

THE EFFECT OF FAT AND FATTY ACIDS ADDED TO THE FEED OF RUMINANTS ON GREENHOUSE GAS

Yazar Meryem Badayman

Gönderim Tarihi: 26-Eki-2022 11:07AM (UTC+0300)

Gönderim Numarası: 1935775922

Dosya adı: kitap_b_l_m_Ruminant.docx (524.28K)

Kelime sayısı: 1718

Karakter sayısı: 9234

THE EFFECT OF FAT AND FATTY ACIDS ADDED TO THE FEED OF RUMINANTS ON GREENHOUSE GAS

ABSTRACT

Greenhouse gases, which have an important place in climatic changes, are increasing rapidly with the increase of gases given to the atmosphere by humans. In relation to this, with the increase in the world population, the demand for animal products such as meat, milk and eggs increases, which is known to increase greenhouse gas emissions with animal production and cause environmental problems.

Worldwide, livestock is responsible for 14.5 percent of anthropogenic greenhouse gas emissions and therefore a significant portion of current climate change. The greatest effect on the formation of greenhouse gases is related to the release of methane gas by enteric fermentation as a result of ruminants breaking down cellulose in feed. About 10% of methane production in livestock is produced from anaerobic manure storage. One of the most effective of these strategies is known to reduce enteric methane emissions by adding oil (rapeseed, sunflower seeds and linseed, sunflower oil, coconut oil, corn oil, etc.) to the diet of ruminants. The effect of medium chain fatty acids on methane production, digestibility and rumen fermentation in ruminant animals has been observed. Methane production of dietary fats; The effect on feed digestibility and rumen fermentation is known to differ between studies, which may be related to the type and concentrations of fat, diet composition, and animal species. The aim of this study; scientific data on the use of fatty acids as feed additives in ruminant rations to reduce enteric methane production have been collected and studies on reducing the emission of greenhouse gases that affect climate change have been included.

1.INTRODUCTION

One of the biggest environmental problems of today is global climate change. Especially the change in temperatures, the main greenhouse gases carbon dioxide, methane, etc. This can be explained by the high level of production that includes emissions (Albergel et al., 2010). Properties such as

temperature, precipitation amount, air humidity and soil are constantly changing with climate change⁸ it is known that the main reason for this is human activities (Alirezai et al., 2017; Bayer, 2015; Poumen et al., 2019; Chehabeddine and Tvaronavičienė, 2020).

The greenhouse effect is an increase in the temperature of the earth's surface due to the heating of the lower layers of the atmosphere by the accumulation of greenhouse gases. As a result, the air temperature is greater than it should be, and this leads to such irreversible consequences as climate change⁷ and global warming (Huang et al., 2016). Methane (CH₄), Carbon Dioxide (CO₂), Nitrous oxide/Diazotyl oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulfur hexafluoride (SF₆) are 6 main compounds greenhouse gas emissions (IPCC, 2007; IPCC, 2013; Singh ve Singh, 2012; Solomon ve ark., 2007). These compounds the most important ones are CH₄, CO₂ and N₂O (Haque, 2018). Especially; the rapid increase in the amount of CO₂ and CH₄ causes climate change that can threaten marine life and human survival. CO₂ leads to the growth of the carbon footprint, also known as it is known, and causes many negative effects on the environment (Hristov et al., 2018). In addition to environmental pollution, the problem of depletion of fossil fuels has also increased. With the studies on climate change issues, awareness of the rise and fall in fossil fuel prices and the sustainability of energy security has also increased. (Edenhofer et al., 2011; Lu et al., 2015).

The aim of this study; scientific data on the use of fatty acids as feed additives in ruminant rations to reduce enteric methane production have been collected and studies on reducing the emission of greenhouse gases that affect climate change have been included.

2. RUMINANTS AND THE RELATIONSHIP OF RUMINANTS WITH GREENHOUSE GAS

Ruminants; They are quite different from monogastric animals in terms of the anatomical and physiological characteristics of their digestive systems (Janssen, 2010). Ruminants, which have four compartments and a highly developed stomach structure, are able to ferment the nutrients

they have taken with feed into animal foods such as meat and milk, thanks to the enzymes secreted by the microorganisms (bacteria, archaea, protozoa and yeast fungi) in their reticulo rumen Jafari et al., 2019). Carbohydrate sources taken with feed are fermented in the rumen and converted into volatile fatty acids (VFA), H₂ and CO₂. The main volatile fatty acids formed as a result of fermentation are acetic, propionic and butyric acids, which are used to meet the energy needs of animals (Zhao et al., 2020). Rumen methane reaction is showed at Figure 1.

