



YOGURT – dead or ALIVE?

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YOGURT – dead or ALIVE?

Tore Midtvedt (Editor-in-Chief)

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The article above reflects the state of the art of available data on the nutritional and physiological properties of live yogurt and heat-treated fermented milk. It includes recent data issued from scientific studies.

As a review article, it has not passed through our normal referee system. The authors behind a review article should be free to express their own opinion – and their own level of knowledge. However, the probiotic field represents a true battle shield at which science might meet commercial interest. It is also a shield at which cultural differences in lifestyle and tradition may influence the design of a research

programme as well as the arguments used in sale promotion.

Therefore, in an attempt to reflect a more worldwide state of the art, the authors submitted the text to several international experts – from Argentina to China – and they were asked to evaluate the relevance of the supporting information and the importance of the addressed theme. Their reactions are listed below.

Surely, there might be other experts who may have other opinions. They are hereby heartily invited to express their opinions in *Microbial Ecology in Health and Disease*.

Esteban Carmuega
Pediatric Nutrition
Nutritional Department
Hospital de Pediatría Juan P Garrahan
Buenos Aires
Argentina

The document 'Methods and markers for *in vivo* studies of the physiological effects of yogurt cultures' is a thorough state of the art review that summarizes the scientific evidence for the nutritional and functional benefits of live yogurt. This review is very consistent and shows that most of the health benefits of yogurt depend on the live cultures and their interaction with the milk matrix. Yogurt has long been known as one of the healthy foods not only for its nutrient composition but also for the role of lactic acid bacteria. They contribute to the modification of milk, synthesis of biologically active peptides and enzymes, modulation of flora and in recent years the addition of new strains of probiotics has increased its value as a functional food. The evidence clearly demonstrates that pasteurization of yogurt results in a completely different food. As the health benefits are clearly different it must receive another name, because the consumer has the right to decide if they want to consume a live product as a yogurt or a pasteurized one.

Finally I fully agree with the concepts presented in this interesting review and consequently I am in favour of limiting the name yogurt to fermented milk containing viable bacteria.

Gabriela Perdígón
Institute of Microbiology
University of Tucuman
Argentina

I think that you treated this topic in an excellent way, making a very consistent bibliographical revision and the parameters you chose to compare conventional and heat-treated yogurts are very adequate since they are the reason why consumers drink yogurt (for nutritional purposes, lactose intolerance, calcium absorption, immune capacity to improve the general health status and prevention of allergic manifestations). I think that all these properties of fermented milks are achieved with viable bacteria. Even though when heat-treated fermented products have some of the beneficial properties of conventional yogurt, they can not be denominated 'yogurt', since by definition it must contain viable bacteria. There must be different names for these two products, also the labelling of the products should state that the product was heated and the traditional consumer should know about the differences between these

two products. If no differences are stated, there could be misleading situations and the consumer would think that the consumption of one or another product is the same, when we know it is not like that.

Gregor Reid
Canadian Research and
Development Centre for Probiotics
Lawson Health Research Institute
London, ON
Canada

Philosophically, I like the idea of stating that yogurt is defined by containing live bacteria (I do not agree that it should only be with the two bacteria proposed, as different organisms can form yogurt). I like the fact that anything that is dead (by heat or pasteurization processes) should be given another name. I don't really like the term 'heat-treated fermented milk' as it is cumbersome and implies that there could be live organisms in it. I don't have a suitable alternative, but such nutritional milk products should state that they 'do not contain live organisms'.

I would have a third category of 'probiotic yogurt' in which proven probiotic strains are used to make the yogurt and/or are added after fermentation and then present in sufficient numbers at the time of consumption to confer a health benefit on the host. One product here in Canada was found to contain 400 colonies of a probiotic strain, which is totally inadequate to be referred to as a probiotic yogurt.

Yuxin Yang
Chinese Academy of Preventive Medicine
Institute of Nutrition and Food Hygiene
Beijing
China

I believe that yogurt and heating of yogurt do not have same nutritional significance, even though they may have same nutritional quality on traditional evaluations.

Or, we can say that they do not have same 'substantial equivalence', not only as regards chemical composition and quality, but also the biological value of the food.

If these two products have the same name, it would be misleading for the consumer. We should let people know what they are consuming.

The China Ministry of Health will hold a meeting at some point to discuss various issues, including yogurt and heat-treated yogurt. The meeting is a preparation for the 26th CAC meeting and the 13th CCASIA meetings.

Pierre Bourlioux
Professor Emeritus
Université Paris-Sud
France

This document is perfect and corresponds to the reality.

I have already been confronted by this topic and I have always been astonished by the fact that the companies which produce heat-treated yogurt use the scientific works produced by the companies that produce living yogurt, claim that their product have the same properties, but bring no corresponding scientific proof of their claims.

