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Note

In vivo digestibility of condensed carob stillage (CCS) (*)

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Summary

Condensed carob stillage (CCS) digestibility was evaluated in an experiment with five mature Bergamo wethers averaging 75 kg. In the trial 3 animals were fed with a ration of 80 p. 100 hay and 20 p. 100 CCS and two with hay alone. The addition of CCS to the ration increased dry matter intake, urine excretion and nitrogen retention. Furthermore, it improved the apparent digestibility of dry and organic matter and energy. However, the CCS was found to reduce the digestibility of nitrogen and of ADF of the diet. The digestibility of dry matter, organic mater, nitrogen and energy of CCS, calculated by difference, is 71.3 ; 67.1 ; 43.0 and 73.1 p. 100 respectively.

I. Introduction

The disposal of the distillery effluents, known as slop or vinasse or stillage, is undoubtedly one of the most serious problems of the distilling industry. A possible way of utilization of these by-products can be provided by animal feeding. To this purpose they are generally condensed to 65 p. 100 dry matter, a further condensation being economically inconvenient. Carob is among one of the diverse products fermented and distilled for the production of alcohol in Italy. Condensed carob stillage (CCS) has been used in previous experiment on fattening lambs (MANFREDINI, CAVANI & LENZI, 1980).

The aim of this research was to determine the digestibility of dry matter, organic matter, nitrogen, energy, acid detergent fiber (ADF) and ether extract of the condensed carob stillage. In addition, the effect of CCS on feed intake and nitrogen balance were investigated in this study.

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II. Material and methods

Five mature Bergamo wethers weighing 75 kg were utilized in this study. Since it is not possible to give CCS as a sole component of the diet, the digestibility was determined by difference. Two animals had received a basal diet consisting of hay, and the other three received a diet consisting of 80 p. 100 hay and 20 p. 100 CCS on wet basis. The animals were kept in individual pens on the floor before they were put in individual crates suitable for the collection of urine and faeces separately. The preliminary period lasted 19 days followed by a collection period of 7 days. Rations for the collection period were prepared on the basis of the feed intakes recorded during the preliminary phase. Wethers were fed twice a day at 9.30 and 16.30 h. All the rations were formulated to supply *ad libitum* amounts of food with minimum refusals. Water was freely provided. The chemical composition of CCS and of the diets are shown in table 1. Prior to the start of the experiment, faeces were examined for parasite detection with negative results.

Animal were weighted at the beginning of the collection period. Excreta were collected daily at 9 a.m. and 10 p. 100 samples stored at — 18 °C. Urine was collected in 10 ml of 50 p. 100 H_2SO_4. Collected samples of feed, faeces and urine, were then analyzed. Acid detergent fibre was determined by the method suggested by GOERING & VAN SOEST (1970) ; water in faecal samples was measured in oven at 60 °C ; ether extract was determined after preliminary acid hydrolysis with HCl 3N. Gross energy determinations were made with a ballistic bomb calorimeter (Gallenkamp).

Other determinations were made according to the methods recommended by A.O.A.C. (1975).

TABLE 1

Chemical composition of the diets and CCS.
Composition chimique des régimes et de CCS.

Feed or diet *Aliment ou régime*	Hay *Foin*	CCS *CCS*	Hay + CCS *Foin + CCS*
Dry matter (p. 100) .... *Matière sèche*	91.15	57.94	84.82
Organic matter (p. 100 DM) .... *Matière organique (p. 100 MS)*	90.85	71.88	88.06
Crude protein (p. 100 DM) .... *Matières azotées (p. 100 MS)*	10.25	13.13	10.50
ADF (p. 100 DM) .... *Lignocellulose (p. 100 MS)*	45.36	—	37.72
Ether extract (p. 100 DM) .... *Matières grasses (p. 100 MS)*	1.91	.83	1.75
Gross energy (MJ/kg DM) .... *Energie brute (MJ/kg MS)*	18.67	—	18.64

III. Results and discussion

a) Feed intake, faeces and urine excretion. — The data in table 2 show that the feed intake and the urine excretion of the animals fed CCS diet is considerably higher than those of the animals fed a hay diet. Also, the quantity of faeces excreted was found to be higher yet less marketed. These results show that the addition of CCS to a hay diet improves the palatability of the diet. The increased quantity of urine excreted can be due, to some extent, to the higher dry matter intake and to the higher ash content of the diet (23.4 p. 100), which are in turn responsible for increased water intake. These results are in agreement with our previous research concerning condensed beet molasses stillage (MANFREDINI & CAVANI, 1981).

TABLE 2

Daily amounts of ingesta and excreta.

Consommation journalière d'aliment et excrétions fécale et urinaire.

