Eesti Maaülikool

Estonian University of Life Sciences

"Loomakasvatus muutuva kliimapoliitika valguses„ – EPKK infopäev 7. oktoober 2021

Veise metaani emissiooni mõjutavad tegurid

Marko Kass, PhD
vanemteadur, Eesti Maaülikool/SRUC

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SISSEJUHATUS

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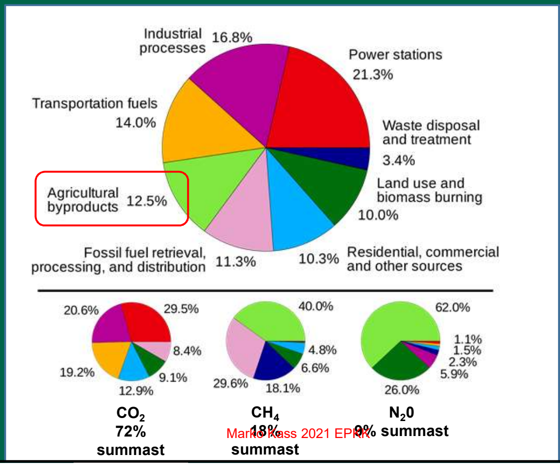
Kasvuhoonegaaside allikad



Emission Database for Global Atmospheric Research

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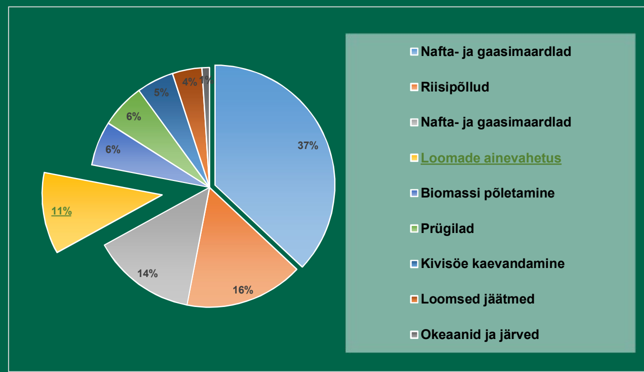
Metaan on üks ohtlikumaid kasvuhoonegaase



Allikas: Moss jt., 2000

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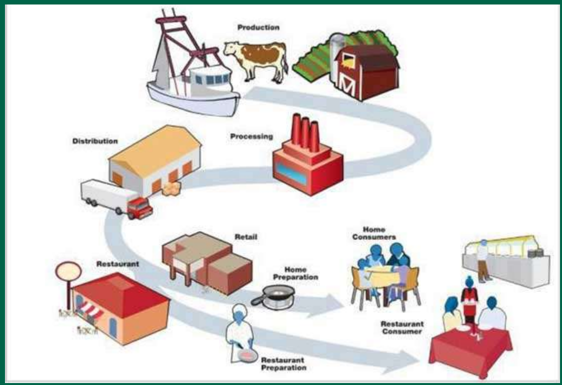

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METAANI PRODUKTSIOON VEISEL

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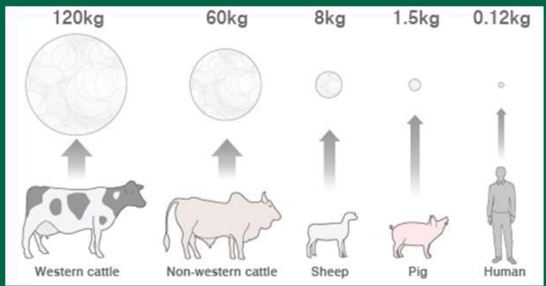
Metaani emissioon loomakasvatuses

- Põllumajandussektor panustab *ca* 10-12% kogu maailma inimtekkelisest kasvuhoonegaasidest
- Loomakasvatuse CH_4 toodang on ligi 50% kogu põllumajanduse CH_4 produktsioonist



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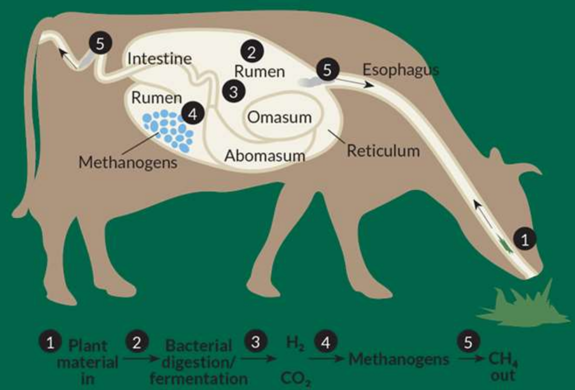
Allikas: NASA Goddard Institute for Space Science

