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Dockets Management Staff (HFA-305)
Food and Drug Administration
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Rockville, MD 20852

RE: Milk and Cream Products and Yogurt Products; Final Rule to Revoke the Standards for Lowfat Yogurt and Nonfat Yogurt and to Amend the Standard for Yogurt [Docket No. FDA-2000-P-0126]

The International Dairy Foods Association (IDFA), Washington, D.C., respectfully submits the following objections and requests for hearings to the U.S. Food and Drug Administration (FDA or "the Agency") regarding the abovementioned Docket. IDFA represents the nation's dairy manufacturing and marketing industry, which supports more than 3 million jobs that generate $159 billion in wages and $620 billion in overall economic impact nationwide. IDFA's diverse membership ranges from multinational organizations to single-plant companies, from dairy companies and cooperatives to food retailers and suppliers. Together, they represent 90 percent of the milk, cheese, ice cream, yogurt and cultured products, and dairy ingredients produced and marketed in the United States and sold throughout the world.

IDFA appreciates the considerable work FDA has undertaken to issue a final rule amending the yogurt standard of identity. Issuance of this final rule has long been a top priority for IDFA and its members. We are generally supportive of the rule and believe that in a number of respects the amended standard reflects the basic nature and essential characteristics of yogurt and thus will promote honesty and fair dealing in the interest of consumers, enabling manufacturers to deliver the product consumers expect. In several ways, however, we are concerned that the revised standard is inconsistent with current manufacturing processes and the products consumers both desire and with which they are familiar. As such, there are several provisions, listed below, to which we are objecting because they do not reflect the basic nature and essential characteristics of yogurt.

In light of our longstanding desire for this final rule, we do not raise these objections lightly. It is imperative, however, that the standard be modern, flexible, enable manufacturers to meet consumer demands, and reflect the basic nature of yogurt. We are concerned that in a number of respects, the final rule reflects the extensive time frame for this rulemaking and the cumbersome nature of using formal rulemaking to amend dairy standards of identity. A 1981 final rule, a 1982 stay of certain provisions; a 2000 citizen petition; a 2003 advanced notice of proposed rulemaking; a 2009 proposed rule with enforcement discretion and then a final rule 12 years later in 2021 reflects a 40-year process cumulatively. And yet, this final rule is not reflective of current manufacturing processes that have been place for many years and will not allow for innovation. To us, this demonstrates that the process is broken. As we have previously committed, we are willing to work with the agency to modernize the process for amending standards of identity, particularly for dairy foods, so that time and resources can be used more efficiently and effectively.

OBJECTION 1

Provision:

> (a) *Description*. ". . . Yogurt, before the addition of bulky flavoring ingredients, . . . has either a titratable acidity of not less than 0.7 percent, expressed as lactic acid, or a pH of 4.6 or lower."

Objection and Proposed Stay:
IDFA objects to the requirement to achieve either a titratable acidity of not less than 0.7 percent, expressed as lactic acid, or a pH of 4.6 or lower prior to the addition of bulky flavoring ingredients and asks FDA to stay this provision.

Grounds for Objection:
IDFA objects to the above requirement in the final rule because it is simply not practical for flavored yogurts and does not reflect consumer taste preferences or current industry practice in the U.S. and internationally. As such, it will not promote honesty and fair dealing in the interest of consumers. There are three specific elements to the requirement in the final rule to which IDFA objects:
(1) The requirement that pH be reached prior to the addition of bulky flavoring ingredients in the manufacturing process;
(2) The inability to reach a pH of 4.6 or below within 24 hours after filling; and,
(3) The minimum titratable acidity requirement of 0.7.

IDFA recommends that this provision be modified to require a titratable acidity of not less than 0.6 percent, expressed as lactic acid, measured in the white mass of the yogurt, or a pH of 4.6 or lower measured in the finished product within 24 hours after filling.