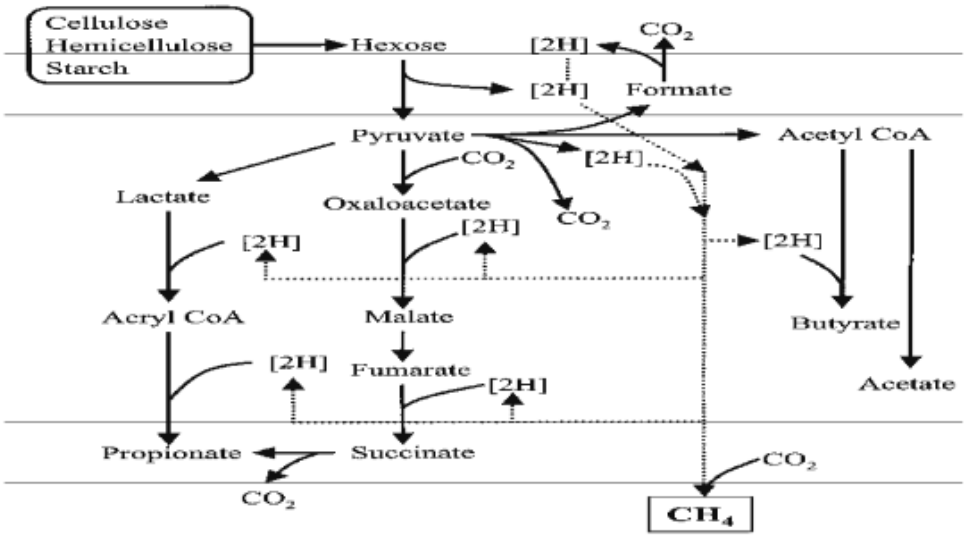


Figure 1. Rumen methane reaction (Görgülü et al., 2009)

H₂ and CO₂ released as a result of rumen fermentation are produced by methanogenic microorganisms (bacteria, archaea, protozoa); $\text{CO}_2 + 4\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$ is directed to methane gas formation (methanogenesis) by reduction reaction (Görgülü et al., 2009). The figure 2 showed methane production processes in ruminant animals.

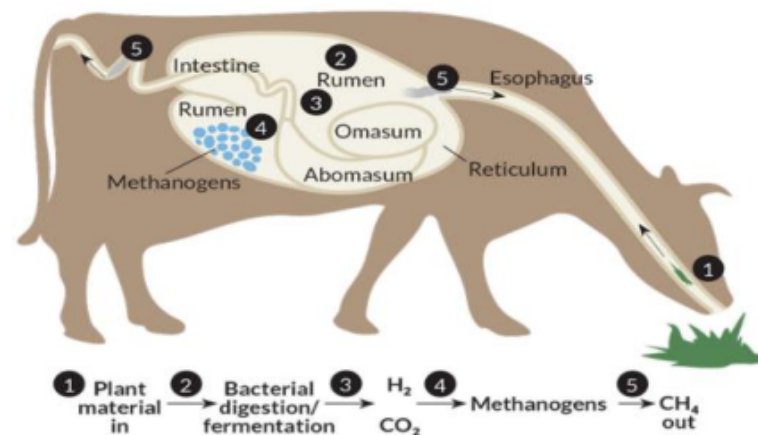


Figure 2. Processes of methane production in ruminants (Zhao et al., 2020)

2.1. Strategies to reduce methane emissions

Ruminant animals contribute to anthropogenic methane (CH₄) in greenhouse gas formation. Therefore estimating gas emissions from these livestock and developing new technology related to it has become an important issue (Haque, 2018).

Feed management decisions are essential to the ruminant animal system as enteric microbial fermentation affects digestion, nutritional value and ruminant feed composition. Among the main causes of greenhouse gas emissions from livestock farming are methane (CH₄) emissions from enteric fermentation and stored manure, and nitrous oxide (N₂O) from animal excreta. As a result, animal nutrition and feeding management have become an important issue in order to reduce greenhouse gas emissions. Reducing the amount of dietary crude protein in animal feeds, forage quality, increasing feed digestibility, reducing the amount of crude protein by increasing grain levels etc. are among the promising options to control gas emissions (de Souza Congio et al., 2021) (Figure 3). Many technologies and methods for reducing greenhouse gasses are implemented in many countries, including the United States.

