

# Yogurt for Health

### **10 evidence-based conclusions**

to mark the 5th anniversary of the Yogurt In Nutrition Initiative





### Contents

#### Contributors

Yogurt from Science to Health - Introduction

The history of yogurt

Scientific Consensus Statements from the

- 1. Yogurt is a nutrient-rich food
- 2. Yogurt consumption is linked with hea
- 3. Yogurt can enhance satiety and help
- 4. Yogurt consumption is associated with
- 5. Yogurt consumption is associated with
- 6. Yogurt consumption is associated with
- 7. Yogurt and other dairy products are re dietary guidelines around the world
- 8. Yogurt improves lactose digestion in
- 9. Yogurt with live cultures can contribut
- 10. Yogurt is part of a sustainable diet

References

### Key to toolbox icons



	4
n from the YINI Chairs	5
	6
YINI Board:	
	8
althier diet and lifestyle	10
to manage energy intake	12
th reduced weight gain over time	14
th reduced risk of Type 2 diabetes	16
th reduced risk of cardiovascular disease	18
ecommended for bone health in	
	20
people with lactose maldigestion	22
te to gut health	24
	26



28

## Contributors

### The Board of the Yogurt In Nutrition Initiative

#### **Co-chairs:**

#### Sharon Donovan

Professor and Melissa M Noel Endowed Chair, Department of Food Science and Human Nutrition, University of Illinois, Urbana, Illinois, USA

#### Members of the Board:

#### Naima Amrani

Professor at the Faculty of Medicine and Pharmacy, Mohammed V University, Rabat-Morocco, President-Elect and Chair of the World Gastroenterology **Organisation Foundation** 

#### Chris Cifelli

Vice President of Nutrition Research at National Dairy Council, USA

#### Mauro Fisberg

Associate Professor, Paediatrics and Nutrology, Nutrition and Feeding Difficulties Centre, PENSI Institute, José Luiz Setubal Foundation- Sabará Children's Hospital, Brazil

#### Frans J Kok

Emeritus Professor of Nutrition and Health, Division of Human Nutrition, Wageningen University, The Netherlands

#### Widjaja Lukito

Human Nutrition Research Center, Indonesian Medical Education and Research Institute, Faculty of Medicine, Universitas Indonesia

#### Luis Moreno

Professor of Public Health, University of Zaragoza, Spain

#### **Olivier Goulet**

Professor of Paediatrics, Head of the Division of Paediatric Gastroenterology-Hepatology-Nutrition, Hôpital Necker Enfants Malades-University, Sorbonne-Paris-Cité and Paris-Descartes Medical School, France

#### **Andrew Prentice**

Director of the Medical Research Council (MRC) International Nutrition Group based at the London School of Hygiene & Tropical Medicine, UK

#### René Rizzoli

Emeritus Professor of Medicine, former Head of the Service of Bone Diseases, Geneva University Hospitals and Faculty of Medicine, Geneva, Switzerland

#### **Barbara Rolls**

Professor and the Helen A Guthrie Chair of Nutritional Sciences, The Pennsylvania State University, USA

#### Seppo Salminen

Professor and Director of the Functional Foods Forum, Faculty of Medicine at the University of Turku, Finland

#### **Michele Sculati**

Assistant Professor of Human Nutrition at the University of Milano Bicocca and at the University of Pavia, Italy

#### **Angelo Tremblay**

Professor at the Department of Kinesiology at Laval University, Quebec City, Canada

#### **Connie Weaver**

Distinguished Professor of Nutrition Science at Purdue University, West Lafayette, Indiana, USA

## Yogurt from Science to Health

### Introduction from the YINI Chairs

#### The Yogurt In Nutrition Initiative (YINI) was established in 2013 with the overall goal to achieve scientific knowledge on the health effects of yogurt and to share the findings with a broad audience.

The YINI represents a unique collaboration between two international scientific organisations - the American Society for Nutrition (ASN) and the non-profit organisation, Danone Institute International (DII). The activities of the initiative are guided by a Scientific Advisory Board of 15 world experts with a passion for advancing knowledge on the links between diet and health.

The goals of YINI are to:

- gather and evaluate current evidence on the health effects of yogurt,
- promote new research, and
- broadly disseminate the scientific knowledge among healthcare professionals and the public.

Over the past five years, the YINI has built a strong portfolio of resources: scientific meetings and proceedings, educational campaigns, printable and online materials. A YINI digital ecosystem includes the popular website, www.yogurtinnutrition.com that provides news and practical information, and social media interfaces, such as Twitter with nearly 17,000 followers of @YogurtNutrition.

#### Inspiring events and supporting innovative research

Each year, the YINI highlights topical areas of research into the scientific and clinical links that are emerging between yogurt and health. Themes include weight management, the risk of diabetes, lactose intolerance, fermentation, and children's health. These themes are reflected in the annual YINI Global Summit on the Health Effects of Yogurt, the proceedings of which are published in peer reviewed journals.

In order to stimulate further research advances and support scientists from around the world, the YINI provides a grant each year (US \$30,000) and launches a Call for Research Proposals concerning a range of projects, focused on yogurt science. Find out how to apply at www.yogurtinnutrition.com/category/grant-application/

#### Celebrating the 5th YINI anniversary

Today, as we celebrate the YINI's 5th anniversary, we can reflect on what has been achieved. In this document, the YINI board reviews the recent advances in scientific understanding about the health effects of yogurt and draws several evidence-based conclusions. Overall, substantial accomplishments have been made in the past five years, highlighting exciting potential developments in managing health through yogurt as part of our diet. Ongoing research is opening new doors - to a bright future.

Professor Sharon Donovan



Co-chairs of the Yogurt In Nutrition Initiative



Professor Olivier Goulet



## The history of yogurt

### Part of the human diet for thousands of years

Made by generations of people over thousands of years, yogurt has become an integral part of the diet in many cultures around the world. Only recently have scientists begun to understand the potential health benefits that yogurt may offer, largely thanks to the discovery of lactic acid bacteria.

#### A way to preserve milk

- The first use of milk products in the human diet can be traced back to the Neolithic period between 10,000 and 5,000 BC, a time when nomadic people were settling down to an agricultural way of life. Simultaneously they were starting to domesticate milk-producing animals such as cows, goats, yaks, buffalo and camels. (1)
- At that time, herdsmen in the Middle East carried milk in bags made of animal gut. Contact with intestinal enzymes may have caused the milk to curdle and sour.<sup>1</sup> This may have led to the realisation that a dairy product could be conserved for a relatively long period.<sup>1</sup>
- Yogurt was well known in the Greek and Roman empires, and it is even mentioned in the Bible.
- The word 'yogurt' is believed to stem from a Turkish word meaning to thicken, coagulate or curdle.

#### Early associations between yogurt and health

• In the 11th century, the curative properties of yogurt were evaluated for the first time in Turkish literature, suggesting its use in conditions such as diarrhoea and stomach cramps.<sup>1</sup>

- According to legend, 12th century Mongolian ruler Genghis Khan fed his army yogurt, believing it instilled strength and bravery. (1)
- Yogurt was introduced into Western Europe in the 16th century by the King of France, François the 1st, after he was given it by a doctor from Turkey as a treatment for severe diarrhoea.<sup>1</sup>

#### **Discovery of lactic acid bacteria**

Starter cultures that convert lactose in milk to lactic acid have been used in the inoculation of fresh milk with small quantities of sour milk since long before anything was known about bacteriology. (2) For people living in primitive sanitary conditions, making fermented milk products offered a safe way of preserving dairy because the acidity of these products destroyed pathogens.<sup>2</sup>

- The first observation of bacteria in sour milk was made by Antonie van Leeuwenhoek in about 1675.<sup>2</sup>
- However, it was not until the 20th century that the first glimpse was caught of an explanation for the health benefits associated with yogurt consumption.
- In 1905 a Bulgarian medical student, Stamen Grigorov, described the lactic acid bacteria in yogurt, Bacillus bulgaricus - now Lactobacillus bulgaricus - which is still used in yogurt nowadays.<sup>1</sup>



#### the first time

Recognising its possible health benefits, Isaac Carasso sold yogurt as a medicine through pharmacies in Spain



First opened in France, then in the USA nine years later by Isaac's son. Daniel Carasso

could prolong life





Yogurt today





Next

**FIND OUT MORE ...** 







1932

2018

summit proceedings

Everything about yogurt

- and that lactic acid bacteria
- First yogurt factory

- Four years later, Nobel Prize-winner Élie Metchnikoff suggested that ageing is caused by toxic bacteria in the gut and that lactic acid could prolong life. (1)
- As the 20th century progressed, yogurt became known for its potential health benefits and it began to be sold commercially, first in pharmacies as a medicine.
- The first yogurt factory was opened in 1932, in France by Daniel Carasso.

"Yogurt is an ancient food and has been part of our diet for thousands of years. It has been valued as a healthy food for much of that time but we're only just beginning to understand how it might be good for us."

