The camel (*Camelus dromedarius*) produced three times less methane than cattle receiving the same feeding ration

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Abstract

The Australian Department of Climate Change and Energy Efficiency announced that a camel produces methane equivalent to one ton of carbon dioxide a year, making the animal one of the country's biggest greenhouse gases emitters. In order to stop pollution, a plan was proposed to shoot the camels from a helicopter or round them up and send them to the slaughterhouse. As scientists working on camel physiology and human beings dealing with animal welfare and protection, we developed a trial to measure camel methane emissions and compared them to dairy cattle receiving the same amount of feed. Seven Holstein cows (average weight 350 kg) and seven she-camels (average weight 330 kg) were used in this study. All animals were not pregnant and are in the latest stage of lactation with very limited milk production. Animals were housed in boxes and fed individually the same ration composed of 3 kg of barley and 2 kg of lucerne hay daily at 9 a.m. After eating, methane emissions measurements were carried out for 2 hours on several periods per day by using a face mask open circuit system. The results showed that the camel eliminated most of the methane by eructation with an average of 18 (eructations) emission cycles per hour. In cattle, the number of emission cycles averaged 54 eructations per hour. Methane emission from the camel was estimated to average 67 liters per day corresponding to 15.2 liters per kg of dry matter intake while dairy cattle methane emissions was estimated to average 194 liters per day corresponding to 42.2 liters per kg of dry matter intake. The present study showed clearly that dairy cattle produced three times more methane than camel when the two species received the same diet. Some digestive and metabolic particularities of each species may explain the difference. Other solutions to reduce the greenhouse gases should be proposed other than the eradication of the camel population of Australia.

Keywords: Greenhouse gas, dairy cattle, camel, methane emission, eructation.

Le chameau (*Camelus dromedarius*) a produit trois fois moins de méthane que la vache recevant la même ration alimentaire

Résumé

Le département australien des changements climatiques et de l'efficacité énergétique a annoncé qu'un dromadaire produit du méthane équivalent à une tonne de dioxyde de carbone par an, faisant de l'animal l'un des plus gros émetteurs de gaz à effet de serre du pays. Afin d'arrêter la pollution, un plan a été proposé pour tirer sur les dromadaires d'un hélicoptère ou les rassembler et les envoyer aux abattoirs. En tant que scientifiques, travaillant sur la physiologie du dromadaire et défenseurs du bien-être des animaux, nous avons développé une expérimentation durant laquelle nous avons mesuré les émissions de méthane chez des chamelles afin de les comparer à celles des bovins laitiers recevant la même quantité d'aliments. Pour cela, sept vaches Holstein (poids moyen 350 kg) et sept chamelles (poids moyen 330 kg) ont été utilisées dans cette étude. Toutes les femelles des 2 espèces n'étaient pas gestantes et ont été au dernier stade de lactation avec une production de lait très limitée. Les animaux ont été logés dans des boxes et nourris individuellement avec la même ration, composée de 3 kg d'orge et 2 kg de foin de luzerne par jour. Les mesures des émissions de méthane ont été effectuées en continu durant 2 heures à plusieurs périodes par jour en utilisant un système de calorimétrie indirecte à circuit ouvert avec l'utilisation d'un masque facial. Les résultats ont montré que les chamelles éliminaient la majeure partie du méthane par éructation avec une moyenne de 18 cycles d'émission par heure. Chez les bovins, le nombre de cycles d'émission a été en moyenne de 54 éructations par heure. Les quantités de méthane émissent par les chamelles ont été estimées à 67 litres par jour, soit 15,2 litres par kg de matière sèche ingérée, tandis que les émissions de méthane des bovins laitiers ont été estimées à 194 litres par jour, soit 42,2 litres par kg de matière sèche ingérée. La présente étude a clairement montré que les bovins laitiers produisaient trois fois plus de méthane que les chamelles lorsque les deux espèces recevaient le même régime alimentaire. Certaines particularités digestives et métaboliques de chaque espèce peuvent expliquer la différence. D'autres solutions pour réduire les gaz à effet de serre devraient être proposées autre que l'éradication de la population des dromadaires en Australie.

Mots-clés: Gaz à effet de serre, bovins laitiers, dromadaire, émission du méthane, éructation.