<u>Titratable Acidity or pH Must Be Reached Before Addition of Bulky Flavoring Ingredients</u>

IDFA agrees with FDA that establishing a minimum titratable acidity or a maximum pH are appropriate acidity measurements for yogurt. We also agree with FDA that titratable acidity or pH should be achieved solely by the fermentation of bacterial culture and not by the addition of acidulants or acids that may be present in bulky flavorings (e.g., fruit preparations). As written, however, the final rule imposes a processing restriction that is not consistent with consumer preferences or current and long-established traditional manufacturing processes.

By way of background, the titratable acidity requirement in the 1981 final rule was stayed in 1982. Therefore, for nearly 40 years there has been no titratable acidity requirement for yogurt. In addition, for far longer than 40 years, even going back centuries, makers of yogurt have commonly used a process of producing yogurt that is "cup-set." Consumers have accepted and enjoyed these cup-set yogurts for many years.

With fruit-on-the-bottom-style, cup-set yogurts, the fruit preparation is first layered at the bottom of the cup, the inoculated, unfermented dairy ingredient mix is layered on top; sealed; incubated for fermentation to occur; and then cooled. For blended-style, cup-set yogurt, the dairy mix is routinely blended with bulky flavorings <u>before</u> it is inoculated ("cultured") with the two yogurt cultures *Lactobacillus delbrueckii* subspecies *bulgaricus* (LB) and *Streptococcus thermophilus* (ST). This is in line with the Pasteurized Milk Ordinance (PMO), which allows the uncultured mix, after the addition of bulky flavoring ingredients, to be inoculated ("cultured") with ST and LB, then immediately filled into the consumer packaging, sealed, then subsequently moved into a culturing room for incubation until it reaches pH of 4.80 or below, at which point it can be removed out of the culturing room and cooled, provided it reaches a pH of 4.6 or below within the following 24 hours and is cooled to 7°C (45°F) or less within 96 hours of being moved out of the culturing room. This practice had been informally permitted for making Grade "A" cup-set yogurt for many years, due to a provision in the 2007 Pasteurized Milk Ordinance adopted by the 2005 National Conference of Interstate Milk Shipments (NCIMS) allowing for pH to be achieved within 24 hours after filling. Then, in 2019, FDA and the NCIMS concluded it was sufficient to produce safe product and approved the addition of a clarifying provision[1] in the 2019 PMO explicitly allowing this process.

Therefore, FDA's statement in the final rule that "The manufacturer controls the condition after filling to ensure that the characterizing bacterial culture continues to ferment the product to produce a yogurt product with a maximum pH of 4.6 **before** [emphasis added] the addition of bulky flavoring ingredients" is inaccurate and does not reflect current and long-established traditional manufacturing processes.

Because it is inconsistent with long standing industry make procedures, a requirement to achieve the target pH before the addition of bulky flavorings will result in significant industry disruption. Yogurt manufacturers will be forced to change processing systems, flows and formulations, which could also result in discontinuation or major changes to safe products that have been in the marketplace and consumed for many years.

IDFA also objects to FDA's statement that "a maximum pH of 4.6 in the cultured and fermented yogurt before the addition of bulky flavor ingredients ensures the inhibition of growth and toxin formation of *Clostridium botulinum* (the pathogenic organism responsible for foodborne botulism)." FDA has presented no evidence of any concerns regarding the safety of cup-set yogurts and we are not aware of any. Pathogenic spore formers such as *C. botulinum*, *C. perfringens* and *B. cereus* may survive typical pasteurization of the pre-cultured mix; however, germination and outgrowth are controlled through fermentative acidification that produces a rapid pH drop below levels that permit growth of these organisms. Adequate fermentation, and resulting pH drop, is considered as a preventive control

