SMÅ ORGANISMER - STOR INDFLYDELSE? PÅVIRKER MIKROBERNE VORES VÆGT?

Ernæringsfokuskonferencen 2024

@HRoager

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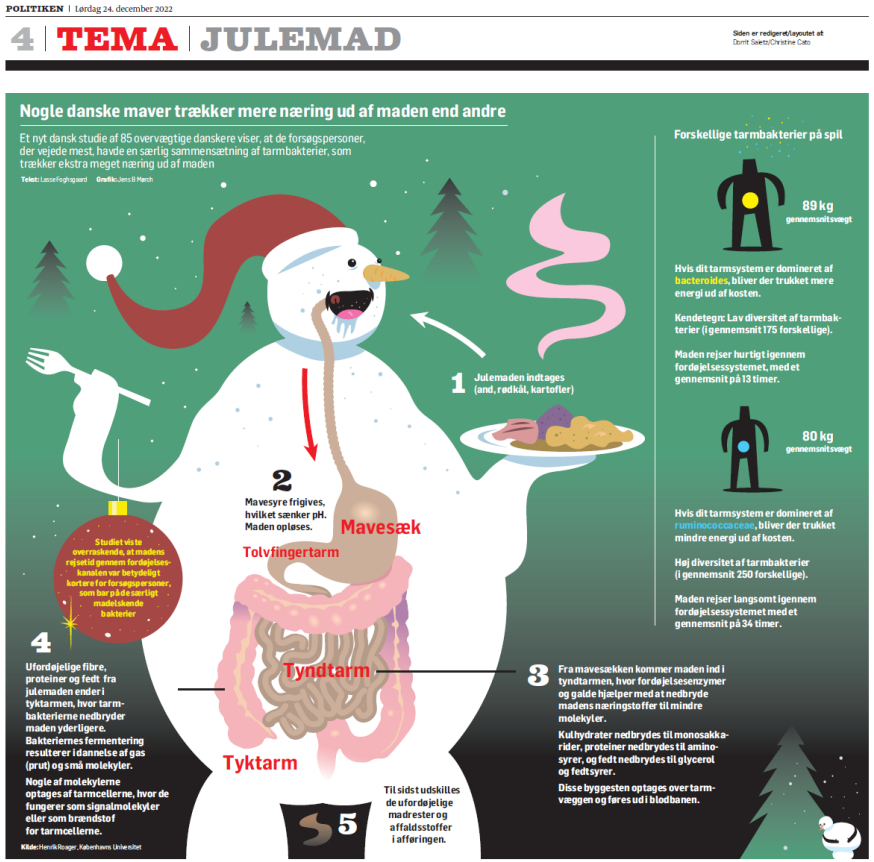
Forskere har måske løst mysteriet om, hvorfor nogle tager mere på i julen



POLITIKEN | Lørdag 24. december 2022

4 | TEMA | JULEMAD

Siden er redigeret/layoutet af Dorrit Saietz/Christine Cato

Nogle danske maver trækker mere næring ud af maden end andre

Et nyt dansk studie af 85 overvægtige danskere viser, at de forsøgspersoner, der vejede mest, havde en særlig sammensætning af tarmbakterier, som trækker ekstra meget næring ud af maden

Tekst: Lasse Foghsgaard Grafik: Jens B March

1 Julemaden indtages (and, rødkål, kartofler)

2 Mavesyre frigives, hvilket sænker pH. Maden opløses.

Mavesæk

Tolvfingertarm

Tyndtarm

Tyktarm

3 Fra mavesækken kommer maden ind i tyndtarmen, hvor fordøjelsesenzymer og galde hjælper med at nedbryde madens næringstoffer til mindre molekyler.

Kulhydrater nedbrydes til monosakkarider, proteiner nedbrydes til aminosyrer, og fedt nedbrydes til glycerol og fedtsyrer.

Disse byggesten optages over tarmvæggen og føres ud i blodbanen.

4 Ufordøjelige fibre, proteiner og fedt fra julemaden ender i tyktarmen, hvor tarmbakterierne nedbryder maden yderligere. Bakteriernes fermentering resulterer i dannelse af gas (prut) og små molekyler.

Nogle af molekylerne optages af tarmcellerne, hvor de fungerer som signalmolekyler eller som brændstof for tarmcellerne.

Studiet viste overraskende, at madens rejsetid gennem fordøjelseskanalen var betydeligt kortere for forsøgspersoner, som her på de særligt madelskende bakterier

5 Til sidst udskilles de ufordøjelige madrester og affaldsstoffer i afføringen.

Kilde: Henrik Roager, Københavns Universitet

Forskellige tarmbakterier på spil

89 kg gennemsnitsvægt

Hvis dit tarmsystem er domineret af bacteroides, bliver der trukket mere energi ud af kosten.

Kendetegn: Lav diversitet af tarmbakterier (i gennemsnit 175 forskellige).

Maden rejser hurtigt igennem fordøjelsessystemet, med et gennemsnit på 13 timer.

80 kg gennemsnitsvægt

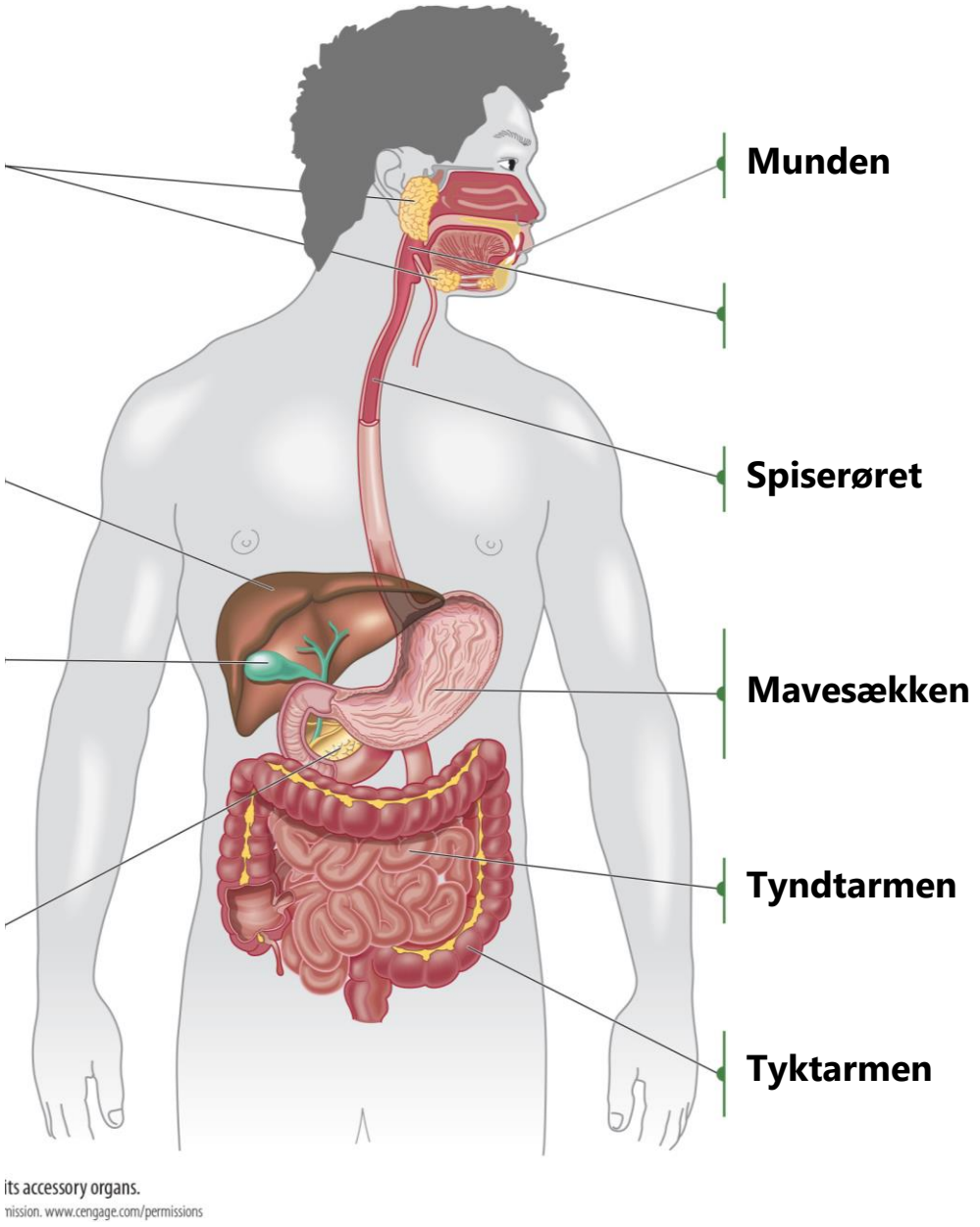
Hvis dit tarmsystem er domineret af ruminococcaceae, bliver der trukket mindre energi ud af kosten.

Høj diversitet af tarmbakterier (i gennemsnit 250 forskellige).

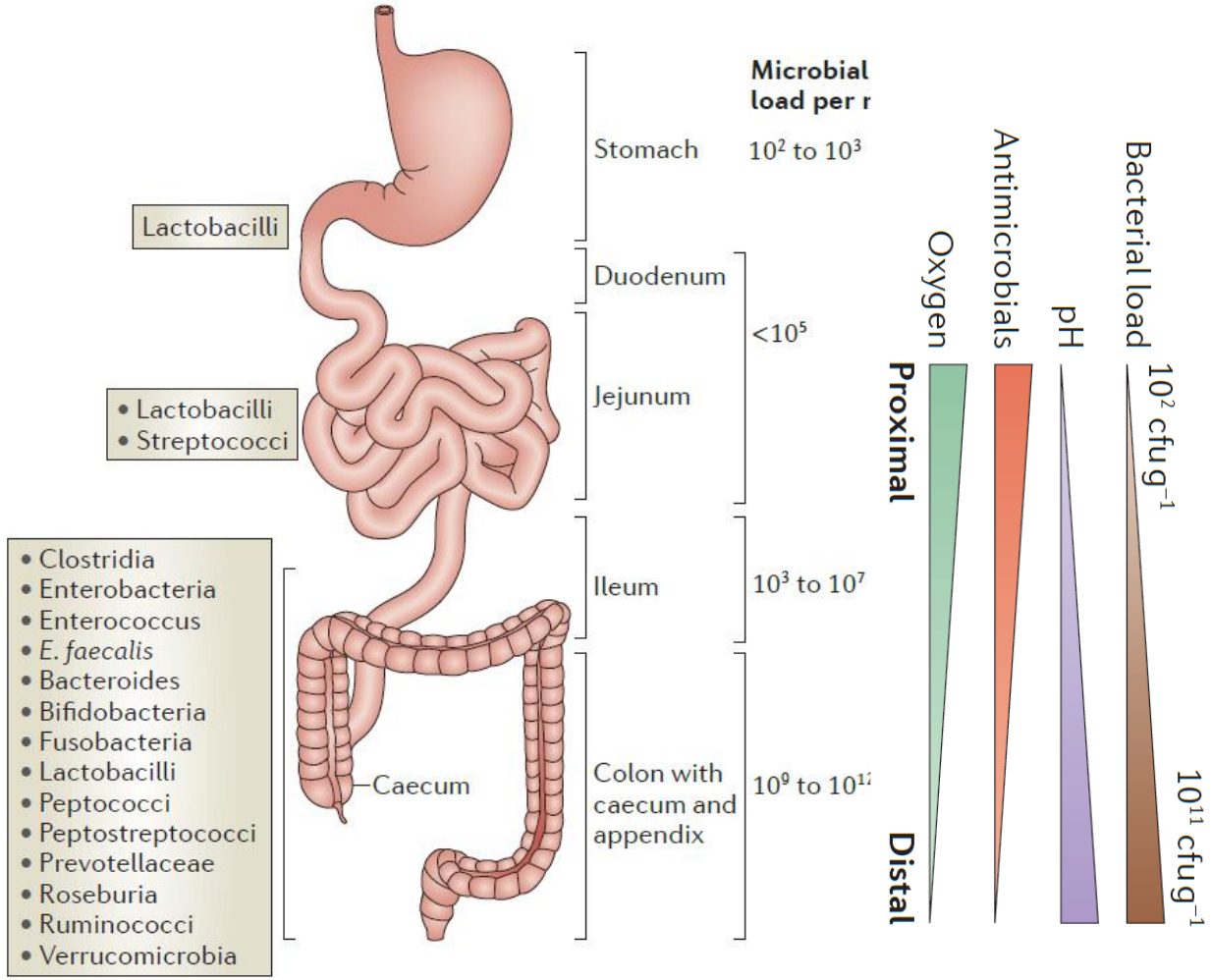
Maden rejser langsomt igennem fordøjelsessystemet med et gennemsnit på 34 timer.