Mäletseja ainevahetus



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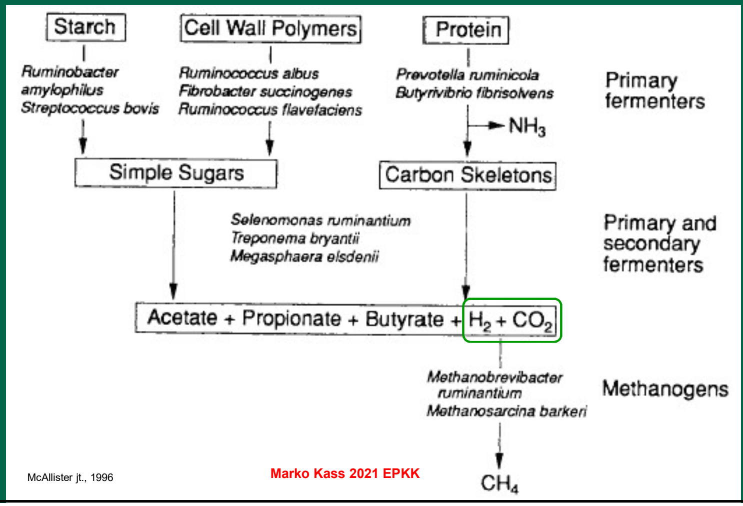

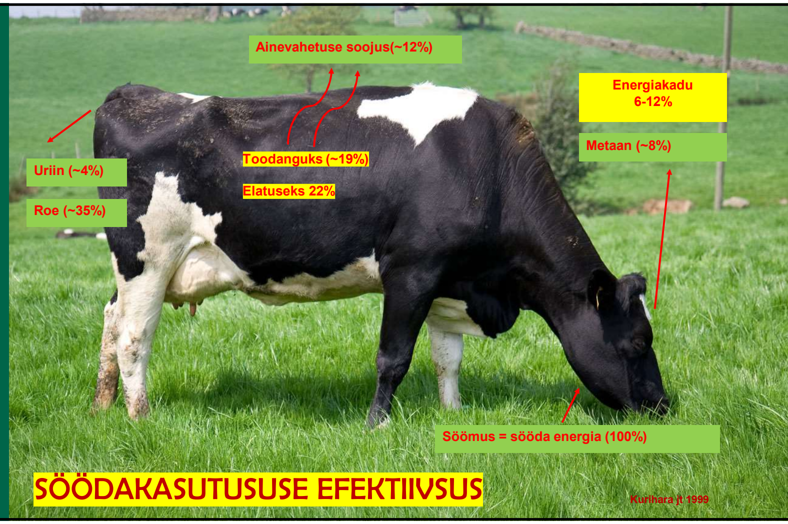

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METAANI MÕÕTMINE

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Metaani emissiooni mõõtmine

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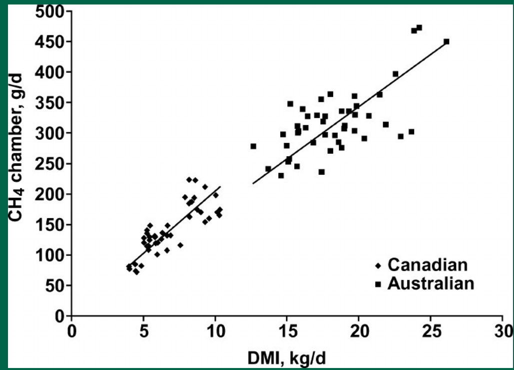
Metaan on võimalik kinni püüda?

Mis mõjutab CH_4 kogust?



