Comparison of rumen ciliate protozoa populations of camel, sheep, and goats fed low or high fiber diets

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Abstract

To determine and compare the protozoa populations, we used four dromedaries, four rams and two rumen fistulated male goats.

This study showed that the rumen content of dromedaries contained less protozoa than sheep and particularly goats but contained some protozoa genera that are very efficient in cell wall degradation (Epidinium, Eudiplodinium).

Key words: Protozoa, rumen, dromedaries, sheep, goats

Résumé : Comparaison de la population des protozoaires ciliés du rumen chez le dromadaire, le mouton et la chèvre alimentés par des régimes riches ou pauvres en fibre

Pour déterminer et comparer les populations des protozoaires ciliés au niveau du rumen, on a utilisé quatre dromadaires, quatre béliers et deux boucs porteurs de canules permanentes au niveau du rumen.

A travers cette étude, il s'est averé que les dromadaires ont moins de protozoaires dans le rumen mais renferment des genres plus efficaces dans la dégradation de la lignocellulose (Epidinium, Eudiplodinium).

Mots clés : Protozoaires, rumen, dromadaires, ovins, caprins

ملخص : دراسة حول البروتوزوار في كرش الإبل مقارنة مع الماعز و الأغنام

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1 المدرسة العليا للفلاحة بماطر
2 المعهد القومي للعلوم الفلاحية بتونس

للمساهمة في فهم جيد لدور البروتوزوار في عملية القرض (الهضم) الميكروبي في الكرش، استعملنا أربعة إبليات و أربعة أكباش و تيسان مثقوبين على مستوى الكرش (طريقة اتناسور).

لقد تبين من خلال هاته الدراسة، أن الإبليات لها مجموعة ميكروبية أقل عددا من التي توجد عند الأغنام و الماعز و لكن تمتاز بوجود أنواع خاصة تقرض الألياف بصفة جيدة.

الكلمات المفتاحية : بروتوزوار، كرش، الإبليات، الماعز، الأغنام

Introduction

There are few existing data about ciliate protozoa in the rumen of camelids as compared to other ruminants. The available data are controversial ; William's (1963) have not observed ciliate protozoa in the rumen of camelids maintained on a low protein diet. However, Farid *and al.* (1979) have observed a ciliate protozoa but they did not find ophryoscolex genera, but Ghosal *and al.* (1981) have also observed a small number in the rumen of camelids fed a diet with low fiber and high protein content.

The present study was conducted to determine the total population and various genera of ciliate protozoa in the rumen of dromedaries and small ruminants maintained on two different diets :

- All forage diet (high in fiber) ;
- A diet low in fiber.

Material and methods

Animals and diets

Four male dromedaries with an average body weight of 200 kg and 1 year of age, four rams "Noire de Thibar" with body weight of 46 kg and 4 years of age, and two male goats "Tuni-

sian breed" with body weight of 34 kg and 4.5 years of age were used in this experiment. All animals were rumen fistulated.

Animals were maintained on two different diets (Table 1):

- Vetch-oat hay (ad libitum) ;
- Vetch-oat hay + concentrate (50 %-50 %).

The water was available 24 h/day and all diets were supplemented with a muniral mixture. The animals received the food twice a day over the experimental period (at 8 h : 30 and at 16 h : 30).

Table 1. Chemical composition of diets ingredients (% D.M)

Nutrients Diets ingredients	DM	CP	Ashe	OM	ADF	ADL	P	Na	K
Vetch-oat hay (1)	91	6.1	6.5	93.4	43.7	7.6	-	-	-
Concentrate (2)	92	12.5	2.8	97.2	8.5	1.5	0.4	0.08	0.3
C.M.V. (3)	95	7.2	42	58.2	-	-	-	0.92	0.3

(1) : Vetch-oat hay, ground to 5 cm
(2) : 70 % barley + 30 % triticale, crashed
(3) : Sheep mineral vitamin premix + salt + $CaCO_3$ + phosphate bicalcique + wheat bran

Protozoa counting

The count of protozoa was carried out on strained filtrated rumen content collected two hours after the morning feeding. The rumen content was conserved in the freezer at 4° C in the presence of a fixant (a 100 ml fixant solution contained 50 ml of glycerol, 2 ml of formaldehyde, and 48 ml of distilled water) until the counting. The number of protozoa was counted inside Hawksley's cell as described by Kayouli (1984). We identified the various genera of ciliate protozoa from decriptions of Ogimoto and Imai (1981).