- Professor Mauro Fisberg

#### What is yogurt?

Today, yogurt is described by the United Nations' Food and Agriculture Organisation and the World Health Organization in their Codex Alimentarius as a fermented milk product containing two strains of live bacteria, Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus. Both strains must remain active in the final product, with a total of at least 10 million

bacteria per gram. (1) (3)



#### Yogurt contains both micronutrients – vitamins and minerals - and macronutrients, including proteins and fatty acids.

- Yogurt contains high-quality protein, including all nine essential amino acids in the proportions needed for protein synthesis. (4)
- Proteins in yogurt are more digestible than proteins in standard milk, probably because the fermentation process starts to break them down into smaller units. (5)
- Yogurt is a well-recognised source of calcium, but it also provides smaller amounts of many other micronutrients, including potassium, zinc, phosphorus, magnesium, vitamin A, riboflavin, vitamin  $B_{5}$ , vitamin  $B_{10}$  and in some countries, vitamin D. (6)(7)

#### Yogurt consumption helps meet nutrient intake requirements in adults and children

Yogurt and other dairy products contribute to key nutrient intakes for adults and children. (6)(8)(9) That is why most countries recommend the consumption of dairy products - and, when amounts are specified, two or three servings per day are typically recommended. (10)

For example, a 125-g pot of plain yogurt provides, among other nutrients, 20% of an adult's recommended daily intake (RDI) of calcium, 21% of vitamin B<sub>o</sub>, 11% of vitamin  $B_{10}$  and 16% of phosphorus (**Figure 1**). (11) (12)

Home

Previous

Next

8

Good diet quality is especially important for children and adolescents to support growth and development. Yogurt is a valuable part of a balanced nutrient-rich diet during this period, contributing a substantial percentage of a child's needs for micronutrients and macronutrients. (8)

In fact, many people do not eat the recommended intakes of certain nutrients, which are therefore referred to as the 'shortfall nutrients'. Teenagers are especially at risk of nutrient shortfall, and vitamin D, calcium, potassium, fibre and iron are of particular concern.

• Data from the National Health Nutrition and Examination Survey (NHANES) show that increasing dairy food consumption (milk, cheese and yogurt) to meet the recommended level in the USA for adolescents of three servings per day can make up for the shortfall of three nutrients of public health concern – calcium, vitamin D and potassium. (9)

"Nutrient density is a key feature of food that we should prefer in the context of a balanced diet, and yogurt is a nutrient-dense food containing a wide range of macro- and micro-nutrients."

- Professor Michele Sculati

**FIND OUT MORE ...** 

### 



#### Figure 1. Nutrient content of yogurt



Adapted from Table Ciqual des aliments 2008, ANSES; Directive européenne (90/496/CEE);11 Martin A et al. 2007. Apports nutritionnels conseillés pour la population française, 3e édition, Ed. TEC&DOC. 605 pp. (12)

• The UK survey data suggest that adding a 125 g pot of low-fat fruit yogurt per day to adolescents' diets would increase mean calcium intake from below to above the Recommended Nutrient Intake. (6)

#### Plain yogurt has a low energy density

Energy density is the amount of energy - or calories - per gram of food. (13) Lower energy density foods provide fewer calories per gram than higher energy density foods. Hence low energy dense foods allow satisfying portions with a relatively low calorie content to be eaten. Compared with other foods, plain low-fat yogurt has a low energy density of 0.6–1.5 kcal/g (Figure 2). (14)

#### Yogurt's contribution to sugar intake is relatively low

The World Health Organization recommends limiting the consumption of non-milk extrinsic sugars – which include those added to food by manufacturers or by consumers – to a maximum of 10% energy intake. (15) However, many people in Western societies, especially children, are exceeding this threshold.

#### Figure 2. Energy density (kcal/g) of selected foods



Best of studies in children

Adapted from British Nutrition Foundation Feed Yourself Fuller chart 2010<sup>14</sup>





1st yogurt global

summit proceedings

Signature of a healthy diet

Yogurt's protein value

A great children's snack

品



in %RDI d adult woman	%RDI child 7-9 years	125g	itake for a pla semi-skimme yogurt	in %RDI d adult woman	%RDI child 7-9 years
-	-	$Vitamin B_1$	0.06mg	6%	8%
-	-	B <sub>2</sub>	0.31mg	21%	24%
-	-	B <sub>3</sub>	0.28mg	3%	3%
-	-	B <sub>5</sub>	0.53mg	11%	15%
20%	20%	B <sub>6</sub>	0.06mg	4%	6%
16%	21%		0		
4%	8%	В,	31 µg	10%	16%
8%	9%	B <sub>12</sub>	0.28 µg	11%	20%

Concerns that sweetened yogurt is contributing to these excess sugar intakes are not supported by the scientific data.

- While more than 50% of total sugars and 66% of added sugars in children's diets come from sweet products such as cakes, sweets and sugary drinks, yogurt accounts for only 1–8% of total sugars and 4-9% of added sugar to children's diets in Europe. (16)
- In the USA, a NHANES analysis found that flavoured yogurt contributes about 1% of added sugars to the diets of adults. This compared with 28.1% from soft drinks. (17)

As sugar may make a food more palatable for children, there is an argument that sweetness (consumed within recommended calorie amounts) may promote consumption of a nutrient-rich food. (18) The American Academy of Pediatrics comments that, while added sugars do not provide nutritional benefits, sugars themselves are not necessarily harmful.<sup>18</sup> It says, 'Used along with nutrient-rich foods and beverages, sugar can be a powerful tool to increase the quality of a child's diet.'18

### Yogurt consumption is linked with healthier diet and lifestyle



Regular yogurt consumers of all ages tend to eat and live healthily. They are less likely to consume junk foods, or smoke or drink alcohol to excess, and are more likely to exercise regularly. (19)(26)(27)(31)(32)(33)

#### Yogurt consumers are more likely to have adequate intakes of key nutrients

- · Yogurt consumers are less likely than nonconsumers to have an inadequate intake of certain vitamins and minerals, including vitamin  $B_0$ ,  $B_{10}$ , calcium, magnesium and zinc.<sup>19</sup>
- In both children and adults (in Spain and the USA), swapping high-calorie, nutrient-poor snacks for fullfat yogurt with fruit could help boost key nutrients and improve dietary quality without contributing to dietary excess and obesity. (20)(21)
- In French adults, rebalancing dairy intake to favour low energy-dense dairy products (milk and yogurt rather than cheese) can help improve dietary nutrient density without increasing calories or less desirable nutrients. (22)

#### Regular yogurt consumers tend to choose healthier diets

Regular yogurt consumers are less likely to consume junk food and more likely to stick to dietary guidelines.

#### Children

10

• Young children who regularly consume yogurt have a better diet quality and the overall nutrient content of their diets is higher. (23)(24)



• The diets of children who eat yogurt regularly are better overall - they consume more fruit, whole grains and milk (Figure 1) (25) and less total and saturated fat. (7)

#### Figure 1. Diet quality among children who are frequent vs infrequent yogurt consumers



HEI: The Healthy Eating Index 2005 is a measure of diet quality that assesses compliance with the US Dietary Guidelines for Americans. A 24-hour dietary recall is used to compare intakes with recommendations for various food groups. Higher HEI scores for dietary components such as fruits, vegetables and grains suggest a diet that more closely follows the Guidelines than one with lower HEI scores.

\*Statistically significant

Adapted from Zhu Y, Wang H, Hollis JH et al. Eur J Nutr. 2015 Jun;54(4):543-50. (25)

#### Adults

- People who frequently consume yogurt have higher nutrient intakes than those who do not often eat yogurt - even when yogurt is not a source of these nutrients. (6)(26) Hence frequent yogurt consumers (at least one serving per day) have been found to have higher intakes of folic acid, copper, manganese and iron.<sup>26</sup>
- Compared with low- or non-consumers, frequent yogurt consumers tend to follow dietary guidelines more closely.<sup>6,26</sup>
- Yogurt consumers are more likely to consume a prudent diet with more fruits, vegetables, nuts, legumes, fish and seafood, and fewer fast foods such as French fries and fried foods, processed and red meats, pizza, snacks, soft drinks, alcohol and hard liquor. (27)

#### Yogurt consumption is a marker of a healthier diet and lifestyle

Numerous studies suggest yogurt consumption is a signature of a healthy diet and lifestyle (Figure 2). (6) (19) (25) (27) (28) (29) (30) Compared with people who do not eat yogurt, those who do consume yogurt:

• are generally healthier, leaner, more highly educated and of higher socio-economic status<sup>30,</sup> (31)

666

Signature of a

healthy diet













Good for every Body

Signature of a healthy diet



show healthier non-nutritional behaviour than non-consumers: they are less likely to smoke, (19)(26)(31)(32)(33) tend to drink less alcohol and are more likely to be physically active in their leisure time than non-consumers<sup>32</sup>

- are more aware of the links between food and health, and are more likely to read food labels and less likely to go to fast food restaurants<sup>33</sup>
- tend to have a better health-related quality of life and mental health. (34)

Yogurt consumption is linked with a lower risk of a variety of chronic diseases. (35)

"Yogurt consumers are characterised by healthier dietary habits than non-consumers and are also known to display healthier non-nutritional behaviours. This has led to the proposal that yogurt consumption may represent the signature of a healthy diet and lifestyle."