Tarmsystemet – et livsvigtigt orkester

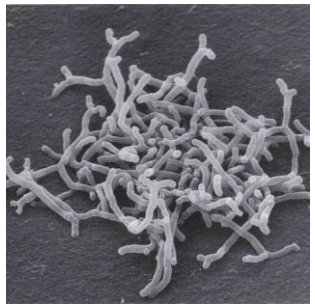
https://commons.wikimedia.org/wiki/File:Gaga_Symphony_Orchestra.jpeg



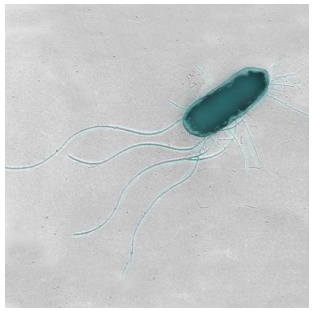
Tarmen huser et kompleks økosystem



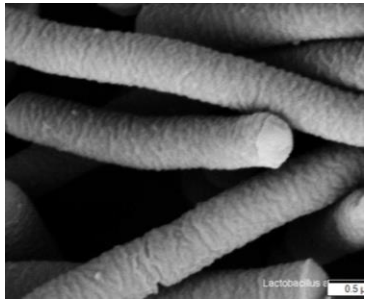
Mowat and Agace, 2014; **Nature Reviews**



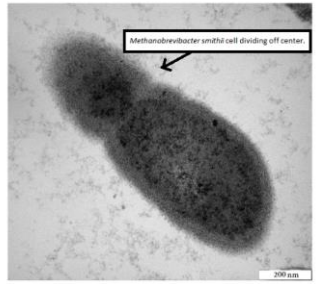
Bifidobacterium



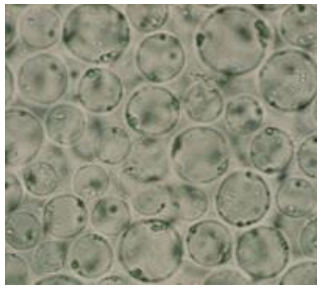
E. coli



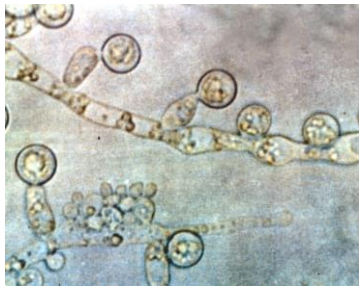
L. acidophilus



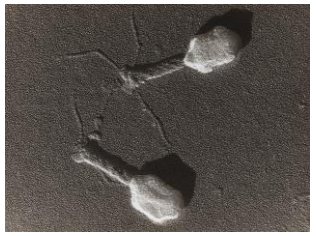
Methanobrevibacter smithii (archaea)



Blastocystis (single-celled parasitic eukaryote)



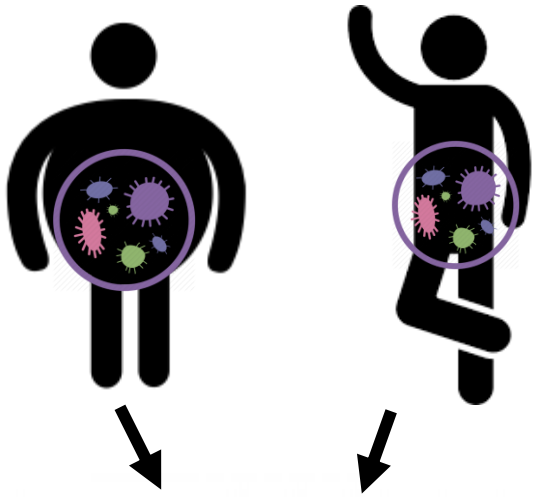
Candida albicans (fungi)



*Bacteriophages**

*Viruses reproduce by infecting cells and hijacking the cell's own machinery to make new viruses (there is a debate as to whether they can be considered alive and they are not included in the universal tree of life)

Tarmmikrobiotaen påvirker fysiologien (i mus)

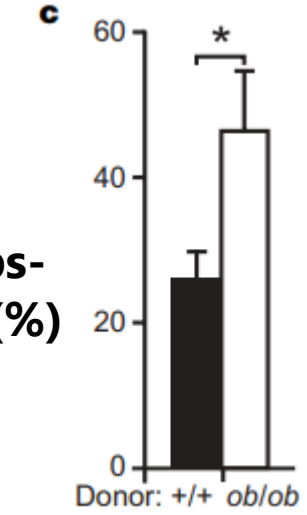


An obesity-associated gut microbiome with increased capacity for energy harvest

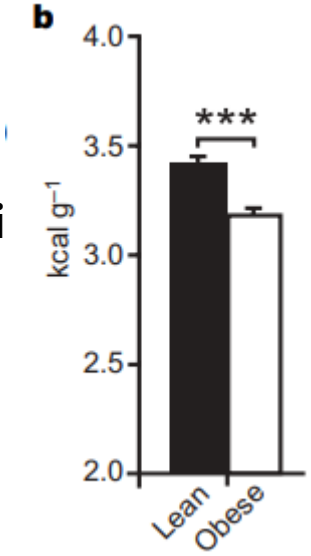
Peter J. Turnbaugh[1], Ruth E. Ley[1], Michael A. Mahowald[1], Vincent Magrini[2], Elaine R. Mardis[1,2] & Jeffrey I. Gordon[1]

Turnbaugh *et al.*, 2006 **Nature**

Krops-fedt (%)

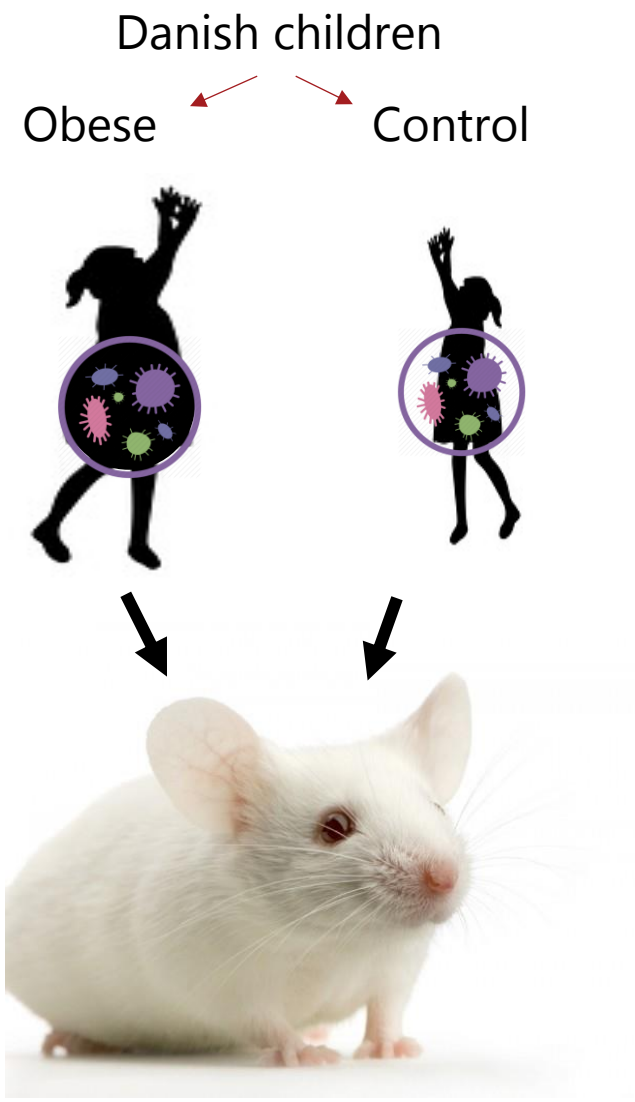


Energi i fæces

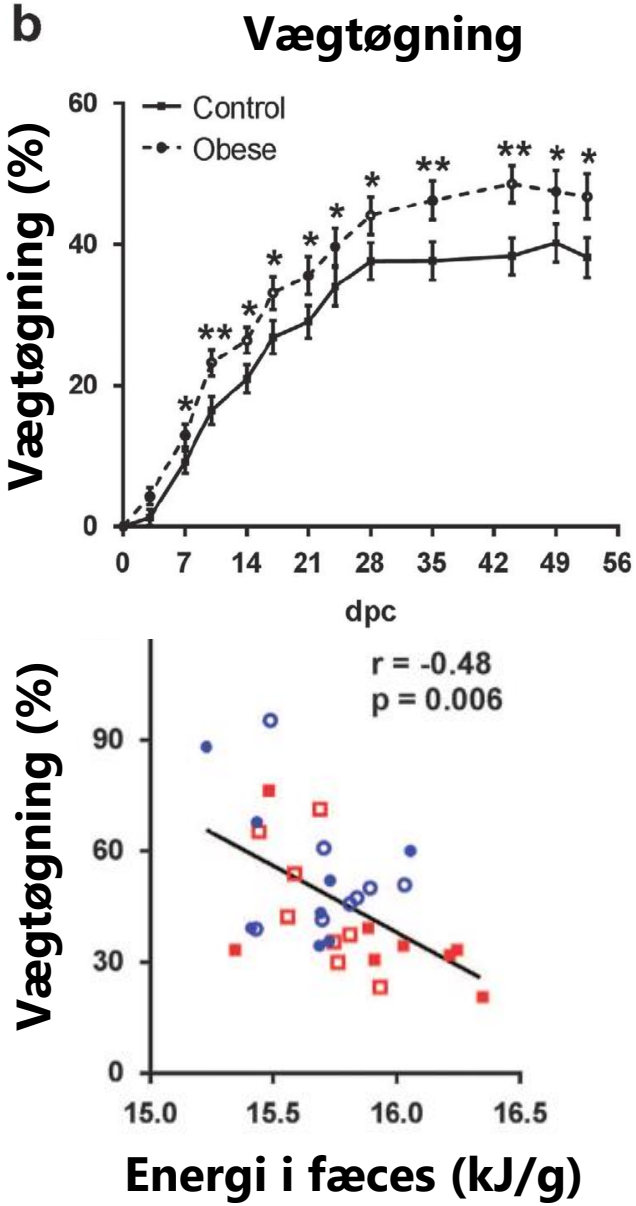


Fortsættelsen…

With Li Zhang in Colorado, USA

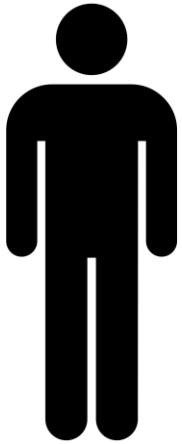


Zhang, Bahl, Roager *et al.*, 2016 ISME



Kan vi ændre tarmbakterierne med kost? Og hvor hurtigt?

