [b]	62.2 [b]	1.21	*
Crude Protein (%)	75.0	75.4	75.4	74.3	2.45	NS
Ether Extract (%)	88.1 [a]	85.4 [a]	44.6 [b]	67.9 [c]	5.15	*

* WCS= whole cotton seed, PCS= cotton seed pellets, CSM= cotton seed meal, CSC= cotton seed cake.

Mean values with different superscripts in a row are significantly different (*a,b,c - P< 0.05, NS= non significant).

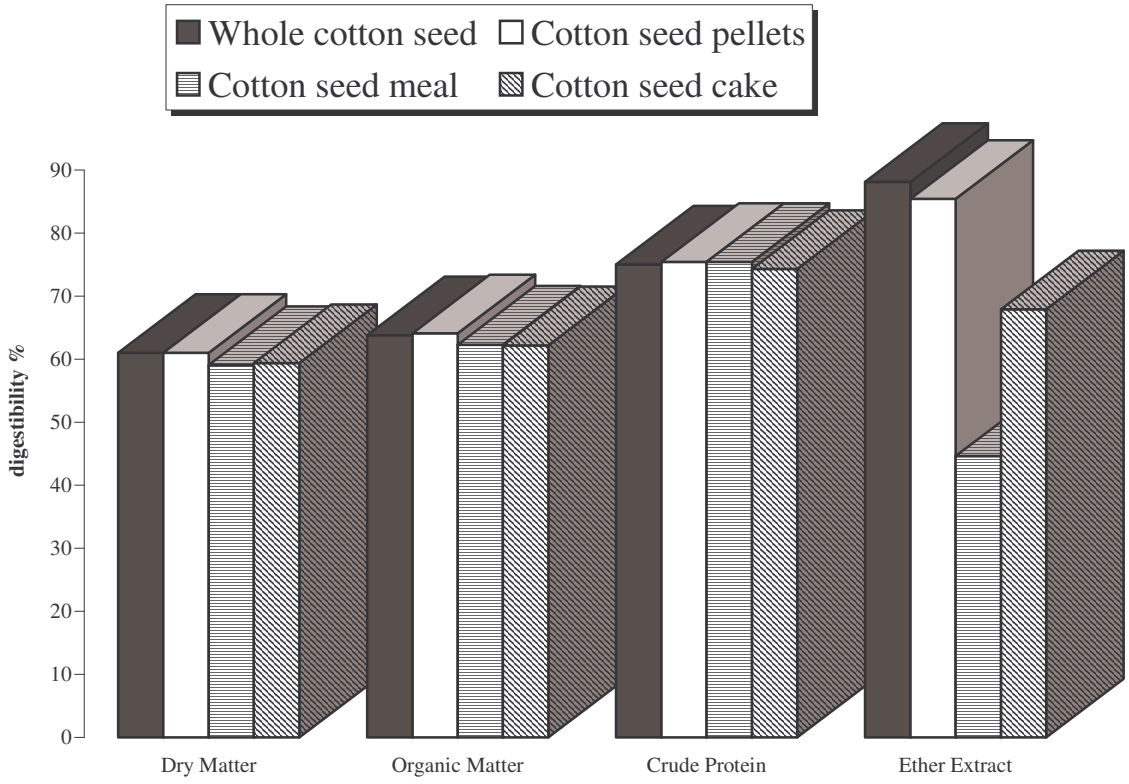

Figure 1. Nutrient digestibility of experimental rations

chmilis@agro.auth.gr

Table 4. N balance of the four diets

N balance	Ration A WCS	B PCS	C CSM	D CSC	SEM	P
Retained N (% intake)	38.6	38.4	37.5	31.6	7.15	NS
Retained N (% digested)	51.5	51.0	49.7	42.6	8.42	NS

* WCS= whole cotton seed, PCS= cotton seed pellets, CSM= cotton seed meal, CSC= cotton seed cake.

Mean values with different superscripts in a row are significantly different (*a,b - P< 0.05, NS= non significant).

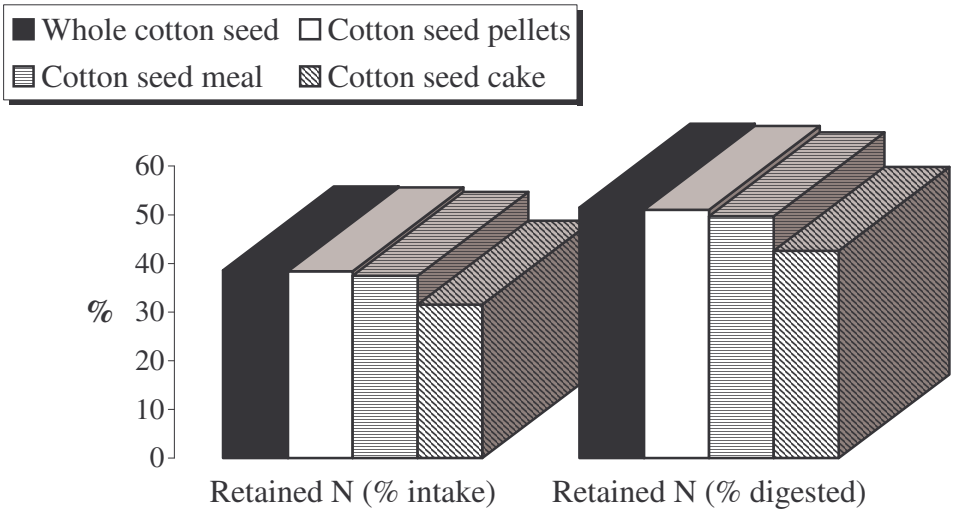

Figure 2. Daily N balance of experimental rations

Conclusions

- Manufacturing process doesn't impair CP digestibility and N balance of cottonseed by-products.
- Whole cotton seed and cotton seed pellets are shown higher OM digestibility compared to cotton seed meal and cotton seed cake, probably due to higher EE digestibility

References

Bertrand, J.A., Pardue, F.E., Jenkins, T.C., 1998. *Effect of ruminally amino acids on milk yield and composition of Jersey cows fed whole cottonseed*. J. Dairy Sci. 81, 2215-2220.

Bertrand, J.A., Jenny, B.F., 1992. *Characteristics of high-producing Jersey herds*. Prof. Anim. Sci. 8, 26-31.

Clark, P.W., Armentano, L.E., 1993. *Effectiveness of neutral detergent fiber in whole cottonseed and dried distillers grains compared with alfalfa haylage*. J. Dairy Sci. 76, 2644-2650.

Mooney, C.S., Allen, M.S., 1997. *Physical effectiveness of the neutral detergent fiber of whole linted cottonseed relative to that of alfalfa silage at two lengths of cut*. J. Dairy Sci. 80, 2052-2061.