- Dr Angelo Tremblay



A marker of healthy habits



How yogurteaters differ

## Yogurt can enhance satiety and help to manage energy intake



Consuming yogurt can increase the feeling of being full and this effect on the appetite may help reduce calorie intake. (36) (37) (38) (39)

#### Yogurt consumption decreases the feeling of hunger more than other dairy products

In a study of dairy snacks, the greatest appetite suppression was seen with yogurt.

- Hunger was 8% lower when participants consumed yogurt as a mid-morning snack than when they ate a portion of cheese matched for calorie content and volume. (36)
- Hunger was 10% lower after the yogurt snack than after a matched serving of milk (Figure 1).<sup>36</sup>

Low-fat yogurts increase feelings of fullness more than fruit-based drinks

A similar pattern of results was drawn from a study comparing low-fat yogurts with fruit drinks containing the same amounts of calories. (37)

"The low energy density of yogurt means that, as a snack or part of a meal, it can be consumed in satisfying portions that help to manage hunger and reduce energy intake."

- Professor Barbara Rolls

Yogurt containing peach – whether in a pot eaten a spoon or in drinkable form - was more satiating a peach-flavoured dairy drink and a peach juice dr Both the yogurts were associated with less hunge higher fullness ratings. (37)

#### Yogurt achieves greater satiety than high energy-dense snack foods such as chocolate

Among healthy young men, a yogurt drink taken as a mid-afternoon snack induced a greater feeling of fullness in the hour before a meal than a chocolate bar of the same calorie content (Figure 2). (38)

#### High-protein yogurt could be a healthy replacement for high energy-dense snacks

Consuming yogurt as a high-protein, less energydense snacks instead of high-fat snack foods can improve appetite control and satiety, and reduce energy intake.

#### Figure 2. Satiety rating of a yogurt drink versus a chocolate bar one hour before a meal



Adapted from Chapelot D, Payen F. Br J Nutr. 2010;103(5):760-7.38





45 minutes after dairy snacks

Figure 1. Hunger rating

\*Significantly different from the other snacks tested

# Significantly different from milk and cheese Protein content is for the following serving sizes: 410 g of mik, 278 g of yogurt + water to complete the volume, 49 g of cheese + water to complete the volume. Hunger was measured using subjective visual analogue scale Adapted from Dougkas A, Minihane AM, Givens, DI, et al. Br J Nutr. 2012 Dec 28:108(12):2274-85.36





Next

Home



Yogurt in appetite control

12

Previous

with	
than	
rink.	
er and	

- 50 40
- 30 20 10
- 0

- Women participating in a study were less hungry after consuming a mid-afternoon snack of highprotein yogurt than after consuming high-fat crackers or chocolate. (39)
- Despite having the same calorie content as the high-fat snacks, yogurt delayed the participants' desire to eat the next meal by around 30 minutes.<sup>39</sup>
- Moreover, the women consumed around 100 fewer calories after consuming yogurt than after eating crackers or chocolate.39

#### How might yogurt exert its satiating effect?

Several factors may account for the satiating properties of yogurt, including nutrient content and effects on appetite-regulating hormones.

- The high protein content of yogurt could partly account for the higher satiety effect of yogurt seen in these findings. (38)
- Protein 'preloading' in which small amounts of protein are eaten at a set time before a meal enhances satiety and reduces appetite. (40)
- Other factors that may influence the satiating effects of yogurt include its energy density, the way it is consumed (with a spoon or drunk), and its rate of passage through the digestive tract. The potential effects of fermentation may also play a role. (36)
- Yogurt may influence appetite-regulating hormones in the gut and brain. These may slow stomach emptying and communicate directly with the brain's appetite-regulation centre. 40

"Yogurt promotes satiety probably because of the satiating properties of dairy proteins. Its high calcium content might also facilitate appetite control in low-calcium consumers."

- Dr Angelo Tremblay



#### Figure 1. Weight change associated with increased consumption of yogurt or other foods

Yogurt

Fruits

Nuts

Whole grains

### Yogurt consumption is associated with reduced weight gain over time



The effect of yogurt on satiety may partly explain findings by recent reviews that yogurt consumption is associated with lower body mass index (BMI), lower body weight or weight gain, smaller waist circumference and lower body fat. (41) (42)

#### Yogurt is linked to reduced risk of overweight/obesity and smaller waist circumference

#### Adults:

Yogurt consumption appears to protect against longterm weight gain, according to pooled results from cohort studies. (43) This effect is doubled with plain or artificially sweetened yogurt compared with flavoured sweetened yogurt.

These results support those of an earlier analysis in which eating more yogurt was associated with less weight gain per 4-year period among 120,877 US healthy non-obese adults followed up for 12-20 years. For each additional serving of yogurt per day there was 372 g less weight gain (Figure 1). (44)

• In the US Framingham Heart Study Offspring Cohort, predominantly overweight people who ate three or more servings of yogurt per week gained about 55% less weight over a year than those who ate less than one serving per week. (45) When it

"In terms of obesity, dairy products in general, and yogurt in particular, have either a neutral or a positive association with reduced body fat both in adults and in children."

#### - Professor Luis Moreno

came to waist size, high-yogurt consumers gained 20% less than low-yogurt consumers.

- A large Spanish cohort study in non-overweight adults found that high-yogurt consumption (seven or more servings per week) was associated with a 20% lower risk of overweight or obesity after six years when compared with low-yogurt consumption (two or more servings per week). (46) (47)
- In a Canadian study, yogurt consumption was associated with lower body weight, waist-to-hip ratio and waist circumference, and tended to be associated with a lower BMI when compared with no yogurt consumption. (27)

#### Children:

Results from the NHANES in US children aged 8-18 years (NHANES 2005-2008) and the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study showed that yogurt consumption was associated with less body fat. (7) (48)



-0.5

#### Yogurt may help when dieting

- Some evidence exists to suggest that including yogurt in a calorie-controlled diet leads to greater weight loss. (49) (50)
- A 3-month trial in 34 obese people found that those including three servings of fat-free yogurt daily as part of an energy-restricted diet lost 22% more body weight and 61% more body fat than those not eating yogurt. (51)

#### How might yogurt influence weight and body fat?

Several theories have been put forward.

- Calcium in yogurt may affect body fat by reducing its absorption from the intestine, (52) and causing less fat to be stored in fat cells. (53)
- Live bacteria in yogurt may beneficially alter the gut microbiota and influence weight, although the mechanism for this is as yet unclear. (8)(50)(54)



Next Home

**FIND OUT MORE ...** 







1st yogurt global summit proceedings



• Obesity is accompanied by chronic, low-grade inflammation in various tissues. (55) A recent Brazilian population-based study suggests that increasing yogurt consumption may protect against inflammation. (56)

"Proteins may influence appetite-regulating hormones, calcium may affect fat absorption, and live bacteria may alter gut microbiota - all of which may explain the beneficial effects that yogurt may have on body weight."

- Professor Frans Kok



### Yogurt consumption is associated with reduced risk of Type 2 diabetes



Three meta-analyses have reported a consistent association between yogurt consumption and reduced risk of Type 2 diabetes (T2D) (Figure 1). (57) (58) (59)

Whole-fat yogurt appears to be best - contrary to the recommendations of most dietary guidelines advocating low-fat dairy products for adults.

- Results of a recent Danish study showed that whole-fat yogurt eaten in place of low- or wholefat milk was associated with a lower rate of T2D during a median follow-up of 15.3 years in people aged 50–64 years at baseline (11–17% reduction per serving/day substituted). (60)
- In contrast, when low-fat yogurt was eaten in place of whole-fat yogurt, there was a 17% higher rate of T2D per serving per day substituted.<sup>60</sup>

"The evidence that regular yogurt consumers have about a 20% lower risk of Type 2 diabetes than non-consumers is really very persuasive."

- Professor Andrew Prentice

Replacing less healthy snacks with yogurt is also associated with reduced risk of T2D

• In an elderly Spanish population at high cardiovascular risk followed up for a median of 4.1 years, replacing one serving per day of snacks with a daily serving of yogurt lowered

the risk of T2D (by 40% when replacing biscuits/ chocolate and 45% when replacing whole-grain biscuits and pastries). (61)

• Similarly, a UK study found substituting yogurt in place of snacks (crisps) was associated with a 47% fall in the risk of T2D in people aged 40–79 years who were followed up for 11 years. (62)

#### The association between vogurt consumption and reduced risk of T2D is seen across populations and age groups

- The inverse association between yogurt consumption and T2D risk has been shown in populations in North America (58) and across Europe.<sup>61,62</sup> (63)
- Chen et al reported that frequent yogurt intake was consistently and inversely associated with T2D risk in young, middle-aged and elderly adults.58
- Among US children and teenagers aged 2–18 years, frequent consumers of yogurt (at least one serving per week) had a healthier insulin profile, suggesting a reduced risk for T2D, compared with those who ate yogurt infrequently (Figure 2). (25)
- A study of young Canadian people of mean age 20 years, concluded that consuming yogurt may protect against insulin resistance more specifically among those at risk of obesity, in a relationship that appeared to be independent of lifestyle factors measured. (64)

#### Figure 2. Association of yogurt consumption with improved insulin profile in children and teenagers

summit proceedings



#### How might yogurt reduce T2D risk?

Several mechanisms may explain this relationship.