10 studerende
21-33 år



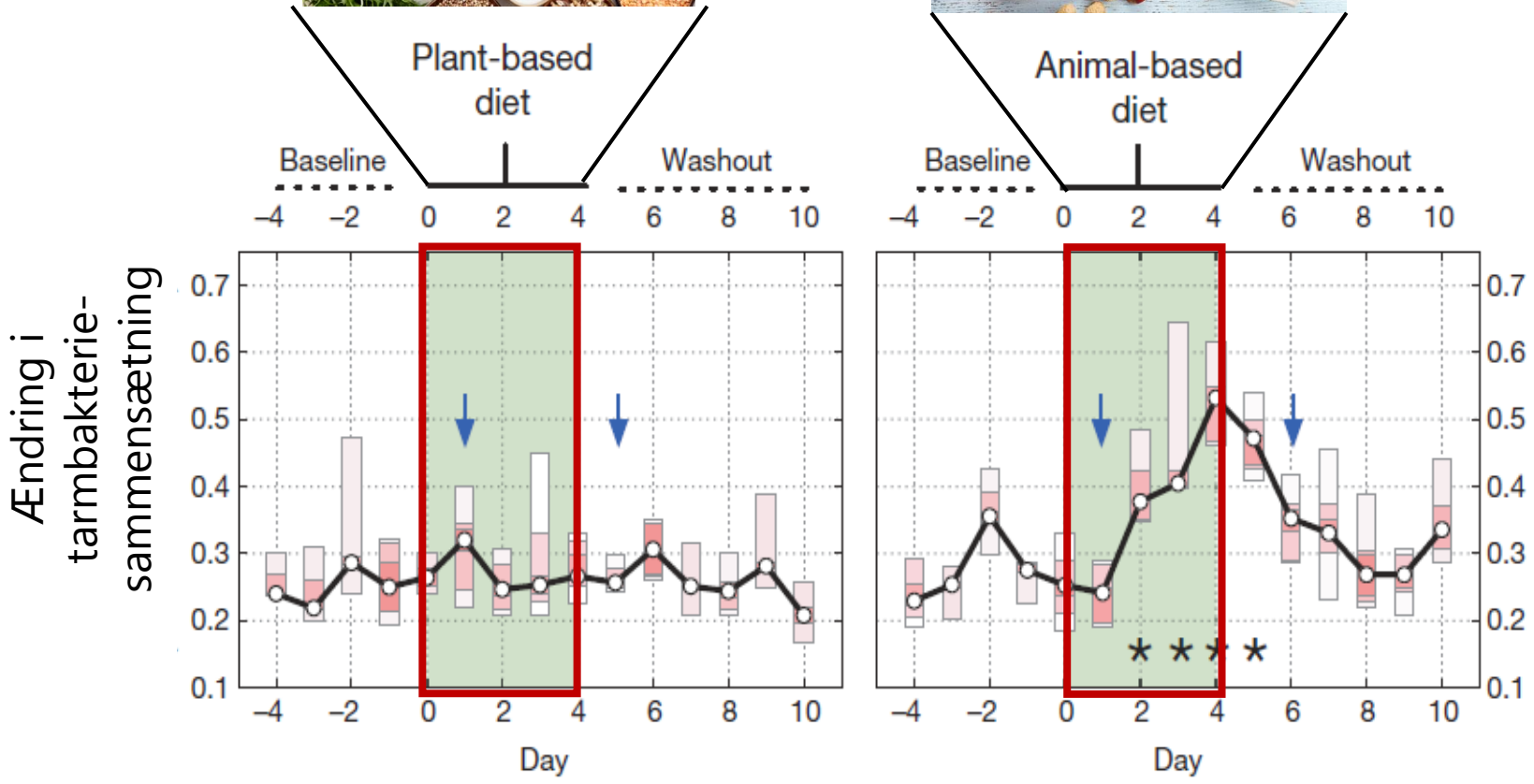
Normal kost
Kostfibre 9.3g/1000 kcal
Fedt (32%)
Protein (16%)

Plante-baseret kost:
Høj fiber (25.6g/1000 kcal)
Lav fedt (22%)
Lav protein (10%)

Animalsk-baseret kost
Ingen fiber (~0 g/1000 kcal)
Høj fedt (69%)
Høj protein (30%)

David *et al.*, 2014; **Nature**

Ja, vi kan ændre tarmbakterier på 24-48 timer med en markant kostændring...



...men en permanent ændring i tarmbakterier kræver vedvarende kostændringer

David *et al.*, 2014; **Nature**

De fleste koststudier viser, at det ikke er nemt, at ændre på tarmmikrobiom-sammensætningen

AEM Journals.ASM.org

Microbial Enterotypes, Inferred by the *Prevotella*-to-*Bacteroides* Ratio, Remained Stable during a 6-Month Randomized Controlled Diet Intervention with the New Nordic Diet

Henrik M. Roager,[a] Tine R. Licht,[a] Sanne K. Poulsen,[b] Thomas M. Larsen,[b] Martin I. Bahl[a]

National Food Institute, Technical University of Denmark, Søborg, Denmark[a]; Department of Nutrition, Exercise and Sports, University of Copenhagen, Frederiksberg, Denmark[b]

OPEN ACCESS

ORIGINAL ARTICLE

Whole grain-rich diet reduces body weight and systemic low-grade inflammation without inducing major changes of the gut microbiome: a randomised cross-over trial

Henrik Munch Roager,[1] Josef K Vogt,[2] Mette Kristensen,[3] Lea Benedicte S Hansen,[2] Sabine Ibrügger,[3] Rasmus B Mærkedahl,[3,4] Martin Iain Bahl,[1] Mads Vendelbo Lind,[3,5] Rikke L Nielsen,[2] Hanne Frøkiær,[4] Rikke Juul Gøbel,[6] Rikard Landberg,[5] Alastair B Ross,[5] Susanne Brix,[7] Jesper Holck,[8] Anne S Meyer,[8] Morten H Sparholt,[9] Anders F Christensen,[9] Vera Carvalho,[1] Jens Juul Holst,[6,10] Jüri Johannes Rumessen,[11] Allan Linneberg,[12,13,14] Thomas Sicheritz-Pontén,[2] Marlene D Dalgaard,[7] Andreas Blennow,[15] Henrik Lauritz Frandsen,[1] Silas Villas-Bôas,[16] Karsten Kristiansen,[17] Henrik Vestergaard,[6,18] Torben Hansen,[6] Claus T Ekstrøm,[19] Christian Ritz,[3] Henrik Bjørn Nielsen,[2,20] Oluf Borbye Pedersen,[6] Ramneek Gupta,[2] Lotte Lauritzen,[3] Tine Rask Licht[1]

OPEN ACCESS

ORIGINAL RESEARCH

Mediterranean diet intervention in overweight and obese subjects lowers plasma cholesterol and causes changes in the gut microbiome and metabolome independently of energy intake

Victoria Meslier,[1] Manolo Laiola,[2] Henrik Munch Roager,[3] Francesca De Filippis,[2,4] Hugo Roume,[1] Benoit Quinquis,[1] Rosalba Giacco,[5] Ilario Mennella,[2] Rosalia Ferracane,[2] Nicolas Pons,[1] Edoardo Pasolli,[2,4] Angela Rivellese,[4,6] Lars Ove Dragsted,[3] Paola Vitaglione,[2,4] Stanislav Dusko Ehrlich,[1] Danilo Ercolini[2,4]

nature COMMUNICATIONS

ARTICLE

DOI: 10.1038/s41467-018-07019-x OPEN

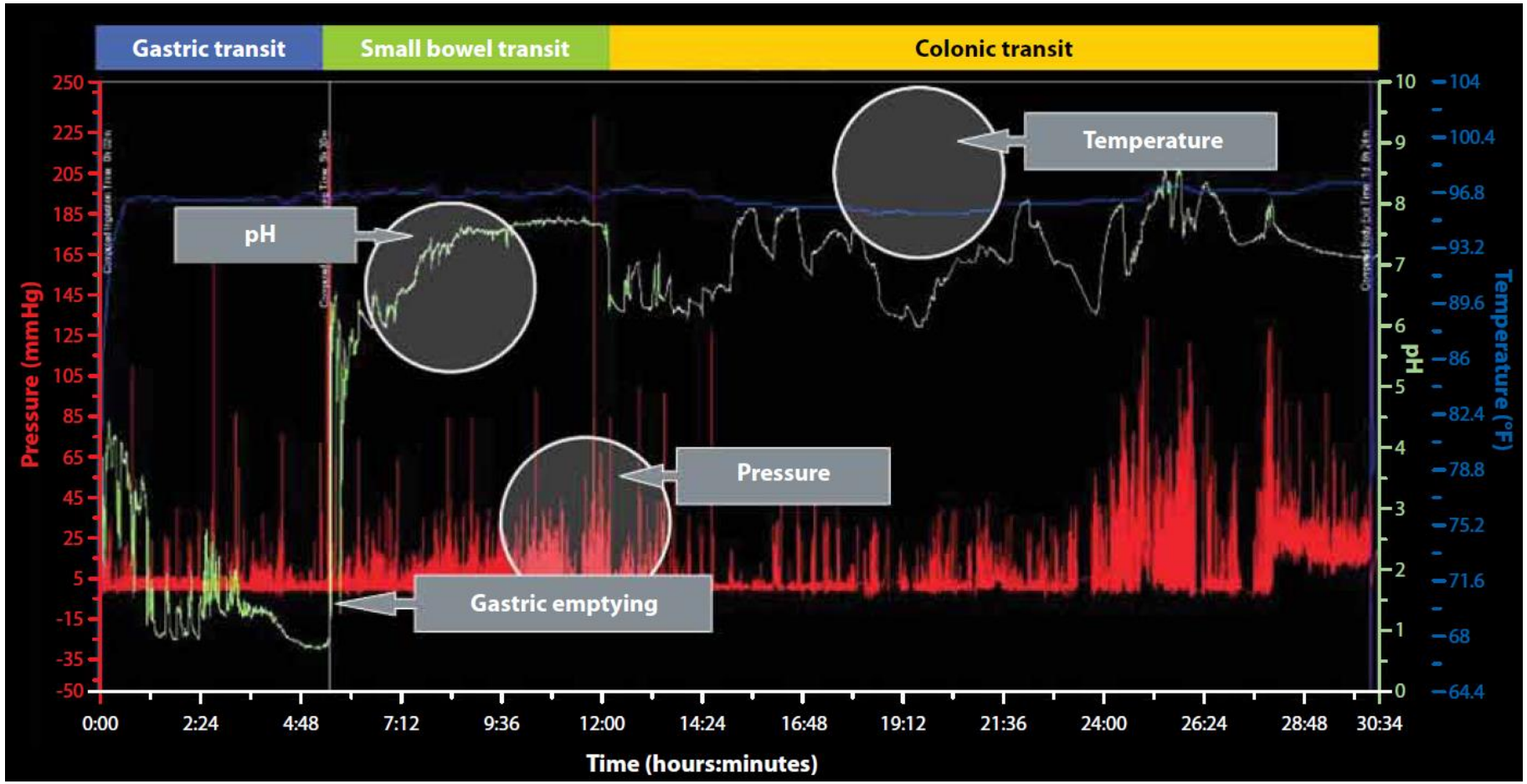
A low-gluten diet induces changes in the intestinal microbiome of healthy Danish adults

