Supplement Article

History of yogurt and current patterns of consumption

Mauro Fisberg and Rachel Machado

*Yogurt has been a part of the human diet for several millennia and goes by many names throughout the world. The word "yogurt" is believed to have come from the Turkish word "yoğurmak," which means to thicken, coagulate, or curdle. While references to the health-promoting properties of yogurt date back to 6000 BC in Indian Ayurvedic scripts, it was not until the 20th century that Stamen Grigorov, a Bulgarian medical student, attributed the benefits to lactic acid bacteria. Today, most yogurt is fermented milk that is acidified with viable and well-defined bacteria (*Lactobacillus bulgaricus *and* Streptococcus thermophiles*). While patterns of yogurt consumption vary greatly from country to country, consumption is generally low. In the United States and Brazil, for example, only 6% of the population consume yogurt on a daily basis. Low consumption of yogurt represents a missed opportunity to contribute to a healthy lifestyle, as yogurt provides a good to excellent source of highly bioavailable protein and an excellent source of calcium as well as a source of probiotics that may provide a range of health benefits.*

HISTORY OF YOGURT

Yogurt (also spelled "yoghurt" or "yoghourt") is considered by most regulatory agencies worldwide to be a fermented milk product that provides digested lactose and specifically defined, viable bacterial strains, typically *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. It is a source of several essential nutrients, including protein, calcium, potassium, phosphorus, and vitamins B_2 and B_{12}, and serves as a vehicle for fortification.[1]

Yogurt is an ancient food that has gone by many names over the millennia: katyk (Armenia), dahi (India), zabadi (Egypt), mast (Iran), leben raib (Saudi Arabia), laban (Iraq and Lebanon), roba (Sudan), iogurte (Brazil), cuajada (Spain), coalhada (Portugal), dovga (Azerbaijan), and matsoni (Georgia, Russia, and Japan). It is believed that milk products were incorporated into the human diet around 10 000–5000 BC, with the domestication of milk-producing animals (cows, sheep, and goats, as well as yaks, horses, buffalo, and camels).[2] However, milk spoiled easily, making it difficult to use. At that time, herdsmen in the Middle East carried milk in bags made of intestinal gut. It was discovered that contact with intestinal juices caused the milk to curdle and sour, preserving it and allowing for conservation of a dairy product for extended periods of time.[3]

Indian Ayurvedic scripts, dating from about 6000 BC, refer to the health benefits of consuming fermented milk products.[4] Today, there are more than 700 yogurt and cheese products found in Indian cuisine. For millennia, making yogurt was the only known safe method for preserving milk, other than drying it. Yogurt was well known in the Greek and Roman empires, and the Greeks were the first to mention it in written references in 100 BC, noting the use of yogurt by barbarous nations. In the Bible (Book of Job), Abraham owed his longevity and fecundity to yogurt consumption, and there is reference to the "Land of Milk and Honey," which many historians have interpreted to be a reference to yogurt.[5]

Affiliation: *M. Fisberg* is with the Pediatrics Department, Escola Paulista de Medicina Federal University of São Paulo, São Paulo SP, Brazil. *R. Machado* is with the Feeding Difficulties Center, Pensi Institute, Sabara Childreńs Hospital, Brazil.

Correspondence: *M. Fisberg*, Feeding Difficulties Center, Pensi Institute, Sabara Children' Hospital, Rua Borges Lagoa 1080 cj 603, 04038-002, São Paulo SP, Brazil. E-mail: mauro.fisberg@gmail.com. Phone: +55-11-557-53875

Key words: consumption, dairy, fermented milk, yogurt.

doi: 10.1093/nutrit/nuv020

It is believed that the word "yogurt" comes from the Turkish word "yoğurmak," which means to thicken, coagulate, or curdle.[3] The use of yogurt by medieval Turks was recorded in the books *Diwan Lughat al-Turk* by Mahmud Kashgari[6] and *Kutadgu Bilig* by K. H. Yusuf,[7] both written in the 11th century. The texts mention the word "yogurt" and describe its use by nomadic Turks. The Turks were also the first to evaluate yogurt's medicinal use for a variety of illnesses and symptoms, such as diarrhea and cramps, and to alleviate the discomfort of sunburned skin.