[1] Pasteurized Milk Ordinance (2019), U.S. Public Health Service/Food and Drug Administration, Item 17p., page 112. "All pasteurized milk and milk products, except the following, shall be stored at a temperature of 7°C (45ºF) or less and be maintained thereat following filling or until further processed:
<u>a. All yogurt products at all milkfat levels, cultured in the cup after filling (cup-set) and subsequently moved out of the culturing room when reaching a pH of 4.80 or below and a pH of 4.6 or below within the following twenty-four (24) hours* and cooled to 7°C (45°F) or less within ninety-six (96) hours of being moved out of the culturing room**;"</u>

measure for all fermented milk products, including yogurt.[2] The rate of acidity development (generally measured as pH) during fermentation is far more important than the end titratable acidity in ensuring protection from pathogen outgrowth and possible toxin formation.[3] The addition of ingredients, such as fruit preparations, are not considered a major risk due to the nature of these ingredients (e.g., heat treated and low pH) and the fact that they will be subjected to rapid acidification during fermentation. Moreover, Item 16p. 2 of the PMO lays out specific requirements and controls for assuring the safety of ingredients added after pasteurization.

For many years, FDA and the states have regulated facilities producing these products without objection and FDA (Dr. Steve Walker) recently confirmed (*see Appendix 2*) to IDFA that FDA does not see any need to pursue any changes to the current provisions in the Pasteurized Milk Ordinance since the 2019 addition note above was made. Current practices reflect a long history of safe production and FDA has not provided any evidence for why current and long-established traditional practices and the current provisions of the PMO should not also be reflected in a modernized, flexible standard.

<u>A Maximum pH of 4.6 as Applied to the Finished Product Is Consistent with the Basic Nature and Essential Characteristics of Yogurt and Current Manufacturing Processes</u>

In many manufacturing processes today for non-cup-set yogurts, the yogurt manufacturer fills the consumer package with fermented yogurt at pH 4.8 (sometimes referred to as a "warm fill" process[4]), then allows the pH to fall to 4.6 or below within 24 hours. Therefore, to reflect current industry practice, the final rule's requirement of a maximum pH of 4.6 needs to be specific to the amount of elapsed time since filling the yogurt in the final package. As previously explained in comments submitted to the agency, modifications made to the 2007 Pasteurized Milk Ordinance, after initial discussion at the 2005 National Conference on Interstate Milk Shipments (NCIMS), specified the time and temperature of yogurt during cooling based on an initial pH of 4.8 or below at filling and with a pH of 4.6 or below within 24 hours of filling. FDA and the NCIMS reviewed pathogen challenge study data regarding this practice and concluded that yogurt is safe when this practice is followed.

Therefore, for more than 15 years FDA has, in effect, endorsed the PMO's allowance for "warm fill" yogurts achieving pH 4.6 within 24 hours of filling, where bulky flavoring ingredients are added before achieving this target pH and prior to filling. Furthermore, as such products have been on the market for many years as "yogurt" and accepted by consumers as such, this highlights that indeed the end products fit within consumer ideals of what the basic nature and essential characteristics of yogurt encompass. In other words, because the process of "warm fill" has been in place for many years, we do not agree with FDA statements in the preamble that an essential in-process characteristic of yogurt is the pH at filling before addition of bulky flavoring ingredients; instead, the pH at filling should apply regardless of whether bulky flavoring ingredients have been added prior to filling.

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[2] Swanson, K. & Buchanan, Robert & Cole, Martin & Cordier, J.-L & Flowers, R. & Gorris, Leon & Taniwaki, Marta & Tompkin, R. & Zwietering, Marcel. (2011). Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance. Springer. (*See Appendix 1*)

[3] IDFA conversation with Kathleen Glass, PhD, Distinguished Scientist, Associate Director, Food Research Institute, University of Wisconsin-Madison, Madison, WI

[4] *Vat Set*: fermented in the vat and cooled prior to filling; *Warm Fill*: fermented in the vat, filled warm (about 80 deg F) and cooled after filling; *Cup Set*: Filled hot (about 110 deg F), fermented in the cup and cooled after fermentation; *Separated (Greek) style*: fermented in the vat, centrifugation or filtration to concentrate, may be filled warm or cold.