Koresööda ja jõusööda mõju

Item	F:C ratio (DM basis) 47:53	54:46	61:39	68:32	SEM	P-value[1] L	Q
DMI (kg/d)	20.7	21.0	20.2	20.2	0.67	0.46	0.82
OM intake (kg/d)	18.2	18.4	17.6	17.5	0.58	0.26	0.77
NDF intake (kg/d)	5.4[c]	5.9[bc]	6.2[ab]	6.5[a]	0.18	<0.01	0.77
Milk yield (kg/d)	38.3	37.9	36.8	36.4	1.45	0.13	0.98
ECM[2] (kg/d)	37.3	37.9	36.2	36.1	0.98	0.20	0.70
CH_4 (g/d)	538[b]	597[ab]	586[ab]	648[a]	29.4	0.01	0.94
CH_4 (g/kg of DMI)	25.9[c]	28.2[b]	29.1[b]	31.9[a]	1.21	<0.01	0.68
CH_4 (g/kg of OM intake)	29.5[c]	32.4[b]	33.5[b]	37.1[a]	1.37	<0.01	0.63
CH_4 (g/kg of NDF intake)	99.2	101.0	95.6	99.4	3.83	0.52	0.56
CH_4 (g/kg of milk)	14.0[c]	15.9[b]	16.1[b]	17.8[a]	0.64	0.01	0.85
CH_4 (g/kg of ECM)	14.4[c]	15.8[bc]	16.3[b]	18.0[a]	0.63	<0.01	0.78
CO_2 (g/d)	18,396	18,653	17,974	18,278	804	0.72	0.97
CO_2 (g/kg of DMI)	889	886	894	902	37.3	0.35	0.60
CO_2 (g/kg of OM intake)	1,011	1,017	1,029	1,048	42.3	0.05	0.60
CO_2 (g/kg of milk)	479	496	492	501	13.9	0.21	0.70
CO_2 (g/kg of ECM)	491	493	496	502	13.4	0.53	0.84

Aguerre jt. 2011

Õlikultuuride (toorrasva) mõju

CON = kontroll; RSC = rapsikook, WCR = purustatud rapsiseeme; RSO = rapsiõli

CH_4 production	Ration[1] CON	RSC	WCR	RSO	SEM[2]	P-value[3]	Contrasts (P-value)[4] CON vs. Fat	RSC and WCR vs. Oil	RSC vs. WCR
L/d	569	531	478	462	51.0	0.04	0.02	0.18	0.10
L/kg of ECM	20.4	19.0	16.9	16.7	2.03	0.008	0.003	0.11	0.02
L/kg of DMI[5]	29.6	26.9	25.8	26.4	1.78	0.07	0.02	0.99	0.37
% of GE[6] intake	6.32	5.60	5.31	5.40	0.03	0.002	<0.001	0.04	0.02
DM									
Intake, kg/d	18.3	18.9	17.9	15.8	2.07	0.54	0.62	0.22	0.58
OM									
Intake, kg/d	17.1	17.7	16.8	14.9	1.96	0.56	0.64	0.23	0.61
Duodenal flow, kg/d	9.84	9.81	10.3	9.19	1.30	0.85	0.94	0.48	0.67
Rumen digestibility, %	42.5	44.6	38.1	40.6	2.34	0.23	0.57	0.79	0.06
Total-tract digestibility, %	73.2	74.3	72.0	71.9	1.36	0.41	0.71	0.41	0.16
NDF									

Brask jt. 2013

Rohusööda mõju – kiud & tärklis

Grass silage:maize silage	70 : 30 (G)		30 : 70 (M)			Significance (*P*)		
Concentrate type	Fibre (F)	Starch (S)	Fibre (F)	Starch (S)	s.e.m.	Forage	Conc	Int[1]
Intake (kg/day)								
Forage mix DMI	14.6	15.2	16.0	16.4	0.4	<0.001	0.12	0.63
Total DMI	20.7	21.3	22.1	22.5	0.4	<0.001	0.12	0.63
Starch	2.04	3.30	3.18	4.37	0.06	<0.001	<0.001	0.49
Fibre (NDF)	8.27	7.55	8.71	7.92	0.17	0.002	<0.001	0.77
Performance								
Live weight (kg)	708	716	708	711	21	0.48	0.10	0.53
Average daily gain (kg/day)	0.656	0.921	0.545	0.642	0.123	0.12	0.15	0.50
Condition score	2.75	2.78	2.81	2.77	0.09	0.64	0.99	0.51
Milk yield, (kg/day)	27.7	26.8	28.4	27.9	1.0	0.028	0.08	0.70
4% fat corrected milk (kg/day)	31.1	30.9	32.1	31.4	1.3	0.17	0.39	0.61
Total CH_4 (g/day)	406	412	410	385	13	0.29	0.41	0.16
CH_4 (g/kg DMI)	19.6	19.5	18.6	17.1	0.5	0.002	0.15	0.22
CH_4 (g/kg milk yield)	15.0	15.9	15.0	14.4	0.6	0.17	0.80	0.21
CH_4 (kJ/MJ GE intake)	56.9	56.1	53.7	49.2	1.6	0.002	0.10	0.23