Emissions, which are the main cause of ruminant livestock, are the result of enteric fermentation and manure management and account for 40% of total emissions (FAOSTAT, 2008). In greenhouse gas emissions, nitrous dioxide emissions directly

from the rumen occur with enteric fermentation. The excretion of faeces and urine, both in the field and in the stable, causes emissions of methane, nitrous oxide and ammonia, due to fermentation, nitrification, denitrification and ammonia volatilisation, respectively (Mekuriaw ve ark., 2020). In addition, direct carbon dioxide and nitrogen oxide emissions occur with silage feeding made with the use of fuel-powered machinery. In addition, methane nitrogen oxide and ammonia emissions occur in stored fertilizers depending on the storage system. Emissions during barn and storage are known to be higher than pasture emissions (Schils, 2005).

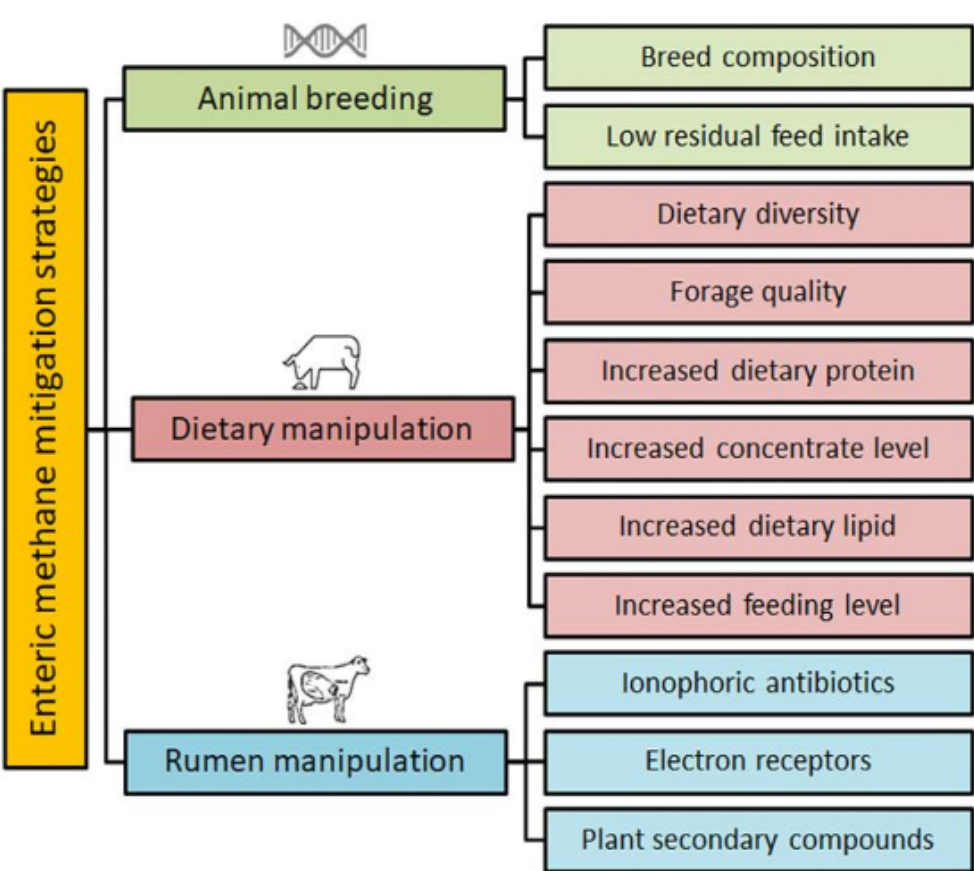


Figure 3. Many technologies and methods lists for reducing greenhouse gasses (de Souza Congio et al. 2021).