A Minimum Titratable Acidity of 0.6% Is Consistent with the Basic Nature and Essential Characteristics of Yogurt and Would Meet Consumer Expectations

As previously discussed in comments submitted to the administrative record, IDFA maintains that the appropriate titratable acidity minimum requirement is 0.6%, not 0.7%. Although only a slight difference, this reduction in the required level of titratable acidity from not less than 0.7% to 0.6% is necessary to produce certain low calorie yogurt products that meet consumer expectations of a delicate and less tart yogurt taste, that is not too acidic or sour. Therefore, if a titratable acidity requirement of 0.7% is imposed, some manufacturers may need to adjust formulations and add sugars to counteract the acidity and deliver a product that meets consumer expectations and preferences – a practice that would be inconsistent with other public health objectives. Finally, establishing the level at 0.6% titratable acidity will provide needed flexibility, while also aligning the U.S. standard with the Codex Standard for Fermented Milks.

Proposed Permanent Resolution:
IDFA recommends that the provision be modified to require a titratable acidity of not less than 0.6 percent expressed as lactic acid, measured in the white mass of the yogurt, or pH of 4.6 or lower measured on the finished product within 24 hours after filling.

Request for a Hearing:
If FDA does not modify the final rule as requested, IDFA requests a hearing on the following factual issues: (1) Whether a requirement that titratable acidity or pH be reached prior to the addition of bulky flavors in the manufacturing process is consistent with the basic nature and essential characteristics of yogurt; (2) Whether a requirement that prohibits yogurt from being filled at a pH of 4.8 or less and reaching a pH of 4.6 or below within 24 hours after filling is consistent with the basic nature and essential characteristics of yogurt; and (3) Whether a minimum titratable acidity requirement of 0.7% is in the interest of consumers and necessary to maintaining the basic nature and essential characteristics of yogurt.

In addition to the information discussed above under "grounds for objection," which we hereby incorporate by cross reference, in support of our request for a hearing, IDFA is prepared to present evidence demonstrating current manufacturing processes, including cup-set yogurt, where yogurt is blended with bulky flavoring ingredients before it is cultured. IDFA is prepared to present evidence regarding the impact of flavoring ingredients on TA or pH and ultimately on the finished product characteristics. IDFA would demonstrate how these practices are consistent with the basic nature of yogurt and therefore promote honesty and fair dealing in the interest of consumers. IDFA also would provide evidence demonstrating that reaching a pH of 4.6 before filling is not an essential characteristic of yogurt and that a pH of 4.6 should be allowed to be reached in the finished product within 24 hours after filling. IDFA also would demonstrate that these manufacturing practices (addition of bulky flavoring ingredients before culturing for cup-set yogurt; achieving pH within 24 hours of filling) have a long history of producing safe products consumers enjoy. In addition, IDFA would present evidence showing that for several decades consumers in the U.S. have preferred yogurt with a milder and less acidic profile, such that a titratable acidity of 0.6% is consistent with the basic nature and essential characteristics of yogurt and meets consumer expectations.

OBJECTION 2

Provision:

Those portions of § 131.200 (a), (b), and (c) insofar as they prohibit the addition of pasteurized cream after culturing.

Objection and Proposed Stay:
IDFA objects to those portions of § 131.200 (a), (b), and (c) insofar as they prohibit the addition of pasteurized cream after culturing, and asks FDA to stay such provisions.

Grounds for Objection:
We understand that FDA's basis for prohibiting the addition of cream (and other dairy ingredients) after culturing hinges on the proposition that such an allowance will negatively affect the essential characteristic flavors and aromas of yogurt. This is not the case. In fact, milkfat is not critical to the basic nature and properties of yogurt, in large part because the yogurt cultures do not act on the milkfat during the culturing process, so the addition of a milk-derived ingredient like cream *after* culturing does not alter the key characteristics of the product. IDFA recognizes, however, that unlike milkfat, the addition of milk and milk-derived ingredients that contain significant amounts of lactose, proteins and amino acid peptides, which are indeed subjected to action by yogurt cultures during fermentation, do play a role in providing the unique organoleptic characteristics of yogurt. Therefore, we do not object to FDA's decision to prohibit the addition of such ingredients after fermentation has taken place.