Lea B.S. Hansen et al.#

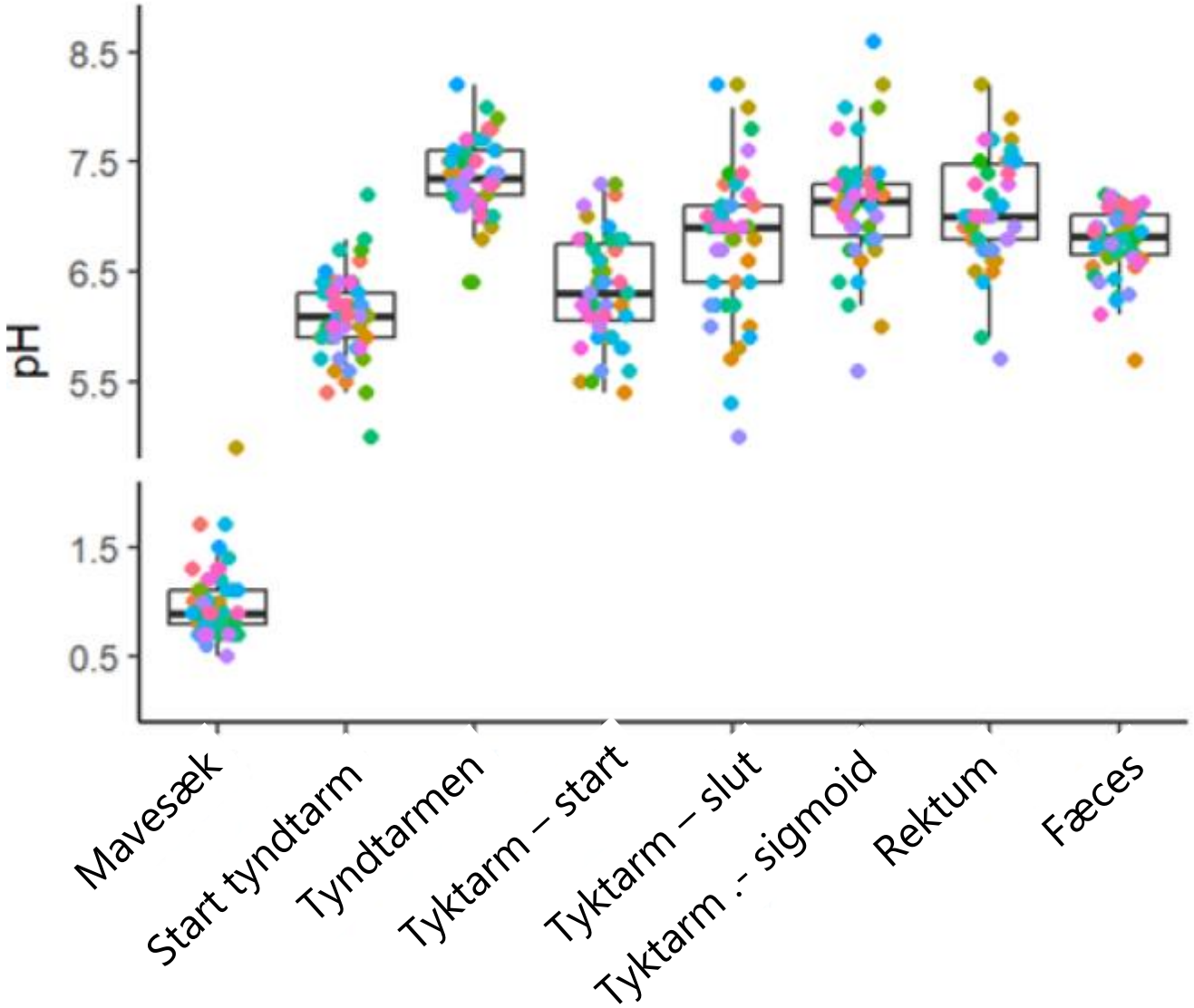

Hvorfor er vores mikrobiom unikt?

Tarmkapsel – til at måle miljøet igennem tarmen

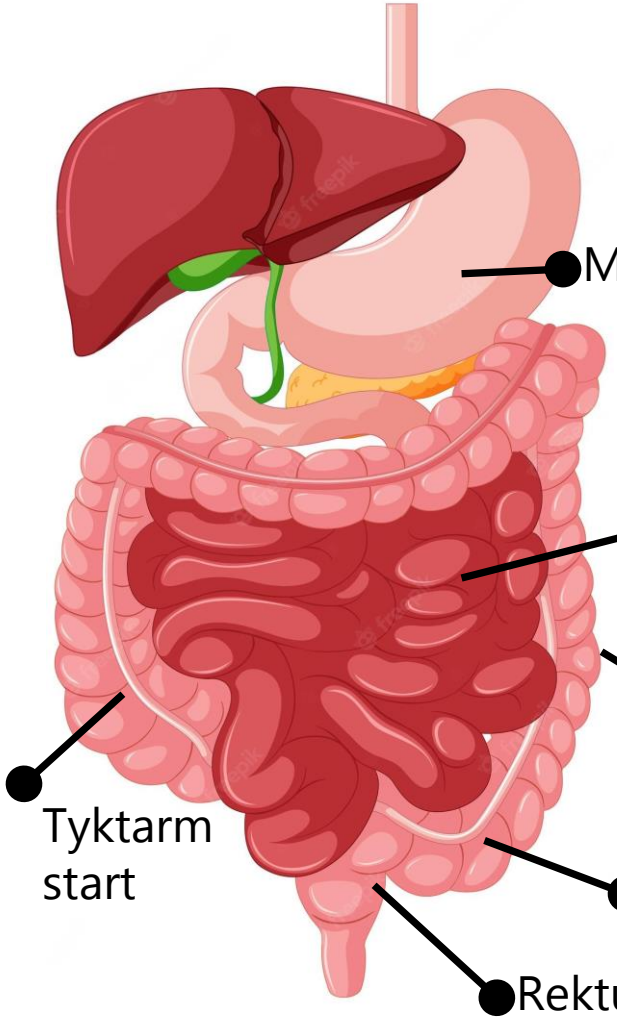
SmartPill
Motility Capsule



Rejsen igennem tarmen – vi er forskellige!