First of all, it is clear that the two products are different, as shown in Table III, and I think that this difference is the first element which must lead to a different denomination.

Secondly the literature about the physiological effects of living yogurt in man is now very well documented and provides proof that there are so many differences between the two products that there really are two different products. I have no doubt that the Codex Alimentarius will approve your document and reserve the word 'yogurt' for the living product.

Gérard Corthier
Unité d'Ecologie et de Physiologie du Système Digestif
Institut National de Recherche Agronomique
Jouy en Josas
France

I really do appreciate your sending me your article: 'Methods and markers for *in vivo* studies of the physiological effects of yogurt cultures'.

The bibliography is scientifically relevant and complete. It is a very interesting neutral review which makes clear that the yogurt (living form) and the heat-inactivated fermented milk are two distinct products. The living yogurt flora has very interesting properties as regards consumer health which the other one has not.

Eric Lerebours
Département d'Hépatogastro-Entérologie et Nutrition
Centre Hospitalier Universitaire Charles Nicolle
Rouen
France

I fully agree with the content of the review. There are clear scientific data showing that yogurt containing live bacteria and heat-treated fermented milk have different physiological effects. The different impact of the two products on

lactose absorption in lactase-deficient subjects was confirmed by the double-blind placebo-controlled trial we published in 1989.

Philippe Marteau
Service de Gastroentérologie
Hôpital Georges Pompidou
Paris
France

I agree with all the points in this good review but wish to stress the following points concerning the better digestibility of lactose and its mechanism (on which I have personally worked).

1. Most studies on digestibility of lactose from yogurt are not quantitative but only provide a comparison of the digestibility of lactose from different sources. However, some studies have also provided quantitative data in subjects with adult-type hypolactasia either by using a control period with lactulose for breath tests or by direct assessment of undigested lactose. In the study by Kolars and co-workers (1984), maldigestion of lactose from milk was around 50%; from yogurt it was only one-third of that (i.e. about 17%). Savaiano et al. (1984) and McDonough et al. (1987) showed that maldigestion of lactose from yogurt was one-fifth of that of milk. We measured the digestion of lactose using the intestinal perfusion technique in eight lactase-deficient subjects who ingested 18 g of lactose in different fermented products. The amount of lactose that reached the terminal ileum was 1.74 g after ingestion of yogurt and 2.85 g after ingestion of heated yogurt (Marteau et al. 1990). Although the maldigestion of lactose from heated yogurt is nearly twice that of yogurt, the absolute difference after ingestion of 18 g lactose (e.g. 400 g of yogurt) is only about 1 g. In one study performed in 17 subjects with short bowel syndrome, the maldigestion of lactose from milk was approximately 50%, and that from yogurt 24% (Arrighi et al. 1994).
2. We measured the lactase flow rate in the human intestine *in vivo* after ingestion of yogurt and heated yogurt and showed that the lactase survived the transit – and helped lactose digestion (Marteau, Br J Nutr 1990).
3. Several facts suggested that the lysis of yogurt bacteria by bile helped lactose digestion (by delivering free active lactase in the intestine). Several authors stressed that other lactic acid bacteria which are more resistant to bile than yogurt bacteria were less efficient in helping lactose digestion despite the same lactase content. We observed that the lactase activity is not increased when the ileal chyme is sonicated but that it is increased when yogurt is sonicated, which suggests that the cell wall is

already disrupted in the chyme collected in the ileum in man after yogurt ingestion.

Noel W. Solomons
Center for Studies of Sensory Impairment
Aging and Metabolism
Guatemala City
Guatemala

There are both semantic and cultural (evolutionary) issues in the context of whether or not 'live bacteria' and 'no bacteria' fermented products should be differentially labelled. On the semantic front, we could not allow all white, creamy beverages to be labelled as 'milk'. There is a 'default' meaning, by tradition, that 'milk' refers to bovine (cow's) milk. Other varieties of white liquid beverages, such as that of the goat, 'goat's milk' or an artificial substitute from soya, 'soy milk' (not to mention 'milk' of magnesia), obviously must be differentiated for the consumer. In this case, cow's milk is the standard.

Perhaps more important is the aspect of human cultural evolution, in which the 40,000 years of pastoralist life style since the first domestication of hooved animals as dairy animals, has led to fermented forms (cheeses, kefirs, yogurts, acidified milks) being the standard. It was only with the advent of pasteurization and refrigeration (fresh liquid milk) and food technology (reconstituted dried milk powders) that unfermented milk became a part of the human milk-drinking culture. The standard in cultural evolution is of a fermented product containing whatever culture bacteria the culinary tradition had adapted. Moreover, as has been amply shown, the traditional processing of milks for millennia produced a synergism for human intestinal and immune health from the reaction of the consumer and host with the naturally fermented dairy products. The evolutionary standard for 'yogurt' is a fermented product with its fermentation flora still intact. Any other variation or variety needs the same qualification as described for the semantic use of 'milk', itself (above).