Rohusilo vs maisisilo

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Hart jt. 2015

Metaani produktsiooni pärssivad tegurid

Method	How it works	Advantages	Disadvantages
Nitrate additive	Promotes formation of ammonia instead of methane	Highly effective in some experiments	Nitrate toxicity for some cows
Plant extract additive	Alters the chemistry of the rumen	Natural	Cost concerns; may affect taste of feed
Increasing concentrates	Substitutes feed that relies less on fermentation	Increases milk production in dairy cows; already available	Can be expensive; environmental cost if transportation needed
Synthetic additive	Blocks enzyme that drives last step of methane formation	In one experiment, methane dropped 30 percent and cows gained weight	Rumen may adapt, reducing effectiveness over time
Vaccine	Antibodies to methanogens	Easy to use	Potential for cows to accumulate hydrogen; effectiveness unknown
Selective breeding	Cows require less feed for same growth	Cumulative and permanent	Changes are slow; may affect other traits, such as health or fertility

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Lee jt 2014
Hristov jt 2015

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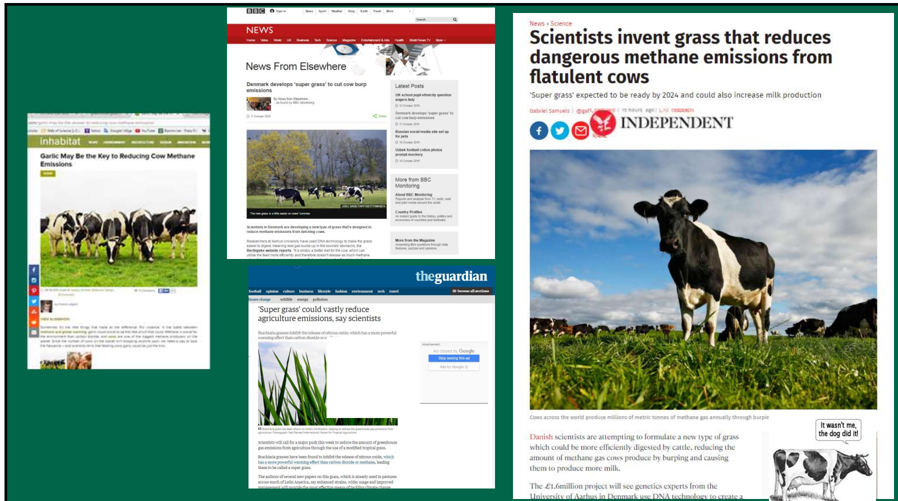

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TEADUSUURINGUD EESTIS

Journal of Dairy Research

Article contents

Abstract

References

The fatty acid composition of Estonian and Latvian retail milk; implications for human nutrition compared with a designer milk

Published online by Cambridge University Press: 22 May 2018

Merike Henno, Tiia Ariko, Tanel Kaart, Sirje Kuusik, Katri Ling, Marko Kass, Hanno Jaakson, Ragnar Leming, D Ian Givens and Vita Sterna ...Show all authors

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Abstract

The study reported in this Research Communication compared retail milks' FA profiles from two neighbouring countries, estimated the potential contributions of these milks and a designer milk (achieved by changing the diet of the dairy cow) to the recommended human dietary intake of FA, and predicted (based on the milk FA profile) methane emission from dairy cows. Retail milks in Estonia and Latvia were purchased from supermarkets monthly for one year. To compare the FA composition of retail milk with designer milk with an increased PUFA content, the bulk milk FA profile from a separate field trial was used. Milk FA concentrations of the two neighbouring countries were affected by state, season and their interaction, while the

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Effects of replacing wheat starch with glycerol on methane emissions, milk production, and feed efficiency in dairy cows fed grass silage-based diets

Johanna Karlsson,[1*] Mohammad Ramin,[2] Marko Kass,[2,3] Mikaela Lindberg,[1] and Kjell Holtenius[1]
[1]Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, SE-75323, Uppsala, Sweden
[2]Department of Agricultural Research for Northern Sweden, Swedish University of Agricultural Sciences, SE-901 83, Umeå, Sweden
[3]Department of Animal Nutrition, Estonian University of Life Sciences, 51006, Tartu, Estonia