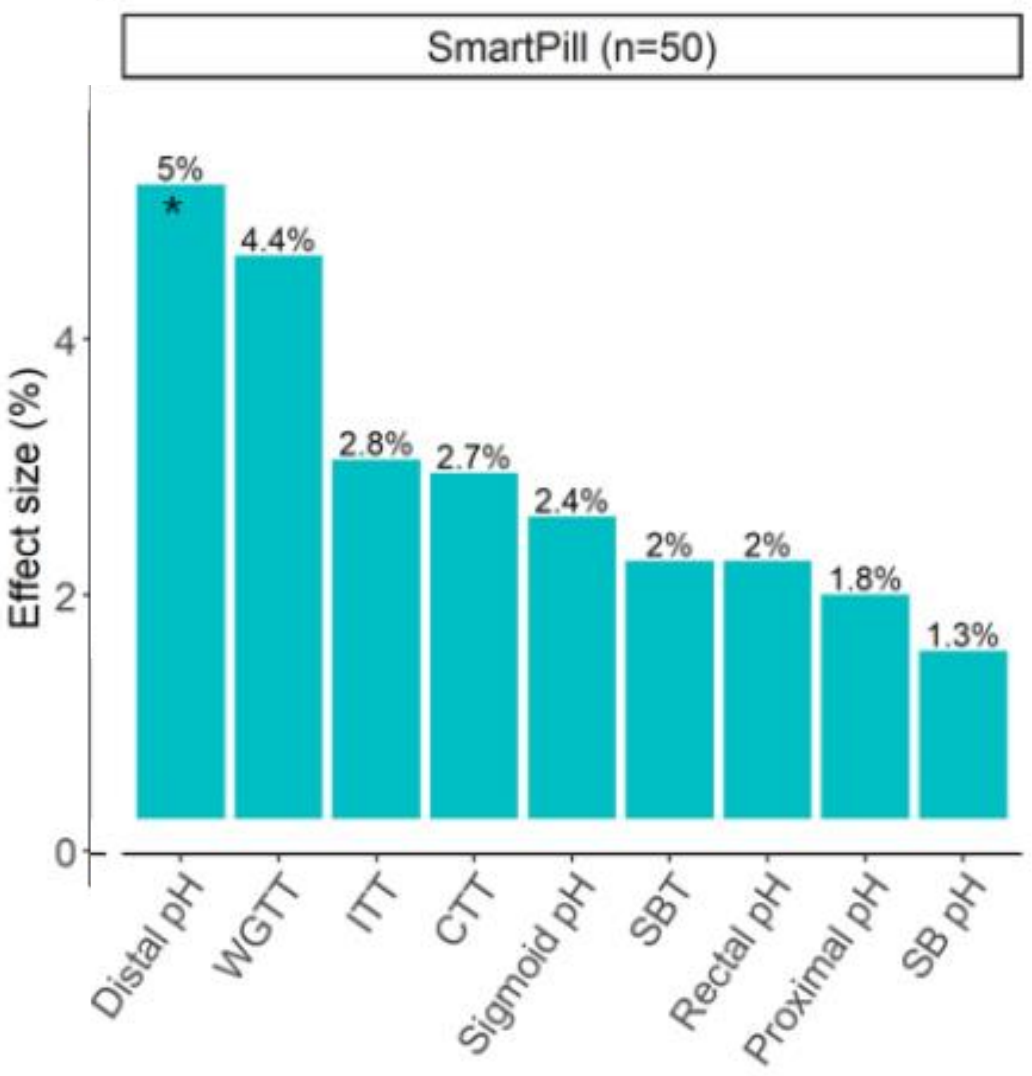


Nicola Procházková



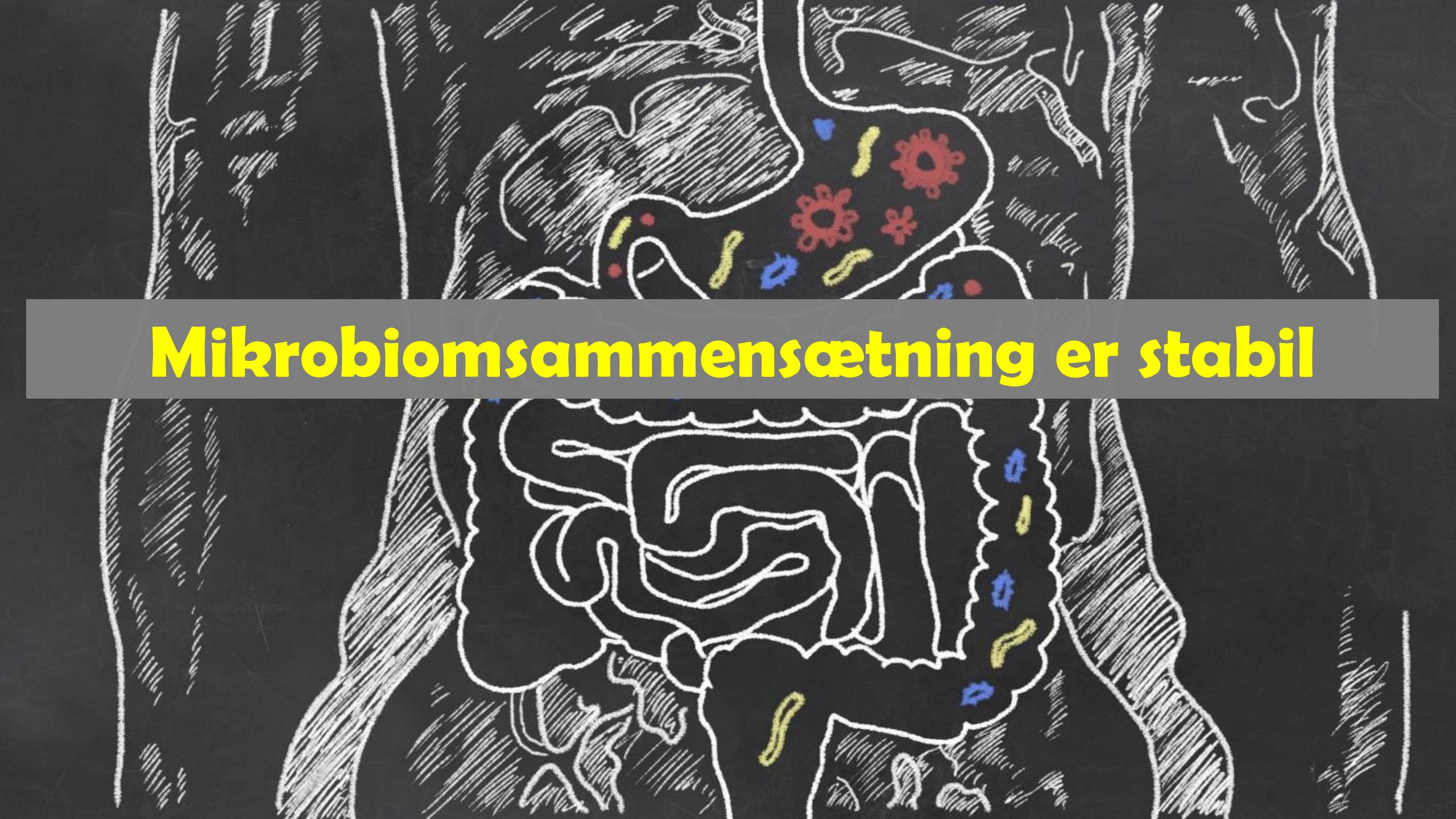
Procházková...Roager, **Nature Microbiology**, accepted

Tarmens miljø (pH) forklarer variation i tarmmikrobiomet



BSS: Bristol stool scale
Corn TT: Sweet-corn transit time
Stool freq: Stool frequency
WGTT: Whole-gut transit time
ITT: Intestinal transit time (small+colon transit)
CTT: Colonic transit time

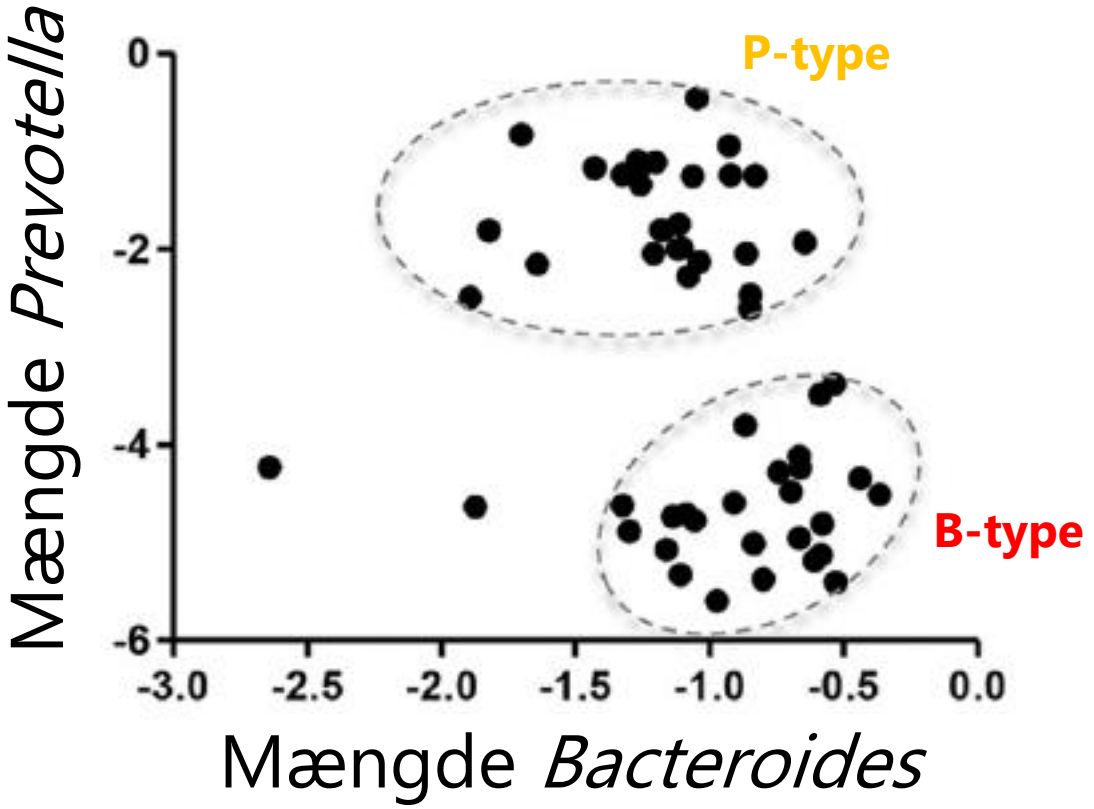
Procházková...Roager, **Nature Microbiology**, accepted


Mikrobiomsammensætning er stabil

Danskere kan inddeles i grupper på baggrund af deres tarmbakterier

P-type
Høj-*Prevotella*
Lav *Bacteroides*

Lav *Prevotella*
Høj *Bacteroides*
B-type



Disse grupper er stabile over 6 måneder!

Roager *et al.*, 2014; **Applied and Environmental Microbiology**

P-type er forbundet med øget vægttab ved fiberrig kost sammenlignet med *B-type*

Lars H. Christensen

OPEN

International Journal of Obesity (2017), 1–4
www.nature.com/ijo

SHORT COMMUNICATION

Pre-treatment microbial *Prevotella*-to-*Bacteroides* ratio, determines body fat loss success during a 6-month randomized controlled diet intervention

MF Hjorth[1], HM Roager[2], TM Larsen[1], SK Poulsen[1,3], TR Licht[2], MI Bahl[2], Y Zohar[4] and A Astrup[1]

On the basis of the abundance of specific bacterial genera, the human gut microbiota can be divided into two relatively stable groups that might have a role in personalized nutrition. We studied these simplified enterotypes as prognostic markers for successful body fat loss on two different diets. A total of 62 participants with increased waist circumference were randomly assigned to receive an *ad libitum* New Nordic Diet (NND) high in fiber/whole grain or an Average Danish Diet for 26 weeks. Participants were grouped into two discrete enterotypes by their relative abundance of *Prevotella* spp. divided by *Bacteroides* spp. (*P/B* ratio) obtained by quantitative PCR analysis. Modifications of dietary effects of pre-treatment *P/B* group were examined by linear mixed models. Among individuals with high *P/B* the NND resulted in a 3.15 kg (95% confidence interval (CI): 1.55; 4.76, $P < 0.001$) larger body fat loss compared with ADD, whereas no differences was observed among individuals with low *P/B* (0.88 kg (95% CI: −0.61; 2.37, $P = 0.25$)). Consequently, a 2.27 kg (95% CI: 0.09; 4.45, $P = 0.041$) difference in responsiveness to the diets were found between the two groups. In summary, subjects with high *P/B* ratio appeared more susceptible to lose body fat on diets high in fiber and whole grain than subjects with a low *P/B* ratio.

International Journal of Obesity advance online publication, 10 October 2017; doi:10.1038/ijo.2017.220

INTRODUCTION

The composition of the gut microbiota in rodents has been shown to affect the efficacy of energy harvest from feed[1] and to influence the secretion of gastrointestinal hormones affecting appetite.[2] Therefore, it seems as if the human gut microbiota has the potential to have a pivotal role in personalized nutrition.[3,4]

Clustering of the human gut microbiota, designated enterotypes, was first described in 2011.[5] The *Bacteroides*-driven enterotype is reported to be predominant in individuals consuming more protein and animal fat (western diet), whereas the *Prevotella*-driven enterotype appears predominant in subjects consuming more carbohydrate and fiber.[6–8] That said, the enterotype of an individual has been shown to remain rather stable.[6,7,9] A limited number of studies have related microbial enterotypes to health markers;[8–10] however, body fat change during a randomized clinical trial is not one of them.

Therefore, as a proxy for enterotypes, we studied pre-treatment *Prevotella*-to-*Bacteroides* (*P/B*) ratio as a prognostic marker for successful body fat loss on two diets differing greatly in dietary fiber and whole-grain content.