- Live bacteria in yogurt can improve the composition of the gut microbiota and this may help to reduce inflammation, which is linked to T2D. (66) (67)
- Yogurt consumers are less likely to have unhealthy lifestyles that are linked to T2D. (30) (68)
- The risk of T2D has been shown to fall by 7% for each 10  $\mu$ g increase in dietary vitamin K<sub>o</sub>. (69) Whole-fat yogurt contains up to 28 µg of vitamin K<sub>a</sub> per 100 g serving. (70)
- Yogurt is a low glycaemic index food, suggesting that it does not cause a spike in blood glucose levels after a meal. (71)

#### Increased yogurt consumption could reduce healthcare costs

Researchers analysing UK data have predicted that if the adult population increased the amount of yogurt they ate by one serving per day, they could generate savings to the National Health Service of £140 million over five years through reductions in the incidence of T2D. (65)

### Yogurt consumption is associated with reduced risk of cardiovascular disease



Dairy products such as yogurt have repeatedly been found to have either neutral or beneficial effects on cardiovascular disease (CVD) risk, a finding highlighted by recent literature reviews and a meta-analysis (Figure 1). (72) (73) (74) (75)

#### Yogurt may reduce the risk of high blood pressure

A study among US adults found that greater intakes of total dairy foods, total low-fat/fat-free dairy foods, lowfat/skimmed milk and yogurt were associated with a smaller increase in systolic blood pressure and a lower risk of high blood pressure incidence per year. (45)

• This correlation seemed to lessen over time except for total dairy foods and yogurt.

 Consuming one extra serving of yogurt per week was related to a 6% reduced risk of developing high blood pressure.45

#### Yogurt may reduce risk of CVD

In people with high blood pressure:

- consuming two or more servings of yogurt per week, especially when part of a healthy diet, is associated with a reduced risk of heart attack or stroke compared with a consumption of less than one serving per month. (76)
- overall, among those eating two or more servings of yogurt per week, women had a 17% lower CVD risk and men had a 21% lower risk compared with those who consumed less than one serving per month.



Adapted from Lordan R, Tsoupras A, Mitra B, et al. Foods 2018;7:29.75 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5867544/



**FIND OUT MORE ...** 





Consuming 200 g of yogurt daily may reduce CVD risk:

- A meta-analysis of nine cohort studies (from the USA, Sweden, The Netherlands, Finland and the UK) did not observe a significant association between yogurt intake and CVD when comparing the highest yogurt consumption with the lowest intake. (77)
- However, in a subgroup analysis, consumption of ≥200 g/day was associated with a significantly reduced risk of CVD.77

#### Children and teenagers could benefit too

- Among US children and teenagers, those who eat yogurt have a lower intake of saturated fat than non-consumers. (7)
- In European adolescents, consumption of milk and yogurt has been found to be inversely associated with being overweight and positively associated with cardiorespiratory fitness. (48) (78)
- Dairy consumption was found to be inversely associated with CVD risk score in girls.78

### How might yogurt reduce CVD risk?

The association between yogurt consumption and reduced risk of CVD may be due to the protective properties of some components. (73) (74) (75)

- Yogurt and other dairy products are rich in micronutrients and proteins, some of which have been shown to lower blood pressure.
- Low-grade inflammation underlies the pathology of CVD, and some saturated fatty acids found in



1st yogurt global summit proceedings



### "There's an inverse association between yogurt consumption and a composite cardiovascular risk factors score."

- Professor Luis Moreno

dairy products (e.g. lauric acid) may have antiinflammatory effects.

- Calcium, potassium and magnesium found in yogurt have been linked to a reduced risk of stroke.
- Milk proteins may have a beneficial effect on blood lipids.
- The dairy matrix may contribute to the beneficial effects of yogurt and other dairy products and determine the fat bioavailability.

In addition, cheese and fermented milk products such as probiotic yogurts and semi-skimmed yogurts in particular have a high antioxidant potential i.e. the ability to combat oxidative damage, (79) and could play a part in healthy and active ageing. (80)

#### Whole-fat or low-fat dairy products?

Although nutritional guidelines recommend consumption of low-fat rather than whole-fat dairy foods to reduce CVD, (81) recent findings suggest that this advice may need to be modified.<sup>75</sup>

A review of meta-analyses has found that the consumption of various forms of dairy products - including total dairy, cheese, yogurt, high-fat and low-fat dairy - shows either favourable or neutral associations with cardiovascular-related outcomes. (72)

Researchers conclude that the current scientific evidence calls into question the negative image of milk fat, and that consumers can continue to consume full-fat dairy products moderately as part of a healthy and balanced lifestyle, with fermented dairy products being preferable for optimum nutrient intake and potential cardiovascular health benefits. (5)



### Yogurt and other dairy products are recommended for bone health in dietary guidelines around the world



Yogurt (as part of the dairy product group) is recommended in many dietary guidelines because of its nutrient content essential for bone health.

#### Yogurt is rich in nutrients essential for bone health

Yogurt is rich in protein and several micronutrients important for bone health, most notably calcium (Figure 1). (7) (82) (83)

#### Figure 1. Yogurt consumption increases children's intake of vital micronutrients for bone health



\* Statistically significant

Adapted from Keast DR, Hill Gallant KM, Albertson AM, et al. Nutrients 2015;7:1577-93.

Yogurts containing live bacteria and those with added prebiotics may benefit bone health by modifying the gut microbiota and increasing calcium absorption. (84)

#### Yogurt is linked to healthy growth of bones during childhood and adolescence

- In a study in China, adding one serving of yogurt to the usual diet of preschool children for 5 days each week over 9 months promoted growth (height and weight gain) and significantly increased bone mineral density compared with those seen in children not receiving yogurt supplementation. (85)
- Fermented dairy products, such as yogurt, are linked to improved bone health, particularly bone mineral density, in children and teenagers.<sup>84</sup>

"Eating more yogurt and other dairy foods has the potential to improve bone health and prevent fractures during childhood, in adolescence, and later in life."

Professor René Rizzoli

#### Yogurt is associated with stronger bones Yogurt could reduce the risk of and better physical function in older osteoporosis people

Increasing yogurt consumption could be a convenient way of improving the nutritional status and health of older adults, including their bone health. (80)

The association between yogurt consumption and bone health was investigated in a study of people aged over 60 years. Results showed:

- women who frequently ate yogurt (more than one serving/day) had stronger bones than those who rarely or never ate yogurt (less than one serving/ week). (86) Total hip and femoral neck bone mineral density was 3.1–3.9% higher among frequent yogurt consumers
- in men, high-yogurt consumers were found to have 12.9% higher mean vitamin D concentrations than low/non-consumers. A protective effect on bone was also suggested by changes in levels of a marker for osteoclasts bone cells involved in the maintenance and repair of bone<sup>86</sup>
- compared with low-/non-consumers, women who often ate yogurt had better scores for daily living activities and physical self-maintenance.86

#### Yogurt may reduce the risk of hip fracture

Available evidence suggests that yogurt is linked to a lower risk of hip fracture in older adults. (87)

- A meta-analysis reported that a higher intake of yogurt was associated with a 25% reduction in hip fracture risk when compared with low intake. (88)
- A recent study in middle-aged and elderly Swedish women showed that low intake of fermented milk products (yogurt and soured milk) was linked to high rates of hip fracture. (89)
- Hip fracture rates were lowest among women with a high intake of fermented milk products in combination with a high intake of fruit and vegetables.89











A spoonful of healthy diet

20

In people over the age of 60 years, statistical modelling of yogurt intake and bone health predicted that each increase of one serving per week of yogurt intake was associated with a 39% lower risk of osteoporosis in women and a 52% lower risk in men. (86)

Encouraging older people to eat yogurt more often, particularly vitamin D- and calcium-fortified yogurt, may be a valuable public health strategy to stave off osteoporosis.<sup>86</sup> (90) (91) (92)

#### Yogurt is recommended as part of a healthy diet

Many international advisory boards recommend the consumption of dairy products in amounts equivalent to 400–500 mL milk per day. (93)

Several countries include yogurt (as part of dairy products) in their dietary guidelines. (94) These include, among others, the USA, Canada, Japan, the UK, Australia, Switzerland, Sweden, and Portugal.

"It is difficult to meet the nutrient requirements for healthy bones without three servings of dairy products each day for most age groups. Getting adequate calcium, magnesium, protein, and potassium are important at all life stages, but two critical periods where bone is rapidly turning over is during pubertal growth and after menopause."