Milkfat Not Critical to the Basic Nature and Essential Characteristics of Yogurt

In the final rule, FDA stated "Because more than 90 different compounds are responsible for the flavor and aroma of fermented yogurt (Ref. 3), it is essential that the dairy ingredients be cultured together." (Response 15 at FR 31127). While it is true that there are many compounds responsible for the flavor and aroma of yogurt, not all of these are derived through fermentation by the two defining yogurt cultures. IDFA advocated for the addition of pasteurized cream after culturing in its 2009 comments and provided FDA with information highlighting the lack of contribution of milkfat to the basic nature and essential character of yogurt starting in 2015 (*see Appendix 3*). IDFA has consulted with and reviewed several authoritative texts and scientific papers by subject matter experts on yogurt cultures and fermentation, from which the following information was derived. [5] From this research, it's clear that the characteristic flavor and aroma of yogurt is based predominately on the presence of lactic acid, acetaldehyde and to a lesser extent acetone, acetoin, and diacetyl. These distinct flavor/aroma compounds, along with the lack of CO_2 and ethanol, are what help distinguish yogurt from other

[5] Expert references:
- Routray, W. & Mishra, H.N. "Scientific and Technical Aspects of Yogurt Aroma and Taste: A Review," *Comprehensive Reviews in Food Science and Food Safety*, 10(4): 208-220, 2011. (*See Appendix 4*)
- Chandan, R.C., & Kilara, A. (Editors). *Manufacturing Yogurt and Fermented Milks, Second Edition*. John Wiley and Sons. 2013. https://doi.org/10.1002/9781118481301 (*See Appendix 5*)
- A.Y. Tamime, R.K. Robinson, Chapter 7 - Biochemistry of fermentation, Editors: A.Y. Tamime, R.K. Robinson, In Woodhead Publishing Series in Food Science, Technology and Nutrition, Tamime and Robinson's Yoghurt (Third Edition), Woodhead Publishing, 2007. (*See Appendix 6*)
- IDFA consulted with Mirjana Curic-Bawden, PhD, Senior Principal Scientist and Application Manager for Fermented Milk and Probiotics, Chr. Hansen. Chr. Hansen is a leading global supplier of dairy cultures and innovative culture and fermentation technologies.

fermented milks, such as kefir, kumis, etc. The reference FDA cited in the preamble—the review by Mishra and Routray (2011)—highlights these contributors to the unique characteristics of yogurt, which, as the authors point out, derive from lactose fermentation, and, in fact, there is no mention in this review of the action of ST and LB cultures on milkfat.

The totality of contributors to aroma, taste, texture, and the body of yogurt as a finished product can vary depending on the strains of cultures and milk, amount of milk fat and nonfat milk solids, fermentation process, and temperature used. The milkfat has an impact on the organoleptic characteristics of yogurt regardless of whether added before or after fermentation, along with the addition of a variety of other permitted optional ingredients; however, it is widely recognized, as noted in Chandan and Kilara (2013), that the main contribution to the *unique* flavor and aroma of plain, unflavored yogurt derives from the homofermentative metabolism of lactose in the milk and the lactose-containing milk-derived ingredients by the two defining thermophilic (or more accurately, "thermotolerant") yogurt cultures *L. bulgaricus* and *S. thermophilus*. This homofermentative process in yogurt yields lactic acid as 95% of the fermentation output, which is recognized as a primary and predominant contributor to the unique flavor of yogurt. Also, in Chandan and Kilara (2013), it is stated that the primary function of the starter cultures in yogurt is to generate lactic acid and the secondary function is to produce other flavor and aroma compounds.