Statistics

The statistical analysis was carried out by the GLM procedure in SAS.

Results and discussion

The total concentration of ciliate protozoa in the rumen content was significantly higher on the species maintained on the diet with the concentrate (Table 2). This result was in agreement with that of Bhatia *and al.* (1986) in dromedaries, Hungate (1966) and DE Smet (1993) in sheep.

The protozoa concentration in the rumen content was significantly lesser in the dromedaries compared to goats and sheep. This result was in accordance with that of Ghosal *and al.*

(1981), Jouany and Kayouli (1988), and Kayouli *and al.* (1993). This could be related to the turn-over of the rumen liquid phase which is very fast in the dromaderies and that the concentration of ammonia-N is lower in the rumen liquid of dromedaries (Jouany and Senaud 1982; Kayouli *and al.* 1995).

We observed also, in this experiment, that the protozoa population was dominated by Entodinium genera in all animal species and regardless of diet. This result is an agreement with that of Farid *and al.* (1979), and Kayouli *and al.* (1993). The rumen content of dromedaries contains a specific genera: Butchlia (Kayouli *and al.* 1993).

According to the classification of Eadie (1967), dromedaries have type "B" population (Epidinium, Eudiplodinium) while the sheep have type "A" population (Ophryoscolex, polyplastron). These results are in accordance with that of Farid *and al.* (1979, 1985), Bhatia *and al.* (1986), Ghosal and Lahiri (1986), Jouany and Kayouli (1988), Kayouli *and al.* (1993), and Jouany *and al.* (1995). In goat species, the protozoa population belong also to type "B".

The fact that "B" type protozoa are found in the dromedary rumen (Table 2) is very interesting as these protozoa are very active in the degradation of cell wall (Jouany 1989).

Table 2. Total count (10^5) and various genera of protozoa in %

Diets	Spe	N	Total	Ento.	Epid.	Eudip.	Poly.	Ophry	Isotr	Butch
Hay	D	16	2.7a	59.6a	20.0aA	10.1a	*	*	*	8.9
	C	8	4.6b	71.2b	12.1b	2.9b	*	*	13.8A	*
	O	16	4.1bA	81.8cA	*	*	1.6A	5.6bA	11.6	*
Hay +	D	20	3.3a	62.9a	17.5aB	10.0a	*	*	*	9.6
Concent	C	10	5.3b	81.1bB	7.9b	1.6b	*	*	9.3b	*
	O	19	5.0bB	83.7cB	*	*	2.1B	4.0B	9.4	*
Error			1.2	7.2	5.5	3.0	0.5	2.2	3.9	0.7
Spe. effect			S	S	S	S	-	S	NS	-
Diet effect			S	S	S	NS	S	S	S	NS

a, b, c: The values, for the same diet, for the same column, with different letters are statistically different (P<0.05). (Species effect).
A,B: The values, for the same specie, for the same column, with different letters are statistically different (P<0.05). (diet effect).
N: Sample number
D: Dromedaries (n=4), C: Goats (n=2), O: Sheep (n=4)
*: Genera does not exist
NS: Not significant (P<0.05)
Spe: Specie
Concent: Concentrate
Ento: Entodinium; Epid.: Epidinium; Eudip.:Eudiplodinium; Poly.: Polyplastron;
Ophry:Ophryoscolex; Isotr.:Isotricha; Butch.: Butchlia.