- Professor Connie Weaver



### Yogurt improves lactose digestion in people with lactose maldigestion



Live yogurt has properties that improve digestion of lactose. (95) (100) (103)

#### Lactose maldigestion is normal

Lactose is a natural sugar found in milk and other dairy products. It can be broken down by the enzyme lactase in the small intestine into glucose and galactose, two simpler sugars that are readily absorbed into the bloodstream. (95)

- After weaning, our ability to digest lactose declines because we produce less lactase. (96) (97) Difficulty in digesting lactose due to this normal reduction in lactase production/activity is known as lactose maldigestion.97
- Undigested lactose reaching the colon is broken down by the resident microbiota, resulting in the

"The living bacteria in yogurt allow people suffering from lactose maldigestion/intolerance to gain the nutritional benefits of dairy products."

- Professor Naima Amrani

production of short-chain fatty acids (SCFAs) and gases (Figure 1). (97) In most people, this maldigestion produces no noticeable symptoms.

- When lactose maldigestion gives rise to symptoms such as bloating, cramps, diarrhoea and flatulence, this is called lactose intolerance.<sup>97</sup> (96)
- Self-diagnosis of lactose intolerance is common, but it is often incorrect and in fact very few people have confirmed clinical lactose intolerance. (82) (98)

#### People with lactose intolerance can eat dairy products without experiencing significant symptoms

Dairy products are recognised as an important part of a healthy diet as they are a source of several nutrients (see page 8). Dairy products are particularly important for providing calcium, for which it is difficult to achieve the recommended daily intake from a dairy-free diet. (82)

It is therefore important that dairy products are part of everyone's diet, including people with lactose maldigestion or intolerance.

People with lactose intolerance or lactose maldigestion can generally tolerate a single intake of up to 12 g of lactose (equivalent to about one glass of milk), particularly when consumed as part of a meal, with no or minor symptoms. (96) (99)

There is some evidence that a daily intake of 24 g of lactose can be tolerated if it is distributed throughout the day and consumed with other foods.96,99

#### Choose yogurt for improved lactose digestion

Dairy products vary in the amount of lactose they contain. A reduced level of lactose is found in yogurt containing the two active bacterial cultures L. delbrueckii subsp. bulgaricus and S. thermophilus. (82) These live bacteria produce lactase which breaks down some of the lactose in yogurt (Figure 2). (95) (100)

#### Figure 2. Bacteria in yogurt aid lactose digestion<sup>95</sup>



#### Figure 1. Lactose maldigestion: a difficulty in digesting lactose<sup>97</sup>



"In countries where lactose maldigestion is common, consuming yogurt as part of one's normal diet can reduce the risk of suffering from it."

– Dr Widjaja Lukito

- The bacteria survive their passage through the gut and the bacterial lactase helps further with digestion of lactose in the small intestine. (101)
- Unlike milk, yogurt's semi-solid state benefits lactose digestion by slowing transit through the gut. (100 (102)

#### Yogurt is recommended for people with lactose maldigestion

The European Food Safety Authority (EFSA) has approved the claim that yogurt improves digestion of lactose (103)

- The EFSA's conclusions were based on 13 studies showing that consumption of live cultures in yogurt improved digestion of lactose in yogurt among people with lactose maldigestion.<sup>103</sup>
- To qualify for this claim, yogurt must contain at least 10<sup>7</sup> live bacteria (*L. bulgaricus* and *S. thermophilus*) per gram of yogurt, and therefore fresh yogurt is best. Ultra-high temperature (UHT) yogurt or yogurt labelled 'long-life' has been heat-treated and this process kills the beneficial bacteria.

Several medical organisations recommend that people with lactose maldigestion - including those with lactose intolerance – consume yogurt as part of a balanced diet. (95) (100 (101) (102 (103)

"... a cause and effect relationship has been established between the consumption of live yogurt cultures in yogurt and improved digestion of lactose in yogurt in individuals with lactose maldigestion."

- European Food Safety Authority<sup>103</sup>



### Yogurt with live cultures can contribute to gut health



Yogurt may beneficially alter the composition and function of the gut microbiota, and this may prove to lead to health benefits. (107) (111)(112)

#### Diet can influence the diversity of the gut microbiota, which is important for health

The gut microbiota plays an important role in digestion. (104)It may also be essential for the normal development of the immune system and nerve function. (105)

- Maintaining the healthy diversity of the gut microbiota is important in preventing disease.<sup>104</sup>
- Recently, it has been proposed that there is a gut microbiota 'signature' that could promote intestinal inflammation and subsequent systemic low-grade inflammation, a condition that predisposes to T2D and obesity. (67)

"I consider yogurt to be an important part of nutrition and dietary guidelines as it offers both a great nutrient density and also live bacteria to contribute to gut health."

Home

- Professor Seppo Salminen

Previous

The composition of the gut microbiota can be influenced by our diet. (67)Moreover, in fermented foods such as yogurt, the products of fermentation and particularly the bacteria involved in the fermentation process, can provide additional properties to the food beyond basic nutrition. (105) (106)

Hence, fermented foods such as yogurt are arousing research interest as potentially having benefits beyond an extended shelf life and improved texture and flavour.105,106

#### Yogurt can deliver millions of live bacteria to the gut and may beneficially alter the gut microbiota

Live yogurt contains millions of bacteria (Figure 1) and eating yogurt could potentially increase the number of bacteria in the diet by up to 10,000-fold.<sup>105</sup>

- · While probiotic bacteria are unlikely to have longlasting effects on the gut microbiota,<sup>105</sup> regular consumption of live yogurt will at least temporarily bolster the live bacteria in the gut.
- In addition, prebiotics may be added to yogurt (often in the form of fruit) and these may stimulate the proliferation of beneficial bacteria in the gut. (20)

Lisko et al monitored the gut microbiota in healthy adult volunteers who ate 250 g of fat-free plain yogurt per day for 42 days. (107)

#### Figure 1. Yogurt can contain millions of live bacteria (3)



Yogurt consumption appeared to boost the numbers of Lactobacilli in the gut, and was associated with a slight increase in microbial diversity. (107)

As well as beneficially altering the composition of the gut microbiota, probiotic bacteria in yogurt may alter the function of the existing resident bacteria by affecting the production of SCFAs; (105) these have beneficial effects on energy metabolism. (108)

#### Yogurt may help to protect the intestinal barrier

Animal studies have suggested that a peptide found in yogurt,  $\beta$ -casein (94-123), increases the production of mucin, an essential component of the mucus layer that lines and protects the intestine. (109 (110)

#### Yogurt may protect against gastrointestinal disease

Research suggests that yogurt might play a role in the treatment and prevention of gastrointestinal disorders.

• For children with mild to moderate persistent diarrhoea, a yogurt-based diet may be





**FIND OUT MORE ...** 





Fermentation of yogurt

666

2nd yogurt global summit proceedings

24



recommended as it has been shown to reduce stool output and the duration of diarrhoea. (11)

- Modulation of the gut microbiota by yogurt, particularly yogurt containing Lactobacillus and Bifidobacterium, might be of value in the treatment or prevention of gastrointestinal diseases such as irritable bowel syndrome, infectious diarrhoea and allergy gastroenteritis. (112) However, any potential benefits have yet to be proven.
- Yogurt may be used in the nutritional management of acute gastroenteritis in children, but data on this approach are limited and large randomised controlled trials are needed to provide evidence to support it. (113)

"Yogurt, as it contains millions of bacteria and fermentation products, is beneficial for longterm health. Its short-term effects, other than its benefits in settling acute infectious diarrhoea, need to be established from large randomised controlled studies. A yogurt a day might help in preventing acute gastroenteritis."

- Professor Olivier Goulet





#### Figure 2. Carbon cost by food category: mean greenhouse gas emissions (GHGE) per 100 g

### Yogurt is part of a sustainable diet



To be sustainable, foods must be environmentally friendly, high in nutrient value, affordable and culturally acceptable.

#### Yogurt meets the four criteria for a sustainable food

Sustainability is more than just having a low carbon footprint. The environmental costs of food production and consumption must be balanced against nutrient value affecting health, affordability and cultural and social acceptability (Figure 1).

Yogurt's high nutrient density balances its environmental cost, while its affordability brings it into the reach of the general population. (83)

#### Figure 1. Characteristics required for a sustainable food (117



#### 1) Yogurt is a nutrient-dense food

Yogurt is well-positioned to be an integral part of a sustainable diets because of its high nutrient value (see page 8).

- In nutrient profiling models, some of the highest nutrient density scores are awarded to unsweetened and low-saturated fat yogurts. (83)
- Yogurt provides more nutrients than calories relative to the body's needs.<sup>83</sup>

#### 2) Yogurt has a low environmental footprint

Typically, nutrient-rich foods have a higher environmental impact than those with a poor nutrient content. (114) However, the environmental cost must be weighed against nutrient needs for health. (115)

- Greenhouse gases gaseous compounds in the atmosphere that trap and hold heat - are a major factor in global warming and climate change.
- Greenhouse gas emissions (GHGEs) occur at every stage of the food production and consumption cycle - from farming and agricultural practices to packaging, transport and storage in the supermarket and the home.<sup>115</sup>
- Milk and yogurt are higher in carbon cost than nutrient-poor foods such as sweetened drinks, sugar and sweets.<sup>114</sup>
- However, yogurt compares favourably with other healthy foods in terms of GHGE.<sup>114</sup> Yogurt's GHGE is lower than the level predicted by its nutrient density.