Lesser enzymatic activity on amino acids present in the milk ingredients also contributes to important compounds. The amino acid threonine is the main precursor of acetaldehyde in yogurt, which is produced mainly by *L. bulgaricus*. Acetaldehyde is widely recognized as a major contributor to the characteristic "green apple" flavor of yogurt. (See Chandan and Kilara, page 257)

Although, yogurt fermented with milkfat included does contain volatile fatty acids that contribute to the flavor and aroma to a minor degree, virtually none of these compounds are the products of lipolysis/hydrolysis due to ST and LB; instead, their presence is due to proteolysis by the starter cultures and other thermotolerant bacteria coming from the raw milk itself that remain after pasteurization (See Tamime and Robinson, page 578; Chandan and Kilara, page 257); therefore, FDA's conclusion that milkfat must be present in the fermented dairy ingredients to contribute to the basic and essential characteristics of yogurt is not based on the scientific evidence. The contribution of milkfat to the characteristics of yogurt is essentially the same, regardless of whether included before or after fermentation.

Importantly, in considering what makes a specific flavor/aroma compound an essential contributor to the *basic nature and essential characteristics* of a product, it is critical that this focuses on flavor/aroma compounds that *differentiate* the product from other similar products and not compounds that are common across similar products. It is clear from the literature, as noted above, that milkfat does not provide such differentiation. To illustrate this, consider what occurs if one takes two containers (A and B) of pasteurized whole milk (full milkfat) and adds the two yogurt cultures (ST and LB) into container B at typical yogurt inoculation levels, and then incubates both containers at typical fermentation temperature and time. Due to the thermotolerant bacteria present in the pasteurized milk, both containers will experience varying degrees of enzymatic and fermentative activity by those bacteria, yielding a variety of new flavor and aroma compounds. What differentiates the two containers are the overwhelming contributions of ST and LB in container B, which will outcompete the naturally occurring bacteria that are present in much lower concentrations. At the end of the fermentation time, container A will, in effect, be "spoiled milk" whereas container B will be "yogurt." The relatively unchanged lipids from the milk fat will certainly contribute to the organoleptic characteristics of both A and B, but what differentiates the two is all the *other* compounds produced specifically through the action of the ST and LB on lactose and to a lesser extent on the amino acids, in addition to the physical changes (texture, viscosity, etc.).

The National Yogurt Association petition and IDFA's comments to the 2009 proposed rule requested the addition of pasteurized milk derived ingredients after culturing, specifically mentioning pasteurized cream. In support of this position, IDFA subsequently submitted comments to FDA in 2015 and thereafter highlighting the lack of contribution of milkfat to the basic nature and essential character of yogurt. IDFA is prepared to supplement this and the above information with additional testimony and information if a hearing is granted.

<u>Allowing the Addition of Pasteurized Cream After Culturing Promotes Honesty and Fair Dealing in the Interest of Consumers</u>

IDFA believes that allowing the addition of pasteurized cream after culturing promotes honesty and fair dealing in the interest of consumers because it improves production efficiency while still maintaining (as discussed above) the basic nature of yogurt. As explained in the comments that NYA submitted to FDA in 2009, the addition of pasteurized cream after culturing has many practical and production efficiency advantages. Specifically, the practice "… improves efficiencies in the plant by reducing the number of different bases and changeovers, which in turn reduces manufacturing costs (which keeps costs down to the consumer), and benefits the environment due to reduced water usage and reduced energy consumption. Finally, the addition of pasteurized cream in such a manner does not present any apparent safety issues and would not change the essential nature of the final yogurt product since it would still need to meet any relevant requirements (such as acidity, milk solids, and LACs) set forth in the standard."