MATERIALS AND METHODS

In total 181 participants with increased waist circumference were randomly assigned to receive an *ad libitum* New Nordic Diet (NND) or a control diet for 26 weeks of which a subgroup of 62 subjects were randomized to collect fecal samples. The macronutrient composition of the NND was based on Nordic Nutrition Recommendations, whereas the control diet was designed to match the macronutrient composition of an Average Danish Diet (ADD).[11] The NND is a whole-food approach characterized by being very high in dietary fiber, whole grain, fruit and vegetables.[12] For both groups, food and beverages were provided from a study shop free of charge throughout the intervention period.[12] Pre-intervention fasting blood samples were drawn from where fasting glucose and insulin were analyzed. Height was measured at baseline and body weight was measured at randomization and week 2, 4, 8, 12, 16, 20, 24 and 26. Furthermore, waist circumference and fat mass (using DEXA) were measured at randomization, week 12 and 26. Fecal samples were collected at baseline and the relative abundance of *Prevotella* spp. and *Bacteroides* spp. was determined using genera-specific quantitative PCR targeting the bacterial 16S ribosomal gene regions as previously described.[9] As previously reported by Roager *et al.*,[9] this resulted in a clear bimodal separation of subjects based on the log *Prevotella* spp. to *Bacteroides* spp. ratio, in the following designated low *P/B* (< 0.01) or high *P/B* (> 0.01). In eight samples, *Prevotella* spp. was below the detection limit and were classified as low *P/B* in the main analysis and excluded in a sensitivity analysis. Regardless of randomization status, after the completion of the first 26 weeks, all participants were instructed to follow the NND for an additional year (weight measured after 52 and 78 weeks) without any provision of food[13] to investigate the diets in a real life setting. The study was approved by the ethical committee of the Capital Region of Denmark (reference H-3-2010-058) and registered at clinicaltrials.gov as NCT01195610.

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2017

International Journal of Obesity
https://doi.org/10.1038/s41366-018-0093-2

ARTICLE

Physiology

Prevotella-to-*Bacteroides* ratio predicts body weight and fat loss success on 24-week diets varying in macronutrient composition and dietary fiber: results from a post-hoc analysis

Mads F. Hjorth[1] · Trine Blædel[1] · Line Q. Bendtsen[1] · Janne K. Lorenzen[1] · Jacob B. Holm[2] · Pia Kiilerich[2] · Henrik M. Roager[1,3] · Karsten Kristiansen[2,4] · Lesli H. Larsen[1] · Arne Astrup[1]

Received: 22 September 2017 / Revised: 22 February 2018 / Accepted: 16 March 2018

Abstract

Background/objectives Individuals with high pre-treatment bacterial *Prevotella*-to-*Bacteroides* (*P/B*) ratio have been reported to lose more body weight on diets high in fiber than subjects with a low *P/B* ratio. Therefore, the aim of the present study was to examine potential differences in dietary weight loss responses between participants with low and high *P/B*.

Subjects/methods Eighty overweight participants were randomized (52 completed) to a 500 kcal/d energy deficit diet with a macronutrient composition of 30 energy percentage (E%) fat, 52 E% carbohydrate and 18 E% protein either high (≈1500 mg calcium/day) or low (≤ 600 mg calcium/day) in dairy products for 24 weeks. Body weight, body fat, and dietary intake (by 7-day dietary records) were determined. Individuals were dichotomized according to their pre-treatment *P/B* ratio derived from 16S rRNA gene sequencing of collected fecal samples to test the potential modification of dietary effects using linear mixed models.

Results Independent of the randomized diets, individuals with high *P/B* lost 3.8 kg (95%CI, 1.8,5.8; $P < 0.001$) more body weight and 3.8 kg (95% CI, 1.1, 6.5; $P = 0.005$) more body fat compared to individuals with low *P/B*. After adjustment for multiple covariates, individuals with high *P/B* ratio lost 8.3 kg (95% CI, 5.8;10.9, $P < 0.001$) more body weight when consuming above compared to below 30 g fiber/10MJ whereas this weight loss was 3.2 kg (95% CI, 0.8;5.5, $P = 0.008$) among individuals with low *P/B* ratio [Mean difference: 5.1 kg (95% CI, 1.7;8.6, $P = 0.003$)]. Partial correlation coefficients between fiber intake and weight change was 0.90 ($P < 0.001$) among individuals with high *P/B* ratio and 0.25 ($P = 0.29$) among individuals with low *P/B* ratio.

Conclusions Individuals with high *P/B* lost more body weight and body fat compared to individuals with low *P/B*, confirming that individuals with a high *P/B* are more susceptible to weight loss on a diet rich in fiber.

Introduction

Current interventions and policies have failed to stop the rise in the global obesity epidemic. Numerous randomized controlled trials have compared a myriad of diets for the treatment of obesity based on the assumption that one diet fits all without being able to provide strong evidence in favor of one or the other [1–5].

Accumulating evidence is linking gut microbiota to obesity. Overall, individuals with obesity show decreased bacterial diversity [6] and gene richness [7, 8] and fecal transplantation even suggest a causal relationship between the microbiome and obesity [9–11]. The composition of the gut microbiota has the potential to affect the efficacy of energy harvest [12] particularly though the fiber-utilization capacity [13], to influence the secretion of gastrointestinal

Electronic supplementary material The online version of this article (https://doi.org/10.1038/s41366-018-0093-2) contains supplementary material, which is available to authorized users.

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[4] Institute of Metagenomics, BGI-Research, Shenzhen 518083, China

Published online: 17 May 2018

2018

European Journal of Clinical Nutrition
https://doi.org/10.1038/s41430-019-0466-1

ARTICLE

Interventions and public health nutrition

Pretreatment *Prevotella*-to-*Bacteroides* ratio and markers of glucose metabolism as prognostic markers for dietary weight loss maintenance

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Abstract

Background/Objectives Pre-treatment gut microbial *Prevotella*-to-*Bacteroides* (P/B) ratio and markers of glucose metabolism (i.e., fasting glucose and insulin) have been suggested as biomarkers for optimal weight management. However, both biomarkers need further validation, and the interactions between them for optimal weight management are largely unknown. To investigate differences in weight loss maintenance between subjects with low and high P/B ratio and the potential interactions with markers of glucose metabolism and dietary fiber intake.

Subjects/Methods Following an 8-week weight loss period using meal replacement products, subjects losing ≥ 8% of their initial body weight were randomized to one of three protein supplements or maltodextrin for a 24-week weight maintenance period. Habitual diet was consumed along with the supplements expected to constitute 10–15% of total energy. For this analysis we stratified the participants into low and high strata based on median values of pre-intervention P/B ratio, pre-weight loss Homeostatic model assessment of insulin resistance (HOMA-IR) (<2.33 or > 2.33), and dietary fiber intake during the intervention (< 28.5 or > 28.5 g/10 MJ).

Results Regardless of weight maintenance regimen, subjects with high P/B ratio ($n = 63$) regained 1.5 (95% CI 0.4, 2.7) kg body weight ($P = 0.007$) more than subjects with low P/B ratio ($n = 63$). The regain among subjects with high P/B ratio was particular evident if HOMA-IR was high and dietary fiber intake was low. Consequently, in the high P/B strata, subjects with high HOMA-IR and low fiber intake ($n = 17$) regained 5.3 (95% CI 3.3, 7.3) kg ($P < 0.001$) more body weight compared with participants with low HOMA-IR and high fiber intake ($n = 16$).

Conclusions Subjects with high P/B ratio were more susceptible to regain body weight compared with subjects with low P/B ratio, especially when dietary fiber intake was low and glucose metabolism was impaired. These observations underline that both the P/B ratio and markers of glucose metabolism should be considered as important biomarkers within personalized nutrition for optimal weight management.

Introduction

During the past several decades, numerous trials have compared diets varying in macronutrients and fiber contents for the management of overweight and obesity, assuming that a single dietary strategy would be appropriate for all individuals [1–4]. However, these studies have failed to provide strong evidence for the efficacy of any particular diet. This has given rise to the notion that the content and source of specific macronutrients are of minor importance compared with the critical element of a person's ability to adhere to a specified diet [5, 6].

However, advances in personalized nutrition have convincingly demonstrated that the metabolic response to

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Prevotella Abundance Predicts Weight Loss Success in Healthy, Overweight Adults Consuming a Whole-Grain Diet Ad Libitum: A Post Hoc Analysis of a 6-Wk Randomized Controlled Trial

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ABSTRACT

Background: The key to effective weight loss may be to match diet and gut microbes, since recent studies have found that subjects with high *Prevotella* abundances in their gut microbiota lose more weight on diets rich in fiber than subjects with low *Prevotella* abundances.

Objectives: We reanalyzed a 6-wk, parallel, randomized trial to investigate difference in body weight changes when participants, stratified by fecal microbiota composition, consumed ad libitum a whole-grain (WG) or a refined-wheat (RW) diet.

Methods: We stratified 46 (19 men, 27 women; ages 30–65 y) healthy, overweight adults by baseline *Prevotella*-to-*Bacteroides* ratios and *Prevotella* abundances. Subjects with no *Prevotella* were analyzed separately ($n = 24$). Compared with the RW diet (mean = 221 g/d), the WG diet (mean = 228 g/d) had a higher fiber content (33 g/d compared with 23 g/d). Linear mixed models and correlations were applied to link 6-wk changes in body weights and metabolic and microbiota markers, according to *Prevotella* groups and diets.

Results: The *Prevotella* abundances correlated inversely with weight changes ($r = -0.34$; $P = 0.043$). Consequently, subjects with high *Prevotella* abundances ($n = 15$) spontaneously lost 1.80 kg (95% CI: −3.23, −0.37 kg; $P = 0.013$) more on the WG diet than on the RW diet, whereas those with low *Prevotella* abundances ($n = 31$) were weight stable (−0.22 kg; 95% CI: −1.40, 0.96 kg; $P = 0.72$). Thus, the mean difference between the *Prevotella* groups was 2.02 kg (95% CI: −3.87, −0.17 kg; $P = 0.032$). Subjects with no *Prevotella* lost 1.59 kg (95% CI: −2.65, −0.52 kg; $P = 0.004$) more on the WG diet than on the RW diet. No 6-wk changes in appetite sensations, glucose metabolisms, or fecal SCFAs were associated with the *Prevotella* groups.

Conclusions: Healthy, overweight adults with high *Prevotella* abundances lost more weight than subjects with low *Prevotella* abundances when consuming a diet rich in WG and fiber ad libitum for 6 wk. This further supports enterotypes as a potential biomarker in personalized nutrition for obesity management. This t rial was registered at clinicaltrials.gov as NCT02358122. *J Nutr* 2019;00:1–8.