**FIND OUT MORE ...** 



Adapted from Drewnowski A, Rehm CD, Martin A, et al. Am J Clin Nutr 2015;101:184-191.<sup>114</sup>

- In a UK diet-modelling study linking nutrient composition with GHGEs, the inclusion of yogurt was associated with a 36% reduction in GHGEs (based on emissions per person). (115)
- Similarly, yogurt and other dairy products had a relatively low carbon cost in a food labelling initiative from the French retailer, Casino, which combined GHGEs and nutrient data (Figure 2). (114)
- Modern farming practices are reducing the impact of dairy foods on natural resources and the environment. (83)

#### 3) Yogurt is a low-cost source of nutrients

Nutritious foods such as meat, fish, poultry, fresh fruit and vegetables generally cost more than high energydense foods - grain snacks, sweets, chocolate and fatty, sugary foods. This remains true across different countries, age groups and indicators of diet quality. (116)

Achieving greater equality between people on high and low incomes requires foods to be high in nutrient quality, yet affordable for all.<sup>116</sup>

• Yogurt is the lowest-cost source of dietary calcium as well as a highly affordable source of high-quality protein. (117)



part of a sustainable food choice?



How yogurt-eaters differ

26



Previous





- Food profiling has suggested that low-fat yogurt and milk are roughly equivalent to sweets in terms of per-calorie cost, yet much higher in overall nutritional quality. (83)
- In terms of calories or nutrients per Euro, yogurt is less expensive than animal-derived foods, such as meat, poultry and fish, and is more comparable with beans and eggs.<sup>83</sup>

#### 4) Yogurt is culturally acceptable

Not all nutrient-rich foods are socially acceptable. People in low- and middle-income countries, for example, often prefer traditional plant-based diets, with milk and dairy foods such as yogurt as their major source of animal protein on grounds of custom, religion or culture.83

"Dairy foods, including yogurt, are an affordable source of high-quality protein, calcium and other essential nutrients."

- Dr Chris Cifelli



27

## References

- 1. Fisberg M, Machado R. History of yogurt and current patterns of consumption. Nutr Rev 2015;73:4–7.
- 2. Aryana KJ, Olson DW. A 100-year review: yogurt and other cultured dairy products. J Dairy Sci 2017;100: 9987–10013.
- 3. World Health Organization; Food and Agriculture Organization of the United Nations. Codex Alimentarius. http://www.fao.org/docrep/015/i2085e/i2085e00.pdf. Last accessed 15 May 2018.
- 4. YINI Digest, 2014. What added value does yogurt bring to dairy protein? http://www.yogurtinnutrition.com/wp-content/uploads/2015/03/digest\_issue-01.pdf. Last accessed 15 May 2018.
- 5. Adolfsson O, Meydani SN, Russell RM. Yogurt and gut function. Am J Clin Nutr 2004;80(2):245-56.
- 6. Williams EB, Hooper B, Spiro A, et al. The contribution of yogurt to nutrient intakes across the life course. Nutrition Bulletin 2015;40:9–32. https://onlinelibrary.wiley.com/doi/pdf/10.1111/nbu.12130. Last accessed 15 May 2018.
- 7. Keast DR, Hill Gallant KM, Albertson AM, et al. Associations between yogurt, dairy, calcium, and vitamin D intake and obesity among U.S. children aged 8–18 years: NHANES, 2005–2008. Nutrients 2015;7:1577–93.
- 8. Marette A, Picard-Deland E. Yogurt consumption and impact on health: focus on children and cardiometabolic risk. Am J Clin Nutr 2014;99:1243S-7S.
- 9. Demmer E, Cifelli CJ, Houchins JA, et al. The impact of doubling dairy or plant-based foods on consumption of nutrients of concern and proper bone health for adolescent females. Public Health Nutr 2017;20:824–31.
- 10. Weaver CM. How sound is the science behind the dietary recommendations for dairy? Am J Clin Nutr 2014; 99(5 Suppl):1217S-22S.
- 11. Table Ciqual des aliments 2008, ANSES ; Directive européenne (90/496/CEE).
- 12. Martin A et al. Apports nutritionnels conseillés pour la population française, 3rd edition, Ed TEC&DOC 2007 pp 605.
- 13. British Nutrition Foundation. What is energy density? https://www.nutrition.org.uk/healthyliving/fuller/what-isenergy-density.html?limit=1&limitstart=0. Last accessed 15 May 2018.
- 14. British Nutrition Foundation. Feed Yourself Fuller Chart 2010. http://nutrition.org.uk/attachments/423\_13209%20 BNF%20feed%20Poster\_PRINT\_2.pdf. Last accessed 15 May 2018.
- 15. World Health Organization: Guideline: Sugars intake for adults and children. 2015. ISBN-13: 978-92-4-154902-8. http://www.who.int/nutrition/publications/guidelines/sugars\_intake/en/. Last accessed 15 May 2018.
- 16. Azaïs-Braesco V, Sluik D, Maillot M, et al. A review of total and added sugar intakes and dietary sources in Europe. Nutr J 2017;16:6.
- National Dairy Council (Nutrition Impact, LLC analysis. Ages 2+ years, NHANES 2007-2008, 2009-2010).
   NHANES 2007-2010 food and beverage sources of added sugars in the diets of children (2-18 years) and adults (19+ years). Available from: http://www.ars.usda.gov/main/site\_main.htm?modecode=80-40-05-30
- 18. American Academy of Pediatrics, Council on School Health, Committee on Nutrition. Snacks, sweetened beverages, added sugars, and schools. Pediatrics 2015;135:575–83. http://pediatrics.aappublications.org/content/135/3/575
- 19. Wang H, Livingston KA, Fox CS, et al. Yogurt consumption is associated with better diet quality and metabolic profile in American men and women. Nutr Res 2013;33:18–26.
- 20. Fernandez MA, Marette A. Potential health benefits of combining yogurt and fruits based on their probiotic and prebiotic properties. Adv Nutr 2017;8:155S-64S.
- 21. Hess J, Slavin J. Snacking for a cause: nutritional insufficiencies and excesses of U.S. children, a critical review of food consumption patterns and macronutrient and micronutrient intake of U.S. children. Nutrients 2014;6:4750–9.
- 22. Clerfeuille E, Maillot M, Verger EO et al. Dairy products: how they fit in nutritionally adequate diets. J Acad Nutr Diet 2013;113:950–6.
- 23. Wajszczyk B, Charzewska J, Chwojnowska Z, et al. [Yogurt consumption and nutritional quality of daily diets in four years old children.] Żywienie Człowieka i Metabolizm [Human Nutrition and Metabolism] 2013;40:166–80. Abstract only. http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.agro-50e69f81-80d1-48f2-b31c-fe6ed32eb7c2. Last accessed 15 May 2018.