2.1.1. Adding fat to the ration

Fat, which is one of the energy sources used in the ration, is known to significantly reduce methane production. Although the addition of oil to the ration varies according to the amount, form and composition of the feed, it has been reported that methane production decreases by 5.6% for each 1% of added oil (Beauchemin et al., 2006). The main reason for this is that methane production decreases with the change of microbial flora and energy use efficiency in the rumen (McGinn et al., 2004; Beauchemin and McGinn, 2006). In studies conducted in dairy cows, it was stated that the addition of 5% myristic acid, 5.7% flaxseed, extruded flaxseed and flax oil to the ration reduced methane release. It was determined that the decrease was caused by the suppression of the activities of methanogens in the rumen by myristic acid (Reverdin et al., 2003; Odongo et al., 2007). In a study carried out by adding coconut oil at different feed rates in beef cattle; It was determined that methane release decreased in all oil added groups (Lovett 2003). Likewise, Martin et al. (2008) concluded that the addition of raw flaxseed, extracted flaxseed, and flaxseed oil to dairy cattle diets significantly reduced methane production, and that the addition of oil to the ration inhibited cellulosic bacteria and protozoa, resulting in decreased feed fermentation. In another study, it was observed that methane release was reduced by 34, 21 and 20 %, respectively, in feeds depleted in stearic acid, enriched in oleic acid, canola oil, palm kernel oil and coconut oil (Blanco et al., 2012).

On the other hand, in another study conducted in dairy cows, it was reported that the addition of a mixture of cottonseed oil: canola oil in equal proportions (50:50) to the ration of 2.3%, 4.0 and 5.6 did not change the methane release (Johnson et al., 2002).

In another study on the inclusion of sunflower oil and proteolytic enzyme in feeds, it was stated that the addition of sunflower oil to the ration significantly reduced methane gas production, but the addition of enzyme did not cause any change in methane gas production (McGinn et al., 2014).

On the other hand, methane production, which decreased by 37% with the addition of flaxseed to barley silage, did not

change when flaxseed was added to meadow grass (Chung et al., 2011).

In a study investigating the effects of thyme, mint and orange oils on rumen fermentation, it was reported that there was a significant decrease in CH₄ and CO₂ gas production with increasing levels of essential oils added to the ration (Canbolat et al., 2011).

9

Patra et al. (2006) found that fennel, clove, garlic, onion and ginger essential oil inhibited methane production in vitro.

3.CONCLUSION

When the mentioned studies on reducing methane release by adding fat to the rations are evaluated, it is seen that the addition of fat sources rich in unsaturated fatty acids to the rations reduces methane release. The main reason for this is the digestion of structural carbohydrates with the addition of fat, the acetate: propionate ratio decreases or the number of methanogenic microorganisms decreases or both situations occur together and methane production decreases. Also, in case of adding fat sources rich in unsaturated fatty acids to the ration, some of the H₂ in the rumen is converted to unsaturated fatty acids by rumen microorganisms. The hydrogen in the environment is reduced by using in the saturation (biohydrogenization) and methane production decreases depending on this decrease.

THE EFFECT OF FAT AND FATTY ACIDS ADDED TO THE FEED OF RUMINANTS ON GREENHOUSE GAS

ORJİNALLİK RAPORU

%15	%12	%7	%7
BENZERLİK ENDEKSİ	İNTERNET KAYNAKLARI	YAYINLAR	ÖĞRENCİ ÖDEVLERİ

BİRİNCİL KAYNAKLAR

1	lib.unnes.ac.id İnternet Kaynağı	%4
2	vetjournal.ankara.edu.tr İnternet Kaynağı	%2
3	R. L. M. Schils. "A farm level approach to define successful mitigation strategies for GHG emissions from ruminant livestock systems", Nutrient Cycling in Agroecosystems, 02/2005 Yayın	%2
4	Ronaldo Vibart, Cecile de Klein, Arjan Jonker, Tony van der Weerden et al. "Challenges and opportunities to capture dietary effects in on-farm greenhouse gas emissions models of ruminant systems", Science of The Total Environment, 2021 Yayın	%2
5	Submitted to University of Sydney Öğrenci Ödevi	%2
6	library.wur.nl İnternet Kaynağı	%1
7	lawdigitalcommons.bc.edu İnternet Kaynağı	%1
8	Submitted to Ivy Tech Community College Central Office Öğrenci Ödevi	%1

C. Benchaar, S. Calsamiglia, A.V. Chaves, G.R. Fraser, D. Colombatto, T.A. McAllister, K.A. Beauchemin. "A review of plant-derived essential oils in ruminant nutrition and production", Animal Feed Science and Technology, 2008

Yayın

Alıntıları çıkart

Kapat

Eşleştirmeleri çıkar

Kapat

Bibliyografyayı Çıkart

üzerinde