Dedication

To my father and mother…

To my loving brothers and sisters…

To Rawia Adam…

For all the wonderful and lovely things you do

I dedicate this work with love and affection.

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List of Contents

List of Tables

Abstract

The effect of cut number, and heat treatment on chemical composition, in vitro gas production, organic matter digestibility (OMD), and metabolizable energy (ME) of Berseem Higazi were investigated. Berseem Higazi (*Medicago sativa*) samples were collected from two cuts (first and second cut) from the same field, in Hillat Kuku, at middle bloom stage on February 2. 2007, for the first cut, and on April 17. 2007, for the second cut. Hay were heated in a forced-air oven at different temperatures and heating intervals, to determine the effect of cut number, and heat treatment on chemical composition, in vitro gas production, organic matter digestibility (OMD), and metabolizable energy (ME) of Berseem Higazi. Gas production was measured at 3, 6, 9, 12, 24, 48, 72, and 96 hours, and gas production kinetics were estimated.

Number of cut had a significant effect on chemical composition, in vitro gas production, OMD, and ME, second cut had the highest dry matter (DM), neutral detergent fiber (NDF), and acid detergent insoluble nitrogen (ADIN) content (95.59%, 53.05%, 7.59%, respectively), while the total nitrogen (TN) and crude protein (CP) contents were not affected by cutting number. Second cut had a significantly ($P<0.05$) higher gas production from quickly soluble fraction (a) (3.11), than the first cut (-2.73), while first cut had a higher gas production from slowly degradable fraction (b), gas

production rate (c), OMD, and ME, (39.45, 0.11, 64.21%, and 8.49MJ/kgDM, respectively), than the second cut (33.43, 0.08, 59.46%, and 4.92MJ/kgDM, respectively). There were no significant differences among cuts in term of potential gas production (a+b).

Heating the hay increased its DM, NDF, ADF, and ADIN, while TN and CP decreased with increased temperatures.

Gas production rate (c), OMD, and ME, decreased with raised temperatures.

Optimal heat treatments as indicated by the greatest increase in OMD and ME were140^{o} C for 120 minutes (66.78%, 9.10MJ/kgDM) and130^{o} C for 120 minutes (65.85%, 8.90MJ/kgDM).

ملخص الدراسة

تمت دراسة أثر رقم القطعات، والمعاملة الحرارية على التركيب الكيميائي، الغاز المنتج معملياً، هضم المادة العضوية، والطاقة الأيضية للبرسيم الحجازي.

جمعت عينات البرسيم الحجازي من قطعتين (أولى وثانية) من نفس الحقل في منطقة حلة كوكو، بنسبة إزهار 50%، قطعت القطعة الأولى في 2 فبراير 2007، والثانية في 17 ابريل 2007، تم معاملة العينات بالحرارة باستخدام فرن الهواء الساخن على درجات مختلفة ولازمان مختلفة.

أخذت قراءات للغاز كل 3، 6، 9، 12، 24، 48، 72، و96 ساعة، وقدرت حركة إنتاج الغاز.

وجد ان رقم القطعات له اثر معنوي على التركيب الكيميائي، الغاز المنتج معملياً، هضم المادة العضوية، والطاقة الأيضية. وجد ان القطعة الثانية بها نسبة اكبر من المادة الجافة، ألياف المنظف – المحايد، والنايتروجين غير الزائب للمنظف الحمضي (95.59، 53.05، و7.59%) على التوالي، بينما لم يتأثر النيتروجين الكلي والبروتين الخام برقم القطعات.

وجد ايضاً ان القطعة الثانية بها اعلى نسبة من الغاز المنتج من الجزء سريع الزوبان(a)، (3.11)، عن القطعة الأولى (-2.73). بينما وجد ان القطعة الأولى بها أعلى نسبة من الغاز المنتج من الجزء البطئ التكسر، معدل إنتاج الغاز، هضم المادة

العضوية، والطاقة الأيضية (39.45، 0.11، 64.21، و8.49) على التوالي، عن القطعة الثانية (33.43، 0.08، 59.46، و4.92) علىالتوالي.

لا توجد فروق معنوية بين القطعات بالنسبة لإنتاج الغاز الكامن.

أدت المعاملة الحرارية لدريس البرسيم لزيادة النادة الجافة، ألياف المنظف – المحايد، ألياف المنظف – الحمضي، والنيتروجين غير الزائب للمنظف الحمضي. بينما تناقص النيتروجن الكلي والبروتين الخام بارتفاع درجة الحرارة.

وجد ان المعاملة الحرارية المثلى، على اساس أعلى زيادة في هضم المادة الضوية والطاقة الأيضية، كانت على درجة حرارة 140^{o} م لمدة 120 دقيقة (66.78، 9.15) ودرجة حرارة 130^{o} م لمدة 120 دقيقة (65.85،8.90).

Introduction

Medicago Sativa is considered the oldest roughage crop in the world that occupies about 75 million acres from different areas of the world; it is a good food for ruminants (Yosif and Gazala, 1994)

According to Agabawi (1968) the crop was first introduced to the Sudan during World War 1 when seeds of the variety "Higazi" were imported from Egypt for cultivation north of Khartoum. Marble (1984) stated that alfalfa is the chief irrigated fodder crop in the Sudan; it is produced by both large farms and small land holders. According to the Ministry of Agriculture and Forests, department of agricultural economic, about 71707 acres were irrigated for alfalfa at 2004 – 2005 in the Sudan. Alfalfa is high in calcium, protein and carotene, and in many other minerals and vitamins (Ensiminger and Olentine, 1978). In addition it is an excellent source of protein, vitamins and minerals. Alfalfa is important for improving the soil; good quality alfalfa hay contains digestible fibers and a useful range of minerals and vitamins (Haiqing, 2004). It is a major source of dietary protein for lactating dairy cows in some regions (Yang *et al*, 1993). Its nutritive value is affected by many factors, like irrigation regimen, stem to

leaf ratio, cut number. Rumen degradability of forage is important because rumen microbial microorganisms depend on rumen degraded proteins as a source for N and peptide requirements. However excessive degradation of forage proteins in the rumen leads to ammonia-N in excess of microbial needs (Broderick and Buxton, 1991). Alfalfa protein is degraded extensively in the rumen which is then utilized for ruminal microbial protein synthesis. Wastage of forage protein caused by NH_3 overflow occurs when fermentable energy is insufficient to support the utilization of NH_3 for microbial growth. Evidence from several experiments suggests that the protein in alfalfa is utilized insufficiently by dairy cows (Broderick *et al,* 1992; Van Horn *et al*, 1996). Alfalfa N utilization can be as low as 23%, whereas values for barley, oats, and triticale are as high as 28% (Van Horn, 1996).

This work was carried out to study the effect of cut number and heat treatment of alfalfa hay on its chemical composition, and organic matter digestibility.

The objective of this study is to determine the effects of cutting number, and heat treatment on chemical composition, in vitro gas production, organic matter digestibility (OMD), and metabolizable energy (ME) of Berseem Higazi hay.