ABSTRACT

To lower the effect of climate change from cattle production, we should aim at decreasing their enteric methane emissions per kilogram of milk or meat. Glycerol may be absorbed through the rumen epithelium and would consequently be less available to microbes in the rumen. Glycerol could thus supply dairy cows with energy for milk production without contributing much to methane production. This study evaluated the effect of replacing wheat starch with glycerol on milk production, feed intake, and methane emissions. Twenty-two Swedish Red cows in mid lactation were used in a switch-back, change-over experiment with 3 periods of 21 d. The 2 dietary treatments consisted of a total mixed ration based on (g/kg of dry matter) grass silage (605), rapeseed meal (120), and barley (70) and either wheat starch or refined glycerol (200) fed ad libitum. The glycerol diet resulted in higher dry matter intake (21.6 vs. 20.1 kg/d) and methane emissions (482 vs. 423 g/d) compared with the diet containing wheat starch, whereas no difference was found in energy-corrected

warming. Future feeding and management systems for dairy cows should aim to decrease CH_4 emissions per kilogram of milk or meat, thus diminishing their effect on the environment (Ramin and Huhtanen, 2013). High-starch diets have been shown to decrease CH_4 emissions in ruminants (Hristov et al., 2013). Starch degradation generally increases production of propionate (Sutton et al., 2003; Agle et al., 2010).

Werner Omazic et al. (2015) showed that glycerol is absorbed across the rumen epithelium in significant amounts and would presumably be less available for fermentation in the rumen. Thus, it could have the potential to provide ruminants with energy without contributing much to CH_4 production in the rumen. Any glycerol that is not absorbed across the rumen epithelium increases propionate, butyrate, and valerate concentrations in the rumen while decreasing acetate (Ariko et al., 2015; Castagnino et al., 2018). When the acetate:propionate ratio decreases, CH_4 production also decreases (Russell, 1998). Thus, both starch and glycerol are considered to have potential in reducing enteric CH_4 emissions because they decrease the acetate:

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Abstract #327

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Session: Ruminant Nutrition III
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Day/Time: Tuesday 9:30 AM–9:45 AM
Location: 310/311 Find It

327
Comparison of Molly and Karoline model to predict methane emissions in cattle.
M. Kass[1,3], M. D. Hanigan[2], M. Ramin[3], P. Huhtanen[*3], [1]*Estonian University of Life Science, Tartu, Estonia,* [2]*Virginia Tech University, Blacksburg, VA,* [3]*Swedish University of Agricultural Sciences, Umeå, Sweden.*

Models originally compiled to predict nutrient absorption from the digestive tract and metabolized in various tissues could be adapted for CH_4 predictions. Numerous empirical equations and mechanistic models to predict CH_4 emission are available. The Molly cow model is a mechanistic, dynamic model describing digestion and metabolism of dairy cattle with the ability to predict the animal-related factors that affect the environment, including CH_4 emission (Hanigan et al., 2013). The Nordic cow model Karoline is a dynamic, mechanistic model describing digestion and metabolism in dairy cows (Danfær et al., 2006), and it was confirmed by Ramin and Huhtanen (2015) to be a useful tool in predicting CH_4 emissions in cattle. The aim was to evaluate these models for predicting CH_4 emissions in cattle using a data set consisting of 267 treatment means from 55 respiration chambers studies. The data set contained DMI, (14.2 ± 5.82 kg/d); ingredient proportions; dietary contents of CP (156 ± 30.8 g/kg) and NDF (356 ± 105.9 g/kg); BW (531 ± 131.1 kg); and CH_4 (303 ± 118.7 g/d) which covers the range of typical cattle diets. The simulations were conducted using observed DMI, BW and dietary nutrient concentrations and digestion rates. Each treatment mean was simulated and

Kass, M., Ramin, M., Hanigan, M., Huhtanen, P. Comparison of Molly and Karoline models to predict methane production in growing and dairy cattle. Journal of Dairy Science 2021/22

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EPKK infopäev "Loomakasvatus muutuva kliimapoliitika valguses"

Tänud kuulamast!

Marko Kass, PhD
Kontakt: marko.kass@emu.ee