INTRODUCTION

The Australian Department of Climate Change and Energy Efficiency announced that a camel produces methane equivalent to one ton of carbon dioxide a year, making the animal one of the country's biggest greenhouse gases emitters. In order to stop pollution, a plan was proposed to shoot the camels from a helicopter or round them up and send them to the slaughterhouse. As scientists working on camel production and defender of animal welfare and protection, we conducted a trial with one objective to measure methane emissions in the camel and to compare them to emissions from dairy cattle receiving the same feeding ration.

MATERIAL AND METHODS

Seven Holstein cows (average weight 350 kg) and seven she-camels (average weight 330 kg) were used in this study. All animals were not pregnant and are in the latest stage of lactation with very limited milk production. Animals were housed in boxes and fed individually the same ration composed of 3 kg of barley grains and 2 kg of

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lucerne hay daily at 9 am. After ration termination, the animals were subjected to methane emission measurements by using facial mask connected to a methane analyzer using an open circuit system (Figure 1). Nitrogen gas and span gas containing 200 ppm of methane were flushed through the system daily to calibrate the analyzer. Before the beginning of the trial, the cows and the camels were adapted to the feeding ration, to the facial mask and to the noise of the aspirating pump. Methane emission was measured continuously for 2 to 3 hours for several periods per day (Figure 2). The data on methane production were expressed in liters per day, liters per kg of dry matter intake and Kg per animal per year (Emission Factor). The data are presented as means and standard of deviations. The difference in methane production between the cows and the camels was tested by using the paired t-test and considered significant when $P<0.05$.

RESULTS AND DISCUSSION

Methane production was measured in both species for several periods of 2 hours each within the day with a mask covering the face of the animal and was recorded on tracing paper continuously showing differences in methane emission cycles between the 2 species. In camel, an average of 18 emission cycles per hour corresponding to eructation number was observed and most of the methane was emitted by eructation (90 %) while the rest is eliminated through the expiratory gases (Figure 3). In cattle, the number of emission cycles, corresponding to the eructation number, averaged 38 eructations per hour and most of the methane was emitted by eructation but less than in camel (85 %) while the rest is eliminated through the respiratory gases (Figure 4). Table 1 shows that methane emission in camel was estimated to average 66.6 liters per day corresponding to 15.2 liters per kg of dry matter intake while in dairy cattle methane emission was estimated to average 193.8 liters per day corresponding to 42.2 liters per kg of dry matter intake (Table 2). The present study showed clearly that dairy cattle produced three times more methane than camel when the 2 species received the same feeding ration. It is for the first time that methane emission was measured in the camel (*Camelius dromedarius*). Vernet *et al.*, (1997) measured the methane emissions in the Lamas put in calorimetric chambers and reported that the production of methane, expressed in liters per kg of dry matter intake, was significantly lower in lamas compared to sheep.

A huge difference in methane emission was observed in camel compared to dairy cattle. This difference in methane production between the 2 species could be attributed to some anatomical and physiological particularities of the digestive tract of the camel. The amount of methane emission by an animal is a good indicator of the amount of feeding ration that was fermented in the fore-stomach. It is probable that in cattle the whole feeding ration was fermented in the fore-stomach while in camel a small part of the feeding ration was fermented in the fore-stomach and the rest of the ration escaped the fore-stomach to be digested in the intestine. It should be noted that the fore-stomach of the camel is composed of three compartments instead of four in cattle with the presence of the reticulo-omasal orifice (absent in the camel) which has a small diameter