Genghis Khan, the founder of the Mongol Empire, is reputed to have fed his army yogurt, a staple of the Mongolian diet, based on the belief that it instilled bravery in his warriors.[3] In 1542, King Francoise I of France introduced this dairy product to Western Europe after being offered yogurt as a treatment by the country's Turkish allies for bouts of severe diarrhea. It was later mixed with a variety of ingredients, such as cinnamon, honey, fruits, and sweets, and was used as a dessert.[3]

It was not until the 20th century that researchers provided an explanation for the health benefits associated with yogurt consumption. In 1905, a Bulgarian medical student, Stamen Grigorov, was the first to discover *Bacillus bulgaricus* (now *L. bulgaricus*), a lactic acid bacteria that is still used in yogurt cultures today. Based on Grigorov's findings, in 1909, the Russian Nobel laureate, Yllia Metchnikoff, from the Pasteur Institute in Paris, suggested that lactobacilli in yogurt were associated with longevity in the Bulgarian peasant population.[3] In the beginning of the 20th century, yogurt became known for its health benefits and was sold in pharmacies as a medicine. Yogurt found commercial success when Isaac Carasso, from Barcelona, began producing yogurt with jams. After fleeing the Nazi occupation, Daniel Carasso, Isaac Carasso's son, founded Dannon (Danone in France). The first yogurt laboratory and factory were opened in France in 1932; in the United States, the first laboratory and factory were opened in 1941.[4]

YOGURT TODAY

Today, yogurt is typically milk that has been fermented and acidified with viable and well-defined bacteria, creating a thickened, often flavored, product with an extended shelf life. It contains essential nutrients and is a vehicle for fortification (added probiotics, fibers, vitamins, and minerals). It is also easily modified by sweeteners, fruits, and flavors to affect consistency and aroma. Yogurt can also be produced from rice, soy, or nuts.

Yogurt is defined by the symbiosis of 2 strains of bacteria (*S. thermophiles* and *L. bulgaricus*) in a sterile environment at a very low temperature (36°C–42°C) for 3–8 h. Both bacterial strains must remain active in the final product (with at least 10 million bacteria/g, according to CODEX 2003).[1] The process to which prepasteurized skimmed milk is submitted, before it is turned into yogurt, is responsible for changes in carbohydrates, proteins, and lipids. It yields an acidic flavor and a product with an improved appearance, taste, consistency, and digestibility. When milk lactose is used as the fermentation substrate, lactic acid and a series of other compounds are formed, contributing to its aroma. As a consequence of a decrease in pH, the development of undesirable microorganisms is delayed, the calcium and phosphorus present in milk are converted into their soluble form, and the majority of proteins, now calcium free, are better digested by proteolytic enzymes, which enhances its digestibility and overall bioavailability.[8,9]

Other bacterial strains, such as *Lactobacillus acidophilus* and *Bifidobacterium bifidus*, are often added for potential health benefits. When yogurt is consumed daily, there may be diminished growth of pathogens, which is ultimately beneficial to the human gut.[2] The protein content of some yogurts, such as Greek yogurt, is modified by concentrating or adding protein to provide twice the amount present in regular yogurt products. Calcium and vitamin D are also added to some products, adding nutritional value for populations with a high incidence of lactose intolerance or a low intake of dairy foods.

The types of yogurt consumed today are influenced by local traditions or correspond to certain lifestyles. In Eastern Europe and Asia, people consume milk that has undergone alcoholic fermentation by combining bacteria and yeasts (e.g., Kefir, Koumis); in Germany and Spain, yogurt is typically heat-treated to kill the bacteria; and in other countries, various probiotics and/or prebiotics are added to the mix.[1]

LOOKING AHEAD: CONSUMPTION OPPORTUNITIES

The majority of populations worldwide do not consume enough dairy products to meet several nutrient needs, particularly calcium. Three common barriers to consuming enough dairy include an allergy to cow's milk, lactose intolerance, and lack of accessibility. Of 16 European Union nations that provide data on dairy intake, the mean intake of dairy was 266 g/day. Denmark and Finland are 2 countries with population calcium intakes at or near 1000 mg/day, which is higher than the majority of the rest of the world. In the United States, 90%–95% of adult females and 75%–90% of adult males fall short of the recommended 3 servings of dairy per day.[10] In Brazil, low calcium intakes are far worse; 99% of adults in Brazil do not reach the minimum amount

of recommended calcium intake. Among Brazilian children, 99% consume only 500–600 mg of calcium per day.[11]

Patterns of yogurt consumption also vary greatly from country to country, but consumption is generally low. In the United States, where consumption of dairy products is broadly encouraged through nutrition education efforts, yogurt consumption is very low, with only about 6% of the population consuming yogurt on a daily basis. Contrast that to consumption levels in France, where the majority of the population consumes at least 1 serving per day and more than 1/3 of the population consumes at least 5 servings each week. Research in 15 countries also shows that those who consume the largest amounts of yogurt live in the Netherlands, France, Turkey, Spain, and Germany, while those who consume the smallest amounts live in Egypt, Colombia, Russia, Romania, and South Africa (Euromonitor 2013 data collected by the A.C. Nielsen Center for Market Research at the University of Wisconsin, Madison).[12]