Keywords: weight loss, overweight, obesity, enterotype, *Prevotella*, whole grain, fiber, gut microbiota

Introduction

Advances in personalized nutrition have found that metabolic responses to specific foods are dependent on the gut microbiota composition (1). This diet–gut microbiota dependency may also play a substantial role within obesity management (2), suggesting that the key to effective weight loss requires a match between diet and gut microbiota. To better understand the role gut microbiota plays in host metabolism and health, stratification according to microbial enterotypes has been proposed (1, 3). The *Prevotella* enterotype is associated with high dietary fiber and carbohydrate intake, whereas the *Bacteroides* enterotype is linked to a Westernized diet, higher in fat (4). Recently, *Bacteroides* spp. were found to displace *Prevotella* spp. after citizens from Thailand immigrated to the United States, and consequently lost fiber-degrading capacity in the gut (5). In 2 independent studies, we found that fiber-rich diets induced greater weight loss in subjects with a high *Prevotella*-to-*Bacteroides* (P/B) ratio than subjects with a

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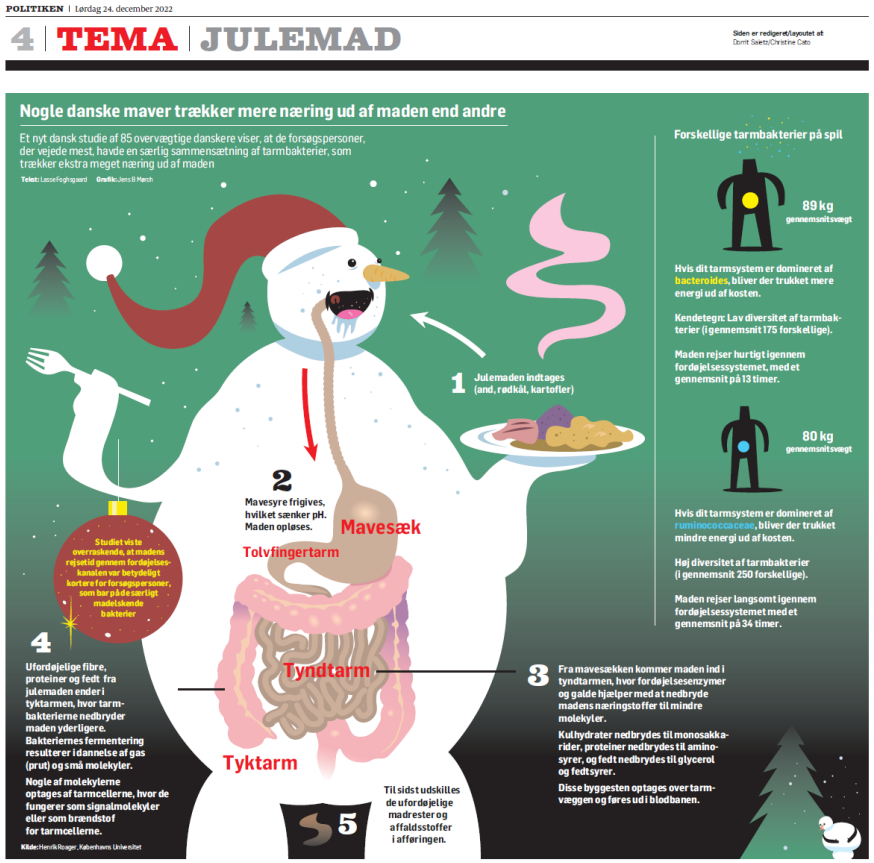
2019

Forskere har måske løst mysteriet om, hvorfor nogle tager mere på i julen

Naomi Venlet



POLITIKEN | Lørdag 24. december 2022

4 | TEMA | JULEMAD

Siden er redigeret/layoutet af Dorrit Saietz/Christine Cato

Nogle danske maver trækker mere næring ud af maden end andre

Et nyt dansk studie af 85 overvægtige danskere viser, at de forsøgspersoner, der vejede mest, havde en særlig sammensætning af tarmbakterier, som trækker ekstra meget næring ud af maden

Tekst: Lasse Foghsgaard Grafik: Jens B March

1 Julemaden indtages (and, rødkål, kartofler)

2 Mavesyre frigives, hvilket sænker pH. Maden opløses.

Mavesæk

Tolvfingertarm

Studiet viste overraskende, at madens rejsetid gennem fordøjelseskanalen var betydeligt kortere for forsøgspersoner, som bar på særligt madelskende bakterier

Tyndtarm

3 Fra mavesækken kommer maden ind i tyndtarmen, hvor fordøjelsesenzymer og galde hjælper med at nedbryde madens næringstoffer til mindre molekyler.

Kulhydrater nedbrydes til monosakkarider, proteiner nedbrydes til aminosyrer, og fedt nedbrydes til glycerol og fedtsyrer.

Disse byggesten optages over tarmvæggen og føres ud i blodbanen.

4 Ufordøjelige fibre, proteiner og fedt fra julemaden ender i tyktarmen, hvor tarmbakterierne nedbryder maden yderligere. Bakteriernes fermentering resulterer i dannelse af gas (prut) og små molekyler.

Nogle af molekylerne optages af tarmcellerne, hvor de fungerer som signalmolekyler eller som brændstof for tarmcellerne.

Tyktarm

5 Til sidst udskilles de ufordøjelige madrester og affaldsstoffer i afføringen.

Kilde: Henrik Roager, Københavns Universitet

Forskellige tarmbakterier på spil

89 kg gennemsnitsvægt

Hvis dit tarmsystem er domineret af bacteroides, bliver der trukket mere energi ud af kosten.

Kendetegn: Lav diversitet af tarmbakterier (i gennemsnit 175 forskellige).

Maden rejser hurtigt igennem fordøjelsessystemet, med et gennemsnit på 13 timer.

80 kg gennemsnitsvægt

Hvis dit tarmsystem er domineret af ruminococcaceae, bliver der trukket mindre energi ud af kosten.

Høj diversitet af tarmbakterier (i gennemsnit 250 forskellige).

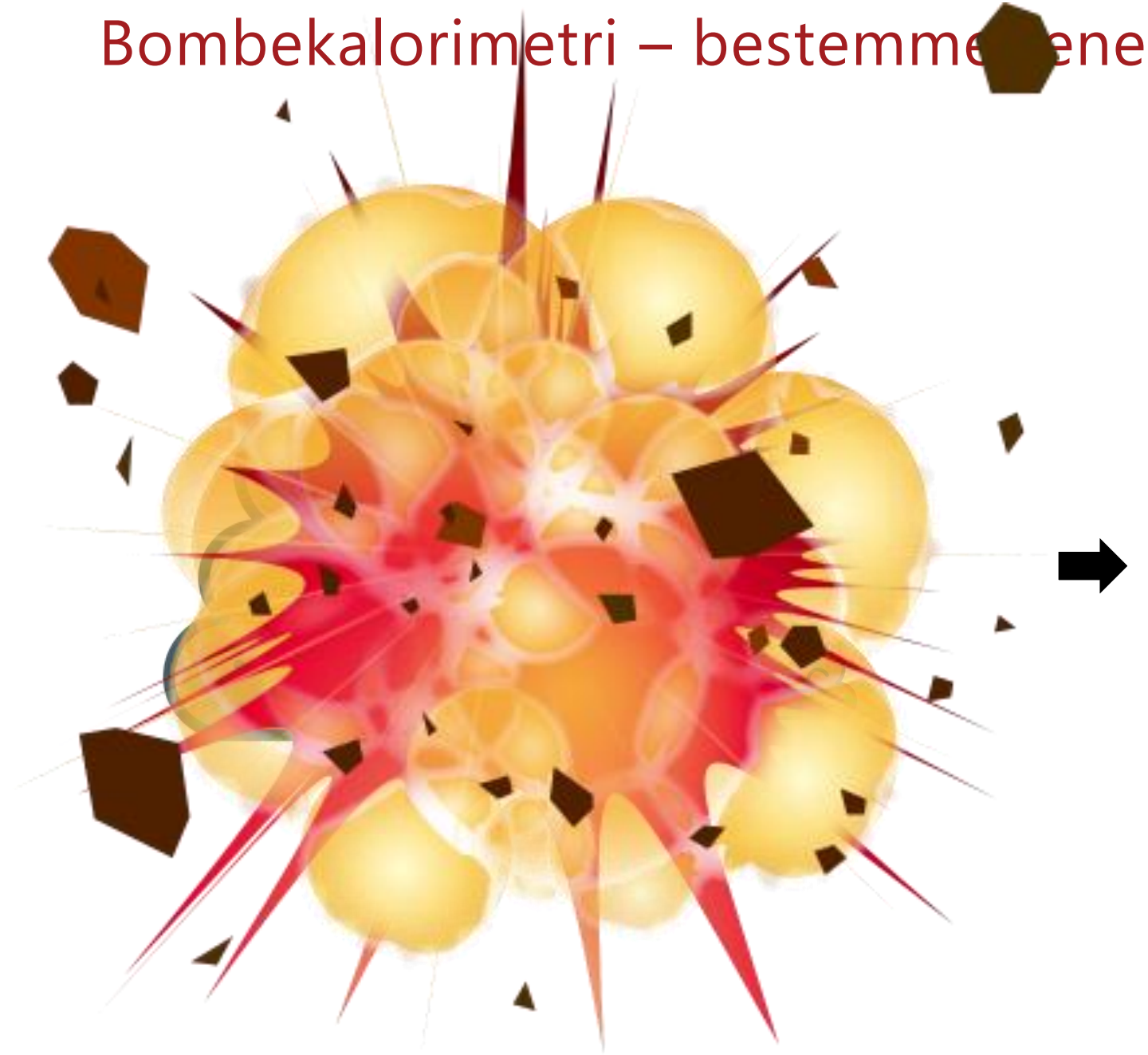
Maden rejser langsomt igennem fordøjelsessystemet med et gennemsnit på 34 timer.

Afføring fra 85 danskere med overvægt

Bestemmer tarmbakterie-sammensætning (**B**, **P** og **R**-type)