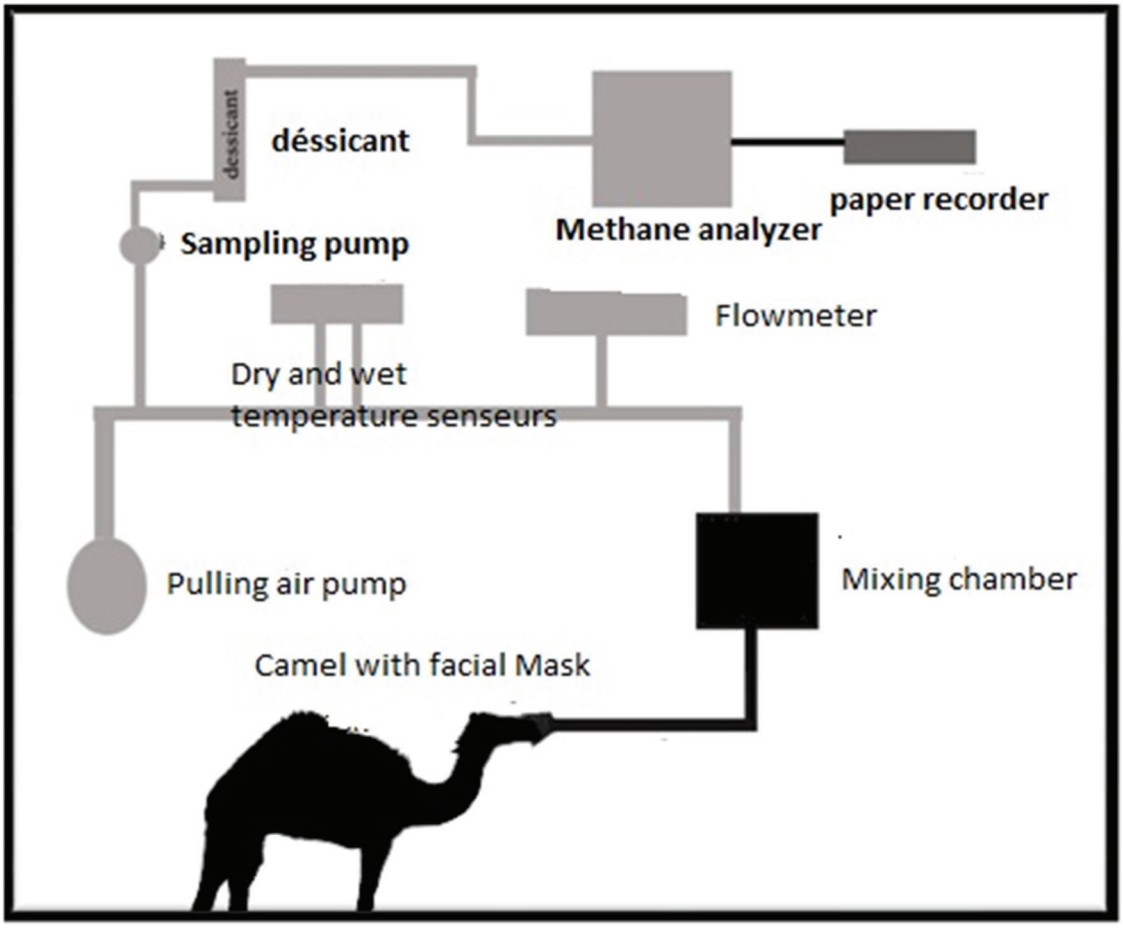

Figure 1: The experimental design showing the technique used to measure methane emission in camel

Figure 2: A camel carrying a facial mask for measurement of methane emission with a companion to reduce the stress on the experimental animal