- 24. Rivera-Dommarco J, López-Olmedo N, Aburto-Soto T, et al. Consumo de productos lácteos en población mexicana. Resultados de la Encuesta Nacional de Salud y Nutrición 2012. México: Instituto Nacional de Salud Pública, 2014. https://www.insp.mx/produccion-editorial/novedades-editoriales/3169-consumo-lacteos-ensanut2012. Last accessed 15 May 2018.
- 25. Zhu Y, Wang H, Hollis JH, et al. The associations between yogurt consumption, diet quality, and metabolic profiles in children in the USA. Eur J Nutr 2015;54:543–50.
- 26. Panahi S, Fernandez MA, Marette A et al. Yogurt, diet quality and lifestyle factors. Eur J Clin Nutr 2017;71:573–9.
- 27. Cormier H, Thifault É, Garneau V, et al. Association between yogurt consumption, dietary patterns, and cardio-metabolic risk factors. Eur J Nutr 2016;55:577–87.
- 28. Hobbs DA, Givens DI, Lovegrove JA. Yogurt consumption is associated with higher nutrient intake, diet quality and favourable metabolic profile in children: a cross-sectional analysis using data from years 1–4 of the National diet and Nutrition Survey, UK. Eur J Nutr 2018 Jan 12 [Epub ahead of print].
- 29. Lecerf J-M, Colin J, Hebel P, et al. Les consommateurs de produits laitiers frais : des consommateurs comme les autres ? Analyse de leurs profils alimentaires et nutritionnels (Who are fresh dairy products consumers? Analysis of their dietary and nutritional profiles). Nutrition clinique et métabolisme 2016;30:11–21.
- 30. Tremblay A, Panahi S. Yogurt consumption as a signature of a healthy diet and lifestyle. J Nutr 2017;147:1476S-80S.
- Possa G. Corrente JE, Fisberg M. Yogurt consumption is associated with a better lifestyle in Brazilian population. BMC Nutrition 2017;3:29. https://bmcnutr.biomedcentral.com/track/pdf/10.1186/s40795-017-0145-3?site=bmcnutr.biomedcentral.com. Last accessed 15 May 2018.
- 32. Possa G, de Castro MA, Marchioni DM, et al. Probability and amounts of yogurt intake are differently affected by sociodemographic, economic, and lifestyle factors in adults and the elderly results from a population-based study. Nutr Res 2015;35:700–6.
- D'Addezio L, Mistura L, Sette S, et al. Sociodemographic and lifestyle characteristics of yogurt consumers in Italy: results from the INRAN-SCAI 2005–06 survey. Mediterranean Journal of Nutrition and Metabolism 2015;8: 119–29.
- 34. Gopinath B, Flood VM, Burlutsky G, et al. Dairy food consumption and health-related quality of life in boys: preliminary findings from a 5-year cohort study. J Am Coll Nutr 2016;35:522–8.
- 35. Thorning TK, Raben A, Tholstrup T, et al. Milk and dairy products: good or bad for human health? An assessment of the totality of scientific evidence. Food Nutr Res 2016;60:32527.
- 36. Dougkas A, Minihane AM, Givens, DI, et al. Differential effects of dairy snacks on appetite, but not overall energy intake. Br J Nutr 2012;108:2274–85.
- 37. Tsuchiya A, Almiron-Roig E, Lluch A, et al. Higher satiety ratings following yogurt consumption relative to fruit drink or dairy fruit drink. J Am Diet Assoc 2006;106:550–7.
- 38. Chapelot D, Payen F. Comparison of the effects of a liquid yogurt and chocolate bars on satiety: a multidimensional approach. Br J Nutr 2010;103:760–7.
- 39. Ortinau LC, Hoertel HA, Douglas SM, et al. Effects of high-protein vs. high-fat snacks on appetite control, satiety, and eating initiation in healthy women. Nutr J 2014 ;13:97.
- 40. YINI Digest, 2015. Role of protein and protein-rich yogurt in appetite control. http://www.yogurtinnutrition.com/ wp-content/uploads/2015/04/digest\_issue\_02-1.pdf
- 41. Eales J, Lenoir-Wijnkoop I, King S, et al. Is consuming yoghurt associated with weight management outcomes? Results from a systematic review. Int J Obes (Lond) 2016;40:731–46.
- 42. Sayón-Orea C, Martínez-González MA, Ruiz-Canela M, et al. Associations between yogurt consumption and weight gain and risk of obesity and metabolic syndrome: a systematic review. Adv Nutr 2017;8:146S–54S.



- 43. Mozaffarian D. Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. Circulation 2016;133:187–225.
- 44. Mozaffarian D, Hao T, Rimm EB, et al. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011;364:2392-404.
- 45. Wang H, Troy LM, Rogers GT, et al. Longitudinal association between dairy consumption and changes of body weight and waist circumference: the Framingham Heart Study. Int J Obes (Lond) 2014;38:299–305.
- 46. Martinez-Gonzalez MA, Sayon-Orea C, Ruiz-Canela M, et al. Yogurt consumption, weight change and risk of overweight/obesity: the SUN cohort study. Nutr Metab Cardiovasc Dis 2014;24:1189–96.
- 47. Sayón-Orea C, Bes-Rastrollo M, Martí A, et al. Association between yogurt consumption and the risk of metabolic syndrome over 6 years in the SUN study. BMC Public Health 2015;15:170.
- 48 Moreno LA, Bel-Serrat S, Santaliestra-Pasías A, et al. Dairy products, yogurt consumption, and cardiometabolic risk in children and adolescents. Nutr Rev 2015;73(Suppl 1):8–14.
- 49. Chen M, Pan A, Malik VS, et al. Effects of dairy intake on body weight and fat: a meta-analysis of randomized controlled trials. Am J Clin Nutr 2012;96:735–47.
- 50. Jacques PF, Wang H. Yogurt and weight management. Am J Clin Nutr 2014;99(5 Suppl):1229S-34S.
- 51. Zemel MB, Richards J, Mathis S, et al. Dairy augmentation of total and central fat loss in obese subjects. Int J Obes (Lond) 2005:29:391–7.
- 52. Christensen R, Lorenzen JK, Svith CR, et al. Effect of calcium from dairy and dietary supplements on faecal fat excretion: a meta-analysis of randomized controlled trials. Obes Rev 2009;10:475–86.
- 53. Zemel MB. Role of calcium and dairy products in energy partitioning and weight management. Am J Clin Nutr 2004;79:907S-12S.
- 54. Kallus SJ, Brandt LJ. The intestinal microbiota and obesity. J Clin Gastroenterol 2012;46:16–24.
- 55. Pei R, Martin DA, DiMarco DM, et al. Evidence for the effects of yogurt on gut health and obesity. Crit Rev Food Sci Nutr 2017;57:1569–83.
- 56. Gadotti TN, Norde MM, Rogero MM, et al. Dairy consumption and inflammatory profile: a cross-sectional populationbased study, São Paulo, Brazil. Nutrition 2018;48:1–5.
- 57. Aune D, Norat T, Romundstad P, et al. Dairy products and the risk of type 2 diabetes: a systematic review and doseresponse meta-analysis of cohort studies. Am J Clin Nutr 2013;98:1066–83.
- 58. Chen M, Sun Q, Giovannucci E, et al. Dairy consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis. BMC Med 2014;12:215.
- 59. Gijsbers L, Ding EL, Malik VS, et al. Consumption of dairy foods and diabetes incidence: a dose-response metaanalysis of observational studies. Am J Clin Nutr 2016;103:1111–24.
- 60. Ibsen DB, Laursen ASD, Lauritzen L, et al. Substitutions between dairy product subgroups and risk of type 2 diabetes: the Danish Diet, Cancer and Health cohort. Br J Nutr 2017;118:989–97.
- 61. Díaz-López A, Bulló M, Martínez-González MA, et al. Dairy product consumption and risk of type 2 diabetes in an elderly Spanish Mediterranean population at high cardiovascular risk. Eur J Nutr 2016;55:349–60.
- 62. O'Connor LM, Lentjes MA, Luben RN, et al. Dietary dairy product intake and incident type 2 diabetes: a prospective study using dietary data from a 7-day food diary. Diabetologia 2014;57:909–17.
- 63. Forouhi NG. Association between consumption of dairy products and incident type 2 diabetes insights from the European Prospective Investigation into Cancer study. Nutr Rev 2015;73(Suppl 1):15–22.
- 64. Panahi S, Gallant A, Tremblay A, et al. The relationship between yogurt consumption, body weight, and metabolic profiles in youth with a familial predisposition to obesity. Eur J Clin Nutr 2018 Apr 25 [Epub ahead of print].
- 65. Lenoir-Wijnkoop I, Mahon J, Claxton L, et al. An economic model for the use of yoghurt in type 2 diabetes risk reduction in the UK. BMC Nutr 2016;2:77. https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-016-0115-1. Last accessed 15 May 2018.
- 66. Pei R, DiMarco DM, Putt KK, et al. Low-fat yogurt consumption reduces biomarkers of chronic inflammation and inhibits markers of endotoxin exposure in healthy premenopausal women: a randomised controlled trial. Br J Nutr 2017;118:1043–51.
- 67. Wen L, Duffy A. Factors influencing the gut microbiota, inflammation, and type 2 diabetes. J Nutr 2017;147:1468S-75S.
- 68. Wu Y, Ding Y, Tanaka Y, et al. Risk factors contributing to type 2 diabetes and recent advances in the treatment and prevention. Int J Med Sci 2014;11:118–-200.



30

- 69. Beulens JW, van der A DL, Grobbee DE, et al. I diabetes. Diabetes Care 2010;33:1699–705.
- 70. Walther B, Karl JP, Booth SL, et al. Menaquinones, bacteria, and the food supply: the relevance of dairy and fermented food products to vitamin K requirements. Adv Nutr 2013;4:463–73.
- 71. Wolever TM. Yogurt is a low-glycemic index food. J Nutr 2017;147:1462S-7S.
- 72. Drouin-Chartier JP, Brassard D, Tessier-Grenier M, et al. Systematic review of the association between dairy product consumption and risk of cardiovascular-related clinical outcomes. Adv Nutr 2016;7:1026–40.
- 73. Givens DI. Saturated fats, dairy foods and health: a curious paradox? Nutrition Bulletin 2017;42:274–82. https://onlinelibrary.wiley.com/doi/full/10.1111/nbu.12283. Last accessed 15 May 2018.
- 74. Guo J, Astrup A, Lovegrove JA, et al. Milk and dairy consumption and risk of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies. Eur J Epidemiol 2017;32:269–87.
- 75. Lordan R, Tsoupras A, Mitra B, et al. Dairy fats and cardiovascular disease: do we really need to be concerned? Foods 2018;7:29.
- 76. Buendia JR, Li Y, Hu FB, et al. Regular yogurt intake and risk of cardiovascular disease among hypertensive adults. Am J Hypertens 2018;31:557–65.
- 77. Wu L, Sun D. Consumption of yogurt and the incident risk of cardiovascular disease: a meta-analysis of nine cohort studies. Nutrients 2017;9:315.
- 78. Bel-Serrat S, Mouratidou T, Jiménez-Pavón D, et al. Is dairy consumption associated with low cardiovascular disease risk in European adolescents? Results from the HELENA Study. Pediatr Obes 2014;9:401–10.
- 79. Fardet A, Rock E. In vitro and in vivo antioxidant potential of milks, yoghurts, fermented milks and cheeses: a narrative review of evidence. Nutr Res Rev 2017; Oct 2:1–19.
- 80. El-Abbadi NH, Dao MC, Meydani SN. Yogurt: role in healthy and active aging. Am J Clin Nutr 2014;99(5 Suppl):1263S-70S.
- 81. Astrup A. Yogurt and dairy product consumption to prevent cardiometabolic diseases: epidemiologic and experimental studies. Am J Clin Nutr 2014;99(5 Suppl):1235S-42S.
- Rozenberg S, Body JJ, Bruyère O, et al. Effects of dairy products consumption on health: Benefits and beliefs