In developing countries, yogurt consumption is often an indicator of economic change taking place. In Brazil, for example, though yogurt consumption is low, it increased more than 7-fold between 1974 and 2003.[13] However, while 40% of the Brazilian population consumes dairy products, only 6% consumes yogurt.[11]

In general, yogurt consumption is more common among healthier, leaner, more highly educated individuals from higher socioeconomic levels and is most common among women. In a survey of the population in São Paulo, Brazil (G. Possa, R. Fisberg, and M. Fisberg, unpublished data), it was found that most consumers were younger, white, female, nondiabetic, nonhypertensive, more educated, nonsmokers, and from higher socioeconomic levels. This has also been found among American and French populations.[14,15] This new pattern of consumption leads to the assumption that consumers may be interested mostly in the health aspects of yogurt, which opens a window of opportunity to introduce new forms of preparation and presentation that could reach populations with the lowest rates of yogurt intake.

In addition to helping to meet nutritional needs, research has demonstrated that yogurt can have positive effects on the gut microbiota and is associated with a reduced risk for gastrointestinal disease and improvement of lactose intolerance (especially among children),[16,17] cardiovascular disease,[2,18,19] metabolic syndrome[2,20] and type 2 diabetes,[2,21] allergies and respiratory diseases,[19] as well as improved dental and bone health[2,22–24] and pregnancy outcomes.[18,25–27] Yogurt can thus be an appealing dairy alternative for increasing nutrient intakes, as well as enhancing health and helping to prevent diseases among populations.

CONCLUSION

Yogurt is an ancient food that has been a part of the human diet for thousands of years and has been promoted as a healthy food for much of that time. Low consumption of yogurt represents a missed opportunity to contribute to a healthy lifestyle, as yogurt provides a good to excellent source of highly bioavailable protein and an excellent source of calcium as well as a source of probiotics that may provide a range of health benefits. Yogurt is not considered a snack or a sweet but rather as a dairy food that can be consumed with any meal. It is rich in calcium and potassium, which is especially important for Asian, African American, and American Indian populations in which lactose intolerance dominates and is a deterrent to consumption of dairy foods.

Acknowledgments

The authors thank Esteban Carmuega and Ricardo Weill for their contributions and insights.

The content of this article was presented as part of the Second Global Summit on the Health Benefits of Yogurt, held as a satellite to the Experimental Biology meeting in San Diego, California, on 30 April 2014. The conference was organized by the American Society for Nutrition and Danone Institute International. The supplement coordinators are Sharon M. Donovan, University of Illinois at Urbana-Champaign, USA, and Raanan Shamir, Schneider Children's Medical Center, Israel.

Funding. Writing and editorial assistance were provided by Densie Webb, PhD, RD, who was contracted and funded by Danone Institute International. M.F. received financial reimbursement for travel expenses and an honorarium from the Danone Institute International for his participation in the conference.

Declaration of interest. M.F. has presented at conferences for private and governmental organizations and nongovernmental organizations; has received grants for research from Abbott, Danone Research, Nestle, Pfizer, and Mondelez; and is a member of the Board of Danone Institute International and Global Stevia Institute.

M.F. also serves on the Yogurt in Nutrition Initiative for Health Advisory Board for the Danone Institute International. R.M. has no disclosures.

REFERENCES

1. Bodot V, Soustre Y, Reverend B. Best of 2013: Yogurt Special. French National Dairy Council (CNIEL): Scientific and Technical Affairs Division; 2013. http://www.idfdairynutrition.org/Files/media/FactSheetsHP/EXE-EN_BofYogurt.pdf. Accessed October 11, 2014.