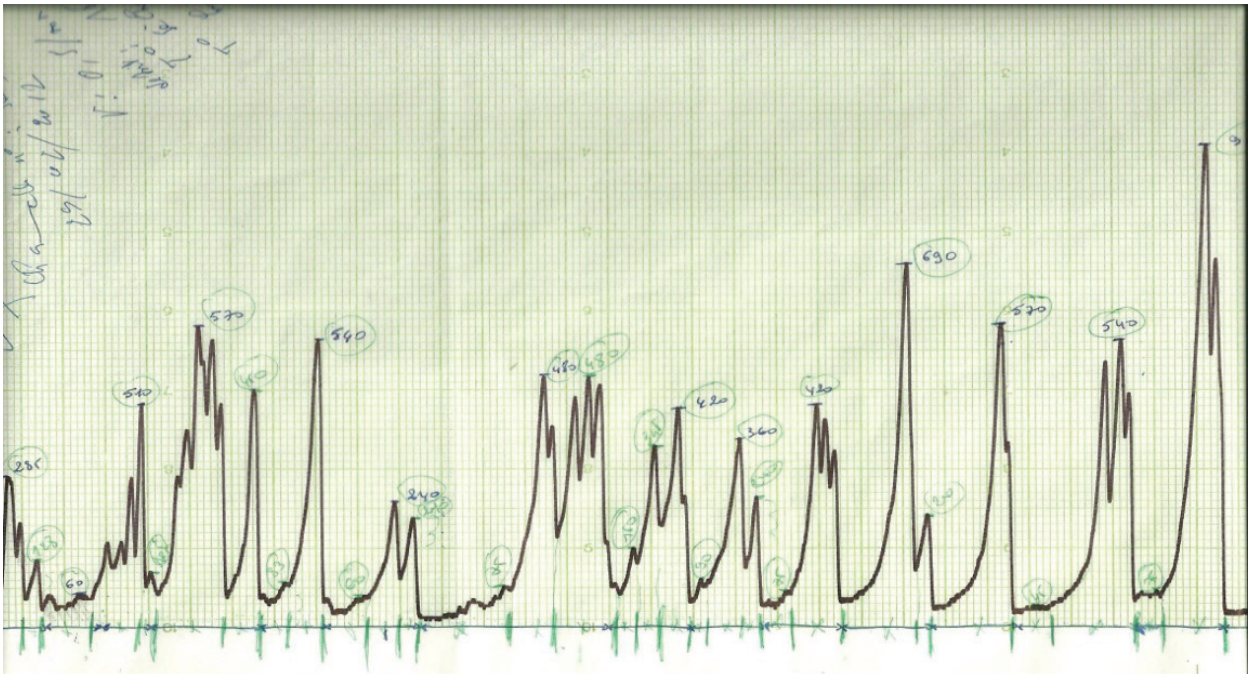

Figure 3: Methane emission in camel and its variations with time (5 mm/min)

Table 1: Methane production in camels expressed in liters/day, liters/kg of dry matter intake and kg/animal /year

Camel	Methane production (Liters/day)	Methane production (Liters/kg of dry matter intake)	Emission factor (Kg/animal/year)
1	52.7	12.0	13.7
2	77.2	17.6	20.0
3	57.7	13.2	15.0
4	73.8	16.8	19.2
5	72.8	16.6	18.9
6	62.4	14.2	16.2
7	69.7	15.9	18.1
Mean	**66.6**	**15.2**	**17.3**
Standards of deviation	8.5	1.9	2.2

with a very selective role with respect to feed particles size. Camels showed higher turnover for the liquid phase of the rumen, allowing the large part of the ration to escape the fermentation and to be digested in the intestine (Heller *et al*.,1986) with consequently less methane is produced.

Grazing camels are very selective looking for feed particles that are rich in soluble carbohydrates and proteins, while the cattle are considered as browsers with no selection with respect to the feed particles grazed. Camels have higher level of glycemia (1.5 g/l) compared to cattle (0.5 g/l) and to maintain this high level of glucose in the blood, most of the soluble carbohydrates provided by the feeding ration should escape the fermentation to be digested in the intestines. Unlike the cattle, the importance of volatile fatty acids (fermentation products) as source of energy for camels is very limited. Compared to cattle, camel spend less time in mastication and rumination but produce more saliva (Kay and Maloiy, 1989), conditions not in favor of methane production. Kayouli *et al*., (1993) have shown that the bacteria populations of the fore-stomach were comparable for the two species but less protozoa are found in camels suggesting that less methane is produced in camel since methane producers bacteria are living in symbiosis with protozoa.

According to Jouany (2000), camel has high buffering capacity for acid feeds with a ruminal pH never below 6 and does not show metabolic disorder such as acidosis which is frequently observed in dairy cattle fed high concentrate diets. Ruissi (1994) measured volatile fatty acid profile in the rumen of the two species and reported that the ratio of propionate over acetate was higher in camel compared to cattle receiving the same feeding ration. The limited production of acetate in the camel may explain to some extent the reduced production of methane.