   a commentary from the Belgian Bone Club and the European Society for Clinical and Economic Aspects of
   Osteoporosis, Osteoarthritis and Musculoskeletal Diseases. Calcif Tissue Int 2016;98:1–17.
- 83. Drewnowski A. Measures and metrics of sustainable diets with a focus on milk, yogurt, and dairy products. Nutr Rev 2018;76:21–8.
- 84. Rizzoli R, Biver E. Effects of fermented milk products on bone. Calcif Tissue Int 2018;102:489–500.
- 85. He M, Yang YX, Han H, et al. Effects of yogurt supplementation on the growth of preschool children in Beijing suburbs. Biomed Environ Sci 2005;18:192–7.
- 86. Laird E, Molloy AM, McNulty H, et al. Greater yogurt consumption is associated with increased bone mineral density and physical function in older adults. Osteoporos Int 2017;28:2409–19.
- 87. van den Heuvel EGHM, Steijns JMJM. Dairy products and bone health: how strong is the scientific evidence? Nutr Res Rev 2018; Mar 21:1–15.
- 88. Bian S, Hu J, Zhang K, et al. Dairy product consumption and risk of hip fracture: a systematic review and metaanalysis. BMC Public Health 2018;18:165.
- Michaëlsson K, Wolk A, Lemming EW, et al. Intake of milk or fermented milk combined with fruit and vegetable consumption in relation to hip fracture rates: a cohort study of Swedish women. J Bone Miner Res 2018;33: 449–57.
- 90. Bonjour JP, Benoit V, Payen F, et al. Consumption of yogurts fortified in vitamin D and calcium reduces serum parathyroid hormone and markers of bone resorption: a double-blind randomized controlled trial in institutionalized elderly women. J Clin Endocrinol Metab 2013;98:2915–21.
- 91. Bonjour JP, Benoit V, Atkin S, et al. Fortification of yogurts with vitamin D and calcium enhances the inhibition of serum parathyroid hormone and bone resorption markers: a double blind randomized controlled trial in women over 60 living in a community dwelling home. J Nutr Health Aging 2015;19:563–9.
- 92. Sahni S, Mangano KM, Kiel DP, et al. Dairy intake is protective against bone loss in older vitamin D supplement users: the Framingham study. J Nutr 2017;147:645–52.
- 93. Prentice AM. Dairy products in global public health. Am J Clin Nutr 2014;99(5 Suppl):1212S-6S.
- 94. Bell V, Ferrão J, Fernandes T. Nutritional guidelines and fermented food frameworks. Foods 2017;6:65.

69. Beulens JW, van der A DL, Grobbee DE, et al. Dietary phylloquinone and menaquinones intakes and risk of type 2

- 95. Suchy FJ, Brannon PM, Carpenter TO, et al. NIH Consensus Development Conference Statement: lactose intolerance and health. NIH Consens State Sci Statements 2010;27:1–27.
- 96. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). Scientific Opinion on lactose thresholds in lactose intolerance and galactosaemia. ESFA Journal 2010a;8:1777. https://efsa.onlinelibrary.wiley.com/doi/abs/10.2903/j. efsa.2010.1777. Last accessed 15 May 2018.
- 97. Lukito W, Malik SG, Surono IS, et al. From 'lactose intolerance' to 'lactose nutrition'. Asia Pac J Clin Nutr 2015;24(Suppl 1):S1-8.
- 98. Casellas F, Aparici A, Casaus M, et al. Subjective perception of lactose intolerance does not always indicate lactose malabsorption. Clin Gastroenterol Hepatol 2010;8:581–6.
- 99. Wilt TJ, Shaukat A, Shamliyan T, et al. Lactose intolerance and health. Evid Rep Technol Assess (Full Rep) 2010;(192):1–410.
- 100. Muehlhoff E, Bennett A, McMahon D. Milk and dairy products in human nutrition. Food and Agriculture Organization of the United Nations. 2013. http://www.fao.org/docrep/018/i3396e/i3396e.pdf. Last accessed 15 May 2018.
- 101. Savaiano DA. Lactose digestion from yogurt: mechanism and relevance. Am J Clin Nutr 2014;99(5 Suppl): 1251S-5S.
- 102. Bailey RK, Fileti CP, Keith J, et al. Lactose intolerance and health disparities among African Americans and Hispanic Americans: an updated consensus statement. J Natl Med Assoc 2013;105:112–27.
- 103. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). Scientific Opinion on the substantiation of health claims related to live yoghurt cultures and improved lactose digestion (ID 1143, 2976) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. EFSA Journal 2010b;8:1763. https://efsa.onlinelibrary.wiley.com/doi/ abs/10.2903/j.efsa.2010.1763. Last accessed 15 May 2018.
- 104. Barengolts E. Gut microbiota, prebiotics, probiotics, and synbiotics in management of obesity and prediabetes: review of randomized controlled trials. Endocr Pract 2016;22:1224–34.
- 105. Marco ML, Heeney D, Binda S, et al. Health benefits of fermented foods: microbiota and beyond. Curr Opin Biotechnol 2017;44:94–102.
- 106. Hill D, Sugrue I, Arendt E, et al. Recent advances in microbial fermentation for dairy and health. F1000Res 2017;6:751.
- 107. Lisko DJ, Johnston GP, Johnston CG. Effects of dietary yogurt on the healthy human gastrointestinal (GI) microbiome. Microorganisms 2017;5:6.
- 108. den Besten G, van Eunen K, Groen AK, et al. The role of short-chain fatty acids in the interplay between diet, gut microbiota, and host energy metabolism. J Lipid Res 2013;54:2325–40.
- 109. Plaisancié P, Claustre J, Estienne M, et al. A novel bioactive peptide from yoghurts modulates expression of the gel-forming MUC2 mucin as well as population of goblet cells and Paneth cells along the small intestine. J Nutr Biochem 2013;24:213–21.
- 110. Plaisancié P, Boutrou R, Estienne M, et al. β-Casein(94–123)-derived peptides differently modulate production of mucins in intestinal goblet cells. J Dairy Res 2015;82:36–46.
- 111. de Mattos AP, Ribeiro TC, Mendes PS, et al. Comparison of yogurt, soybean, casein, and amino acid-based diets in children with persistent diarrhea. Nutr Res 2009;29:462–9.
- 112. Goulet O. Potential role of the intestinal microbiota in programming health and disease. Nutr Rev 2015;73(Suppl 1): 32–40.
- 113. Patro-Gołąb B, Shamir R, Szajewska H. Yogurt for treating acute gastroenteritis in children: systematic review and meta-analysis. Clin Nutr 2015a;34:818–24.
- 114. Drewnowski A, Rehm CD, Martin A, et al. Energy and nutrient density of foods in relation to their carbon footprint. Am J Clin Nutr 2015;101:184–91.
- 115. Macdiarmid JI, Kyle J, Horgan GW, et al. Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? Am J Clin Nutr 2012;96:632–9.
- 116. Darmon N, Drewnowski A. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. Nutr Rev 2015;73:643–60.
- 117. YINI Digest, 2016. Yogurt as a sustainable food: an expert's opinion and supporting evidence. http://www.yogurtinnutrition.com/wp-content/uploads/2018/02/yini\_digest\_issue\_10.pdf. Last accessed 24 May 2018.



32

## Notes



## Notes






#### "Yogurt is a nutrient-rich food"

"Yogurt consumption is linked with healthier diet and lifestyle"

"Yogurt can enhance satiety and help to manage energy intake"

"Yogurt consumption is associated with reduced weight gain over time"

"Yogurt consumption is associated with reduced risk of Type 2 diabetes"

"Yogurt consumption is associated with reduced risk of cardiovascular disease"

"Yogurt and other dairy products are recommended for bone health in dietary guidelines around the world"

"Yogurt improves lactose digestion in people with lactose maldigestion"

"Yogurt with live cultures can contribute to gut health"

"Yogurt is part of a sustainable diet"



www.yogurtinnutrition.com