We must understand and respect that humans and their diet underwent thousands of years of evolution and co-adaptation, with important lessons from the wisdom of Nature that should not be unlearned in an era of imposing food microbiology concerns. For the issues of health, eliminating culture bacteria in yogurts is (literally) 'throwing out the baby with the bath water'.

Beatrice L. Pool-Zobel
Institute for Nutrition &
Chair of Nutritional Toxicology
Friedrich-Schiller-University
Jena
Germany

A recognizable distinction between live yogurt and heat-treated fermented milk products based on the recent overview of the scientific literature is very important. We have data on the efficacy of viable bacteria to protect from DNA damage by genotoxic carcinogens, and have looked at mechanisms. If you read my articles you will see that the protective effects we describe are completely abolished after heat treatment of the bacteria. There may be 'bifidogenic factors' in heat-treated foods (whatever that means), but viable bacteria are simply better according to our studies.

K.N. Agarwal
Department of Pediatrics
University College of Medical Sciences
and Guru Teg Bahadur Hospital
Delhi
India

Thanks for the document on yogurt. I enjoyed reading it. I strongly support the view.

Lorenzo Morelli
Fac. Agraria, Istituto di Microbiologia
Universita Cattolica del Sacro Cuore
Piacenza
Italy

I have carefully read the document 'Methods and markers for *in vivo* studies of the physiological effects of yogurt cultures'.

I am strongly in favour of limiting the name yogurt to fermented dairy products containing viable bacteria, then you can add my name to the above cited document.

I would also like to draw your attention to the publication by I. Wollowski and co-workers: 'Bacteria used for the production of yogurt inactivate carcinogens and prevent DNA damage in the colon of rats', *J Nutr* 1999; 129: 77–82. This paper reports an anti-cancer effect of viable yogurt bacteria and the suggested mechanism is exerted only by viable bacteria.

Francisco Guarner
Digestive System Research Unit
Hospital General Vall d'Hebron
Autonomous University of Barcelona
Barcelona
Spain

The document 'Methods and markers for *in vivo* studies of the physiological effects of yogurt cultures' reviews and summarizes our current scientific knowledge on the nutritional and functional benefits of live yogurt that cannot be achieved by consumption of pasteurized (heat-killed) versions of the product. The report comments on data well

known by the scientific community. The concepts behind these data are sound and very consistent. Most findings have been observed and reproduced by several laboratories working in different parts of the world and using different technological approaches.

The concept of a product that includes live bacteria will always be perceived as different from a product containing non-viable ingredients only. This is becoming particularly clear in recent years since we are very much aware of the symbiosis of bacteria and host in the gut (Hooper & Gordon, *Science* 2001; 292: 115–18). The impact of live bacteria on host physiology is well recognized with our current data, but there is no doubt that new technologies will provide much more information in forthcoming years (Guarner & Malagelada, *Lancet* 2003; 360: 512–19).

Ascensión Marcos Sánchez
Grupo Inmunonutrición
Dpto de Metabolismo y Nutrición, Instituto del Frío
Consejo Superior de Investigaciones Científicas (CSIC)
Madrid
Spain

The immunonutrition group, directed by Dr Ascensión Marcos, supports the opinion that the information given in the report called 'Methods and markers for *in vivo* studies of the physiological effects of yogurt cultures' is relevant in order to evaluate the scientific evidence to differentiate between the nutritional and functional properties of yogurt and heat-treated fermented milks. Since a much smaller amount of research has been done on heat-treated fermented milks in comparison with yogurt, it seems sensible to consider that a requisite for equivalent properties being shown for both products is desirable if they are to be known by the same name.

J. Alfredo Martínez
Dpto Fisiología y Nutrición
Universidad de Navarra
Pamplona
Spain

- a. Yogurt and heat-treated fermented milk have a comparable nutrient composition but not the same biological value.
- b. The role of yogurt in the digestion and absorption of lactose is clearly differentiated as compared to heat-treated fermented milk in many individuals.
- c. Other properties of the yogurt appear to contribute to establish additional healthy values for this dairy product.

Rosa M. Ortega
Departamento de Nutrición
Facultad de Farmacia
Universidad Complutense
Madrid
Spain

Undoubtedly, pasteurized fermented milk products are not the same as those that supply live microorganisms. There are considerable differences between the two types of product that can be crucial for the health and nutritional status of a subject.

We very much agree with your interesting review. The advantages associated with the intake of fermented milk or live microorganism-containing yogurt have been described in the many investigations recompiled in 'Functional Foods. Probiotics' (Panamericana ed., Madrid, 2002) by R.M. Ortega et al. This book was recently presented at the V Congress of the Spanish Society of Community Nutrition and III Ibero-American Congress on Nutrition and Public Health held in Madrid in September 2002, co-sponsored by the World Health Organization and officially recognized as a health event of interest by the Spanish Ministry of Health and Consumption and the Universidad Complutense de Madrid.