Conclusion

We conclude that the rumen content of dromedaries have less protozoa compared to small ruminants. It may contains some protozoa genera that are very efficient in cell wall degradation.

Further studies should explore the effects of the other components of the microbial ecosystem (Bacteria, fungi) in relation to cell wall degradation. They are necessary to contribute to understand the specificity of these animal species.

References

Bhatia J.S., Ghosal A.K., Raisinghani M.M. and Tauner R.K. (1986). Studies on rumen protozoa of camels. *Ind. Vet.J.*, **63:** 109.

De smet S. (1993). Effects of defaunation on site, nature, and extent of digestion in sheep. Doctorat thesis. State University of Gent (Belgium).

Eadie J.M. (1967). Studies on the ecology of certain rumen ciliate protozoa. *J. Gen. Microbial,* **49:** 175.

Farid M.F.A., Shawket S.M. and Abdelrahman M.F.A. (1979). Observations on nutrition of camels and sheep under stress. Proc. I.F.S. Workshop on camels. Khartoom (Sudan), dec. 1979. I.F.C. Provisional report 06: 125.

Farid M.F.A., Sooud A.O. and Hassan N.I. (1985). Effects of type of diet, of level of protein intake on feed utilisation in camel and sheep. Proc. Of the 3rd a.A.A.P. Animal Science Congress, may 1985, seoul (Korea), 781-784.

Ghosal A.K., Tauner R.K. and Dwaraknath P.K. (1981). Note on rumen microorganisms and fermentation pattern in dromedary. *Ind. J. Anim. Sci.*, **51:** 1011.

Ghosal A.K. and Lahiri S.B. (1986). Some observations on protozoan protein and amino-acids from rumen of camel. *Ind. Vet. J.*, **63 :** 729.

Hungate R.E. (1966). The rumen and its microbs. Acad. Press, New York and London.

Jouany J.P. and Senaud J. (1982). Influence des ciliés du rumen sur la digestion des différents glucides chez le mouton. 1. Utilisation des glucides pariétaux (cellulose et hémicellulose) et de l'amidon. Reprod. Nutr. *Develop.*, **22:** 735.

Jouany J.P. and Kayouli C. (1988). La digestion microbiennes chez les camélidés. In : J. L. Tisserand (Editor), actes des séminaires sur la nutrition, la digestion et l'alimentation du dromadaire, ouergla (Algérie) : 28 fev-1 mars 1988. Ciheam, a2, 89-96.

Jouany J.P. (1989). Effects of diets on populations of rumen protozoa in relation to fiber digestion. In the roles of protozoa and fungi in ruminant digestion (1989). (J.V. Nolan, R.A. Leng, and D.I. Demeyer, editors), Armidale NS 2531, Austria : Penambul books. 26-29 sept. 59-74.

Jouany J.P., Dardillat C. and Kayouli C. (1995). Microbial cell wall digestion in camelids. *Opt. medit.* B13: 33

Kayouli C. (1984). Etude des effets de la défaunation du rumen sur la digestion chez le mouton. Thèse de doctorat en sciences agronomiques. Université de Gand (Belgique).

Kayouli C., Jouany J.P., Demeyer D.I., Ali A., Taoueb H. and Dardillat C. (1993). Comparative studies on the degradation and mean retention time of solid and liquid phases in the forestomachs of dromedaries and sheep fed low quality roughages from Tunisia. *Anim. Feed. Sci. Tech.* **40:** 343

Kayouli C., Jouany J.P., Dardillat C. and Tisserand J.L. (1995). Particularités physiologiques du dromadaire : conséquences sur son alimentation. *Opt. medit.* B13: 143

Ogimoto K. and Imai S. (1981). Atlas of rumen microbiology. Jap. Sci. Soc. Press, Tokyo.

Williams V.J. (1963). Rumen function in the dromedary. Nature, 197: 1221.).