2. Moreno Aznar LA, Cervera Ral P, Ortega Anta RM, et al. [Scientific evidence about the role of yogurt and other fermented milks in the healthy diet for the Spanish population (Spanish)]. Nutr Hosp. 2013;28:2039–2089.
3. McGee H. Fresh fermented milks and creams. In: P Dorfman, J Greene, A McGee, eds. Food and Cooking: The Science and Lore of the Kitchen. New York: Scribner; 2004; 44–51.
4. Brothwell D, Brothwell P. Food in antiquity: a survey of the diet of early peoples. Baltimore: Johns Hopkins University Press; 1997.
5. Batmanglij N. A Taste of Persia: An Introduction to Persian Cooking. Washington, DC: Mage Publishers; 2007.
6. Kashgari M. Divan-Lugat at-Turk. Tranlated by R. Dankoff with J. Kelley as A Compendium of Turkish Dialects. Vol 2. Cambridge, MA: Cambridge University Press; 1984.
7. Yusuf KH. Wisdom of Royal Glory (Kutadgu Bilig): A Turko-Islamic Mirror for Princes, translated with an introduction and notes by Robert Dankoff. Chicago: University of Chicago Press; 1983.
8. Cirone K, Huberman Y, Morsella C, et al. Growth of *Mycobacterium avium* subsp. paratuberculosis, *Escherichia coli*, and *Salmonella enteritidis* during preparation and storage of yogurt. Microbiol. Dec. 16;2013:247018.
9. Atamian S, Olabi A, Kebbe Baghdadi O, et al. The characterization of the physicochemical and sensory properties of full-fat, reduced-fat and low-fat bovine, caprine, and ovine Greek yogurt (Labneh). Food Sci Nutr. 2014;2:164–173.
10. International Dairy Federation (IDF). Global Dairy Plaform: Sustainable Dairy Nutrients Are Essential to Human Health. 2012. www.fil-idf.org. Accessed October 5, 2014.
11. Instituo Brasileiro de Geografia e Estatistica. Pesquisa de orçamentos familiares 2008–2009: Antropometria e estado nutricional de crianças adolescentes e adultos no Brasil Ministerio da Saude. Ministerio do Planejamento, Orcamento e Gestao, Rio de Janeiro; 2010.
12. Danone Nutricia Research. Global Yoghurt Consumption Per Capita and Per Year. The NutriJournal Web site. December 30, 2013. http://nutrijournal.danone.com/en/articles/stories/global-yoghurt-consumption-per-capita-and-per-year. Accessed October 5, 2014.
13. Schlindwein MM, Kassouf AL. Mudancas o padrao de consumo de alimentos temp-intensivos e de alimentos poupadores de temp, por regiao do Brasil: Gasto e consumo das familias brasileiras contemporaneas. Brasilia: IPEA; 2007.
14. 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. 2014;38:299–305.
15. Samara A, Herbeth B, Ndiaye NC, et al. Dairy product consumption, calcium intakes, and metabolic syndrome-related factors over 5 years in the STANISLAS study. Nutrition. 2013;29:519–524.
16. Thum C, Cookson AL, Otter DE, et al. Can nutritional modulation of maternal intestinal microbiota influence the development of the infant gastrointestinal tract? J Nutr. 2012;142:1921–1928.
17. Canani RB, Di Costanzo M. Gut microbiota as potential therapeutic target for the treatment of cow's milk allergy. Nutrients. 2013;5:651–662.
18. Kai SH, Bongard V, Simon C, et al. Low-fat and high-fat dairy products are differently related to blood lipids and cardiovascular risk score. Eur J Prev Cardiol. 2014;21:1557–1567.
19. Ralston RA, Lee JH, Truby H, et al. A systematic review and meta-analysis of elevated blood pressure and consumption of dairy foods. J Hum Hypertens. 2012;26:3–13.
20. Beydoun MA, Gary TL, Caballero BH, et al. Ethnic differences in dairy and related nutrient consumption among US adults and their association with obesity, central obesity, and the metabolic syndrome. Am J Clin Nutr. 2008;87:1914–1925.
21. Tong X, Dong JY, Wu ZW, et al. Dairy consumption and risk of type 2 diabetes mellitus: a meta-analysis of cohort studies. Eur J Clin Nutr. 2011;65:1027–1031.
22. Li H, Zou Y, Ding G. Dietary factors associated with dental erosion: a meta-analysis. PLoS One. 2012;7:e42626.
23. Twetman S, Keller MK. Probiotics for caries prevention and control. Adv Dent Res. 2012;24:98–102.
24. Wu L, Chang R, Mu Y, et al. Association between obesity and dental caries in Chinese children. Caries Res. 2013;47:171–176.
25. Rushing J, Neu J. Probiotics for pregnant women and preterm neonates. Am J Clin Nutr. 2011;93:3–4.
26. Sanz Y. Gut microbiota and probiotics in maternal and infant health. Am J Clin Nutr. 2011;94(6 Suppl):2000S–2005S.
27. Brantsaeter AL, Myhre R, Haugen M, et al. Intake of probiotic food and risk of preeclampsia in primiparous women: the Norwegian Mother and Child Cohort Study. Am J Epidemiol. 2011;174:807–815.