Bombekalorimetri – bestemmelse af energiindhold

Naomi Venlet

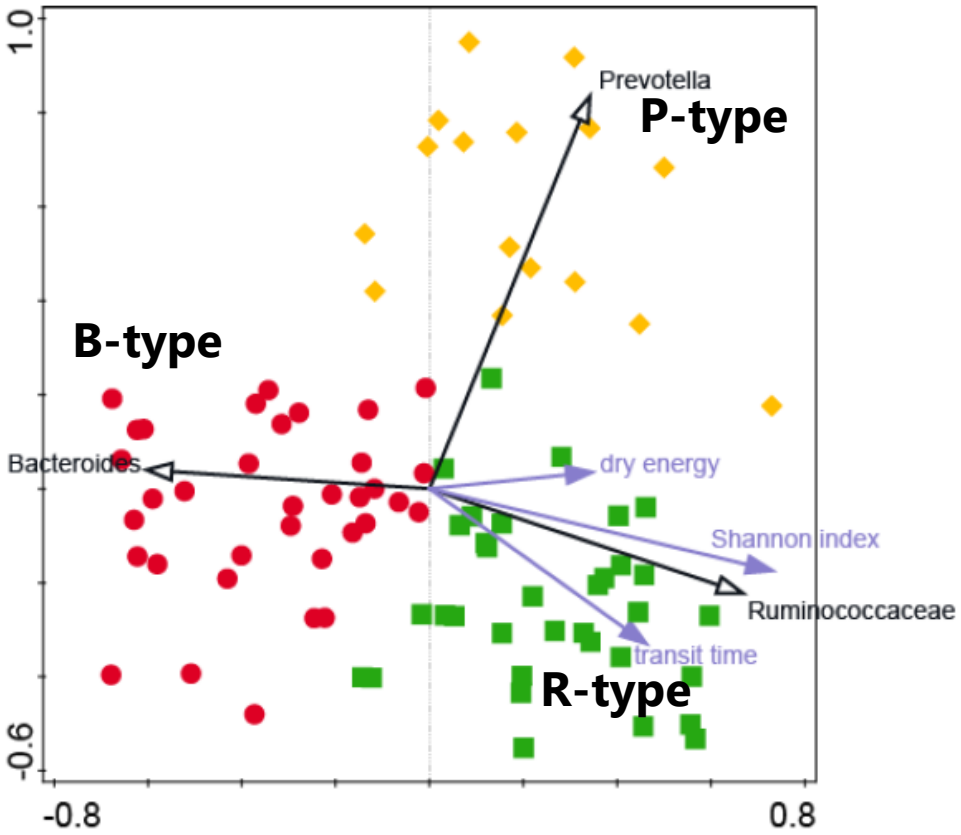


Nogle danskere trækker måske mere energi ud af maden

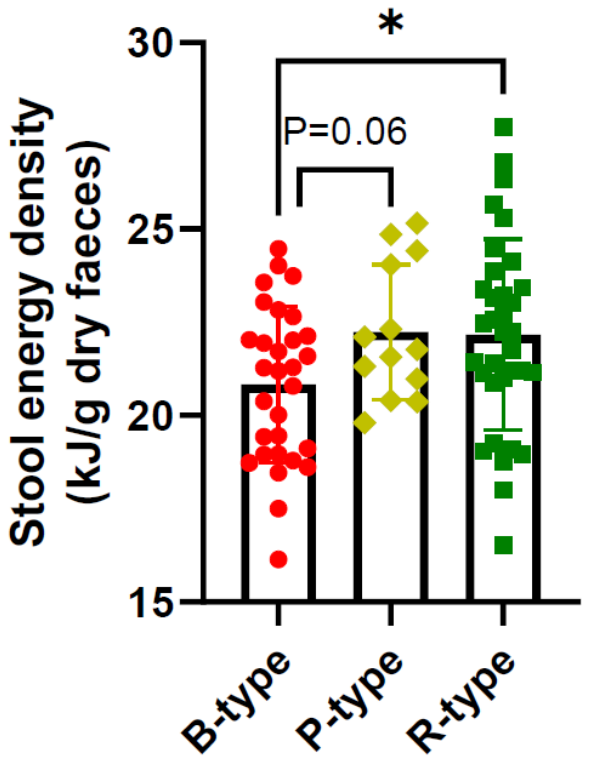
Naomi Venlet

Tarmmikrobiomet

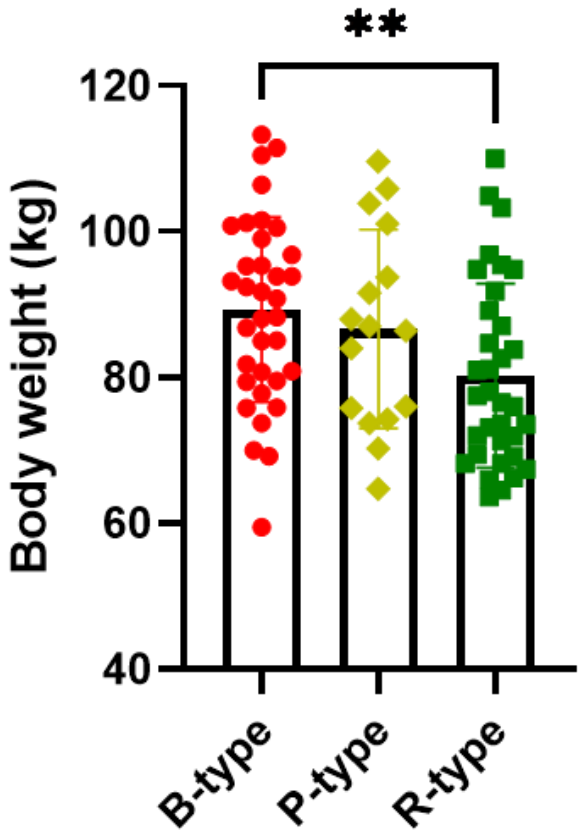
- Vi kan inddele danskere i tre grupper



Energi i fæces



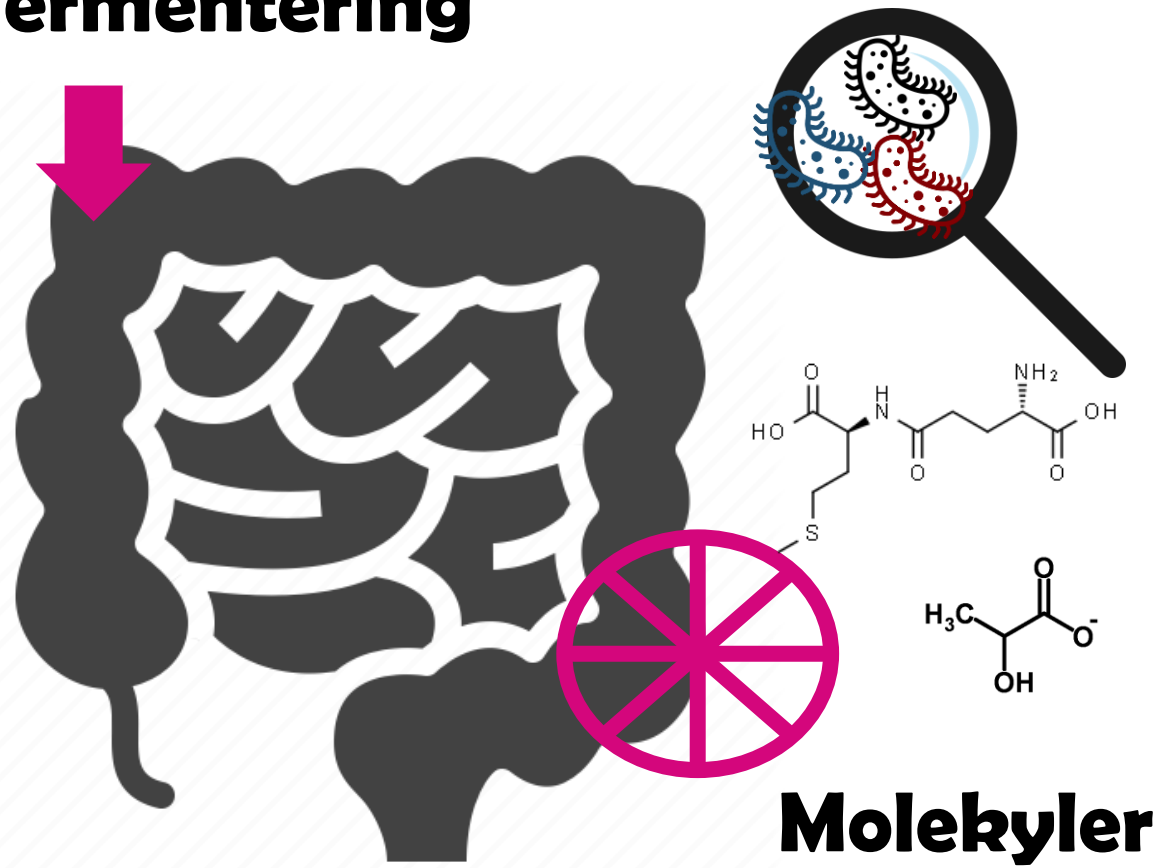
Kropsvægt



Boekhorst *et al.*, 2022; **Microbiome**

Hvordan kan mikrobiomet påvirke energiudskillelse?

Fermentering



Molekyler

Gas

Hypoteser

- Tarmbakterier påvirker, hvor effektivt kostfibre nedbrydes
  => forskel i udnyttelse af maden
- Tarmbakterier udnytter energien til at danne bakteriel biomasse ("growth rate")
  => mindre energi til kroppens celler
- Tarmbakterier danner molekyler, som regulerer dannelsen af appetit-hormoner i tarmen (f.eks. GLP-1 og PYY)
  => mindsker appetit
- Tarmbakterier regulerer transittid
  => mere/mindre tid til absorption af næring

Roager and Christensen, 2022; **Proceedings of the Nutrition Society**

Nyt forskningsprojekt (2024-2027)

GutEnergy

Projektet skal undersøge om forskelle i tarmbakterier påvirker, hvor meget energi, vi trækker ud af maden

- Omkring 10% af vores daglige energiindtag udskilles via afføringen
- Dog er der stor variation i hvor meget vi udskiller (1-15%)
- Vi kommer til at søge forsøgspersoner i 2025

WAGENINGEN UNIVERSITY & RESEARCH

novo nordisk foundation

Opsummering - hovedpointer

- Dit tarmmikrobiom er **unikt**
- **Markante kostændringer** kan ændre mikrobiomet, **men er ellers meget stabilt** (måske pga. miljøet i tarmen)
- Dyrestudier har vist, at **mikrobiomet kan påvirke vægtøgning**
- **Energiindhold i fæces** er relateret til forskelle i tarmbakterier hos mennesker
- Hvis tarmbakterier påvirker energiudnyttelsen, så kan det over tid have betydning for **tilbøjelighed til vægtøgning**
- **Vi kender til en række mulige mekanismer**, hvormed tarmbakterier kan påvirke kroppens vægt og stofskifte, men **evidens fra mennesker mangler stadig**.

Tak til kollegaer, samarbejdspartnere, fonde og frivillige!

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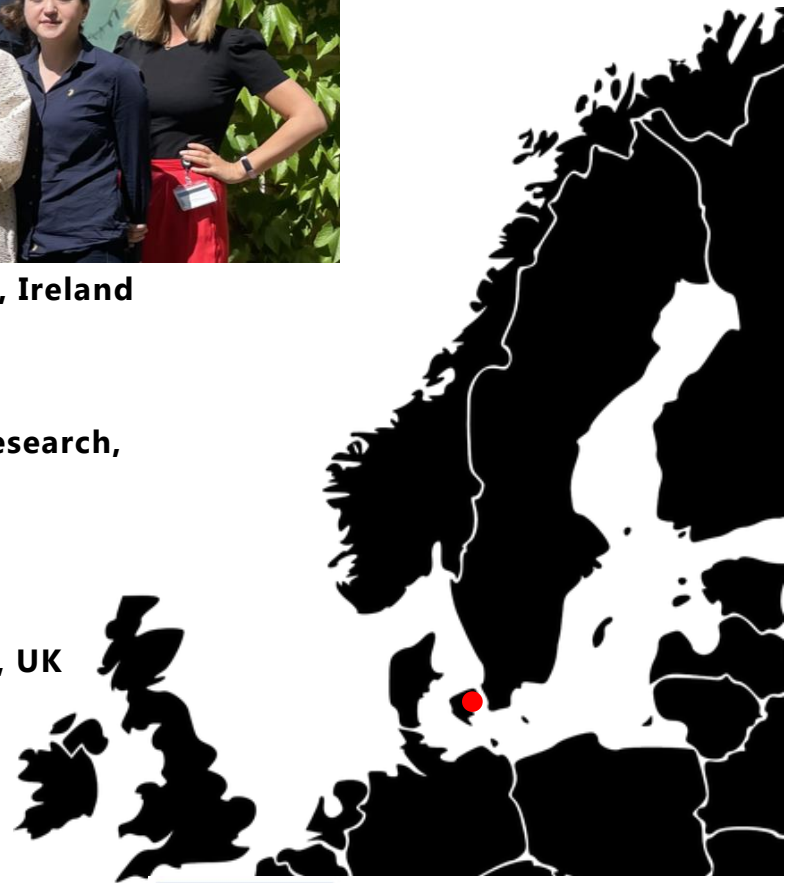

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