Diets *Régimes*	Hay *Foin*	Hay + CCS *Foin + CCS*
Feed intake (g of DM) .... *Consommation journalière (g de MS)*	1775 ± 12	2184 ± 3
Faeces (g of DM) .... Fèces (g de MS)	847 ± 30	985 ± 17
Urine (g) .... *Urine (g)*	2155 ± 165	3265 ± 110

b) Digestibility. — The digestibility of the basal diet (hay) was not influenced to a great extent by the addition of CCS as shown in table 3. The stillage was found to increase the digestibility of dry matter, organic matter, and energy while it was responsible for a decrease in the digestibility of nitrogen and ADF. Ether extract is of little importance in the digestibility trials on ruminants. It is difficult to indicate the reason for these differences as these may be due to many factors : the different chemical composition of the diets (particularly with regard to the content of ADF and the nature of the N-free extracts) and the associative effects between hay and stillage which modify the fermentation process in the rumen. The digestibility of CCS, calculated by difference, is 71.3 p. 100 for dry matter, 67.1 p. 100 for organic matter, 43.0 p. 100 for nitrogen and 73.1 p. 100 for energy. In the literature available to us we have been unable to find any research with which we can compare our results.

c) Nitrogen balance. — The values of nitrogen balance are shown in table 4. In the CCS diet, the nitrogen retention was higher regardless of how it is expressed : g per day ; p. 100 of ingested N, or p. 100 of digested N. The differences can be attributed to various factors : a) the kind of nitrogenous matter contained in CCS, which might be less degradable in the rumen. This can be demonstrated by comparing the percentages of nitrogen excreted in the faeces and in the urine. With the diet consisting of hay and CCS the percentage of urinary nitrogen decreases while the percentage of faecal nitrogen slightly increases ; b) the kind of N-free extract contained in CCS, which might improve microbial protein synthesis in the rumen ; c) the different amounts of nitrogen and digestible organic matter ingested. According to GRENET & DEMARQUILLY (1977) there is a significant correlation between the quantities of nitrogen ingested and nitrogen retained ; this relationship, however, exists only if a sufficient amount of energy is present in the diet (BLACK & GRIFFITHS, 1975).

TABLE 3

Intake and apparent digestibility of diets and CCS.

Consommation de matière sèche et coefficients d'utilisation digestive.

Diets *Régimes*	Hay *Foin*	Hay + CCS *Foin + CCS*	CCS *CCS*
Dry matter intake (g/kg $W^{0,75}$/d) *Consommation de matière sèche*	69.0 ± 0.7	84.6 ± 0.5	
p. 100 of body weight *p. 100 de poids vif*	2.3 ± 0.03	2.9 ± 0.02	
Apparent digestibility (p. 100) *Utilisation digestive apparente (p. 100)*			
Dry matter *Matière sèche*	52.3 ± 1.9	54.9 ± 0.8	71.3
Organic matter *Matière organique*	55.7 ± 1.8	56.9 ± 0.7	67.1
Nitrogen *Azote*	50.9 ± 1.9	49.6 ± 0.9	43.0
Acid detergent fibre *Lignocellulose*	51.1 ± 1.9	48.6 ± 0.8	—
Ether extract *Extrait éthéré*	41.7 ± 1.7	49.0 ± 0.7	—
Energy *Energie*	51.1 ± 1.7	55.0 ± 0.6	73.1

TABLE 4

Effect of CCS on nitrogen balance.
Influence de CCS sur la rétention azotée.

Diets *Régimes*	Hay *Foin*	Hay + CCS *Foin + CCS*
Nitrogen intake (g/d) .... *Azote ingéré*	29.1 ± 0.2	36.6 ± 0.1
Faecal nitrogen (g/d) .... *Azote fécal*	14.3 ± 0.5	18.5 ± 0.3
Urinary nitrogen (g/d) .... *Azote urinaire*	14.4 ± 0.5	14.8 ± 1.2
Nitrogen retention (g/d) .... *Rétention azotée*	0.1 ± 1.6	3.8 ± 0.5
Nitrogen retention (p. 100 of N intake) .... *Rétention azotée (p. 100 de l'azote ingéré)*	0.2 ± 1.6	10.8 ± 1.3
Nitrogen retention (p. 100 of digested N) .... *Rétention azotée (p. 100 de l'azote digéré)*	0.3 ± 2.8	22.5 ± 2.5

IV. Conclusion

The findings determined by this research indicate that rations containing CCS plus hay increased the intake of dry matter, slightly improved the digestibility of dry matter, organic matter and energy, and elevated nitrogen retention in comparison with diets containing only hay. The digestibility of dry matter, organic matter, nitrogen and energy of CCS, calculated by difference, is 71.3 ; 67.1 ; 43.0 and 73.1 p. 100 respectively.

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Résumé

La détermination in vivo *de la digestibilité de la vinasse concentrée de caroube (CCS)*

La digestibilité de la vinasse concentrée de caroube a été évaluée au cours d'une expérience sur cinq moutons d'un poids moyen de 75 kg. Trois animaux étaient alimentés avec une ration de 80 p. 100 de foin pour 20 p. 100 de CCS et deux avec le foin seulement. L'addition de CCS dans la ration a provoqué un accroissement de la consommation de matière sèche, de l'excrétion d'urine et de la rétention azotée. Elle a par ailleurs amélioré la digestibilité apparente de l'énergie, de la matière sèche et de la matière orga-

nique. Toutefois il s'est avéré que le CCS réduisait la digestibilité de l'azote et de la lignocellulose de la ration. La digestibilité de la matière sèche, matière organique, azote et énergie de la CCS est de 71,3 ; 67,1 ; 43,0 et 73,1 p. 100 respectivement.

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