Given that fermented and fermented/heat-treated milk products are not identical and that their specific differences tilt the balance in favour of milk products fermented using live microorganisms (most noticeable in subjects with problems such as lactose intolerance, an impaired immune response, predisposition towards allergies/carcinogenesis/collagen-induced arthritis, etc.), these products should be denoted differently to enable the consumer to distinguish between them.

Specifically, Shermak et al. (1995) indicated that lactose-malabsorbing children experienced significantly fewer symptoms after consuming yogurt containing active cultures than after consuming milk ($p < 0.005$). Further, Gil et al. (2001) reported that some lactic acid bacteria can act as an effective probiotic dietary supplement for enhancing some aspects of cellular immunity in several population groups, especially in the elderly.

These studies, along with those mentioned in your review and our own experience, all point to the fact that a clear distinction should be made between pasteurized yogurt and yogurt containing active microorganisms. Milk fermented with live microorganisms would appear to have health and nutritional advantages, and although further work is needed, based on present knowledge these products are

not identical and the consumer should be able to distinguish between them.

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Lluís Serra Majem
Departamento de Ciencias Clínicas
Universidad de Las Palmas de Gran Canaria
Spain

You can count on my name for the endorsement of this report.

Joseph J. Rafter
Department of Medical Nutrition
Karolinska Institutet
Huddinge
Sweden

Several interesting and positive health effects have been demonstrated for probiotic bacteria, some of which are present in fermented milk products. To my knowledge, the majority of these effects are dependent on the bacteria being 'alive'. Before yogurt and 'heat-treated fermented milk' are known by the same name, these effects would also have to be demonstrated for the heat-treated product. This has not been done.

Zdenko Puhan
Institute of Food Science
Zürich
Switzerland

I read your very good report which contains the latest results of research favouring live bacteria in fermented milk, particularly in yogurt. I hope that this document will help to keep yogurt also for the future what it has been in the past.

David Heber
UCLA Center for Human Nutrition
David Geffen School of Medicine
University of California
Los Angeles, CA
USA

I strongly believe that consumers need to be informed about whether yogurt is a healthy live culture or pasteurized fermented milk. This is an important distinction with

important health benefits:

- 1) bacterial overgrowth in women treated with antibiotics for urine infections
- 2) enhancement of immune function
- 3) colon cancer prevention.

While not all of these are completely proven, these potential benefits should be available to consumers who want to consume live yogurt cultures.

Todd R. Klaenhammer
Southeast Dairy Foods Research Center
Department of Food Science
North Carolina State University
Raleigh, NC
USA

I am confident that pasteurization of yogurt results in a completely different product, as heat treatment denatures milk proteins, but most importantly kills the lactic acid bacterial cultures that are one of the major characteristic features of yogurt.

Yogurt has long been known as one of the most important food vehicles to deliver beneficial lactic acid bacteria to the human. These bacteria have been shown in many studies to deliver lactase (lowering the incidence of lactose intolerance responses) and interact positively with our intestinal microflora and immune system.

Yogurt in its most traditional sense and definition is a fermented dairy product that contains live cultures at significant levels reaching between 10 and 100 million cells/g.

In my view, I strongly oppose equating pasteurized fermented milks with yogurt. They are completely different products and the identity of 'yogurt' should not be tainted by non-equivalent imitations.

Paul A. Lachance
Food Science and Nutrition
Rutgers University
New Brunswick, NJ
USA

I support the overview and position taken in this document in describing the product 'yogurt'. I ascribe to the combination of culture standards and the nutritive standards as a combination.

Mary Ellen Sanders
Dairy and Food Culture Technologies
Centennial, CO
USA
President, International Scientific Association for Probiotics and Prebiotics

I am strongly in favour of limiting the name yogurt to fermented milk containing viable bacteria. This conclusion is based on (1) research which documents functional differences between these two products, (2) research which documents the value to human health of consumption of viable lactic acid bacteria, and (3) acknowledgement that consumers expect that yogurts contain live bacteria and product confidence would be eroded and confusion result if the term 'yogurt' were used for products which do not contain viable bacteria. Heat-treated yogurts are nutritionally valuable products, but should be labelled so that consumers can differentiate them from yogurt.

John H. Weisburger
Senior Member, Director Emeritus
Institute for Cancer Prevention
American Health Foundation
Valhalla, NY
USA

In preventive medicine research, the data show that bacteria are health-promoting in yogurt. Heat-treated yogurt does not have the same beneficial effects. Thus, Codex should specify that the proper name for yogurt is a food that contains a health-promoting bacterial flora.