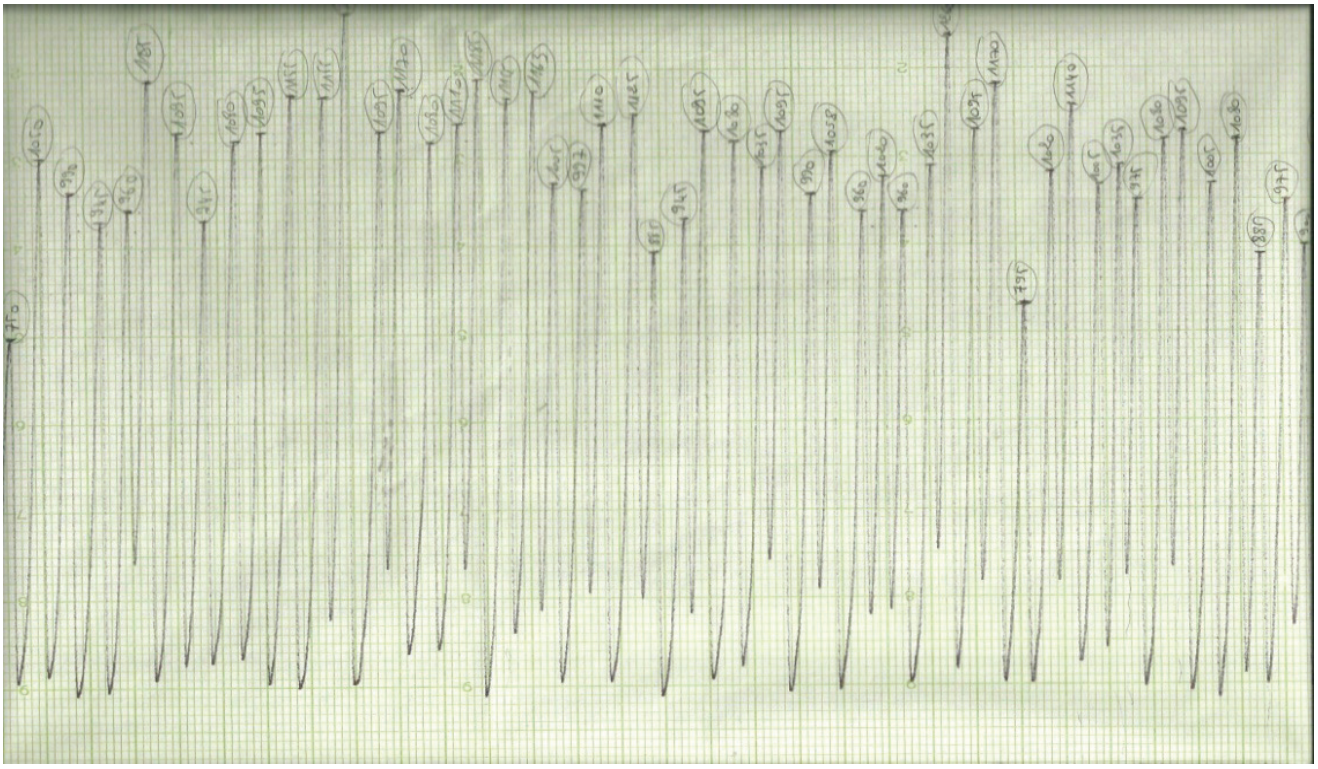

Figure 4: Methane emission in dairy cattle and its variations with time (5mm/min)

Table 2: Methane production in dairy cattle expressed in liters/day, liters/kg of dry matter intake and kg/animal/year

Dairy cattle	Methane production (Liter/day)	Methane production (Liter/kg of dry matter intake)	Emission factor (Kg/animal/year)
1	148.7	34.0	38.6
2	157.8	36.0	41.0
3	303.1	69.2	78.7
4	200.1	45.7	51.9
5	219.3	35.8	56.9
6	159.9	36.5	41.5
7	167.5	38.2	43.5
Mean	**193.8**	**42.2**	**50.3**
Standards of deviation	50.5	11.6	13.1

CONCLUSION

Methane production was measured in camel and dairy cattle receiving the same diet and the data indicated that dairy cattle produce three times more methane that camel, expressed in liter per kg of dry matter intake. Some anatomical and physiological particularities in relation to the digestive tract and carbohydrates metabolism of the camel compared to cattle may explain the difference. Other solutions to reduce the greenhouse gases should be proposed rather than the eradication of the camel population of Australia.

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