Processing a fermented yogurt containing moderate to higher levels of milkfat through a centrifugal separator, to concentrate the yogurt by removing whey (e.g., in making a higher fat, high-protein, Greek-style yogurt), results in high loss of milkfat along with the whey stream. To account for this loss, the fermented mass needs to be formulated with extra milkfat to account for the expected percentage lost during the separation to end up with the target milkfat level in the concentrated yogurt. Milkfat can also accumulate and clog up the nozzles of the separator leading to more production stoppage and cleaning, as well. Therefore, to achieve higher levels of milkfat, including milkfat upstream of separation in the process adds significant costs and loss of efficiency, plus generates more waste of valuable milkfat, and there are process limitations as to how high a final milkfat percentage can be achieved.

Consumers are increasingly concerned with the environmental impacts of the products they purchase and consume, as well as their costs. At the same time, the end product they would receive if cream were allowed to be added after culturing would meet their expectations and be consistent with the basic nature and essential characteristics of yogurt. It is therefore in the interest of consumers to allow for the addition of pasteurized cream after culturing.

Request for Hearing:
IDFA requests a hearing on the factual issue of whether the addition of pasteurized cream after culturing is consistent with the basic nature and essential characteristics of yogurt. If this request is granted, IDFA would present evidence on the lack of impact of the addition of pasteurized cream after culturing on the aroma, taste, and other characteristics of the yogurt, as well as on the other factors that we believe are most critical to the basic characteristics of yogurt. This information would include testimony by experts

in yogurt production and technical, scientific literature, as summarized above in the grounds for objection, which we hereby incorporate by cross reference in support of this request for a hearing. We believe this information would establish that the addition of pasteurized cream after culturing does not alter the basic nature or safety of yogurt. IDFA would also provide expert testimony on the production efficiencies and reduced environmental impacts created by allowing cream addition after culturing.

Proposed Permanent Resolution:
FDA should revise and publish an amended final rule to allow for pasteurized cream to be added after culturing. IDFA suggests pasteurized cream be added to (d) Other optional ingredients as follows: "(9) Pasteurized cream, which may be added after the ingredients in paragraphs (b) and (c) of this section have been cultured, provided the minimum 8.25 percent milk solids not fat required in paragraph (a) of this section is maintained upon such addition, prior to the addition of bulky flavoring ingredients."

OBJECTION 3

Provision:

> (d) *Other optional ingredients* (8)(ii) If added, vitamin D must be present in such quantity that the food contains not less than 25 percent Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practices.

Objection and Proposed Stay:
IDFA objects to this provision insofar as it would require a yogurt with added vitamin D to contain at least 25% Daily Value (DV) vitamin D per RACC, and asks FDA to stay this provision.

Grounds for Objection:
IDFA objects to the provision on added vitamin D on two grounds: (1) it conflicts with FDA's generally recognized as safe (GRAS) regulation for vitamin D, which does not allow this level of vitamin D to be added to yogurt, and (2) the required level of vitamin D provided for in the final rule is unreasonably high in light of the basic nature of yogurt and does not promote the interests of consumers.

The new final yogurt standard requires that vitamin D, if added, must be present at no less than 25% of the DV, or 5 mcg per 170 g RACC. However, this level is higher than the level authorized by FDA's GRAS regulation for vitamin D, which sets the limit for vitamin D in milk products at 89 IU per 100 grams of food, equivalent to 3.8 mcg per 170 g RACC. 21 CFR 184.1950(c)(1). Since a yogurt with vitamin D added would be required to contain at least 5 mcg per RACC to comply with the standard of identity, which is higher than the limit of 3.8 mcg per RACC set by the GRAS regulation, yogurts with added vitamin D could not comply with both the standard and the GRAS regulation. This would result in an effective *prohibition* on yogurt containing added vitamin D. Such an outcome would run contrary to FDA's public health goals under the 2020-2025 Dietary Guidelines for Americans, which identified vitamin D as a nutrient of public health concern.

Further, in light of the recent changes to both the RACC for yogurt and the DV for vitamin D, requiring that yogurts with added vitamin D must contain 25% DV per RACC is an unreasonably high standard that is not consistent with consumer expectations or the basic nature and characteristics of yogurt. Indeed, this amount would be higher than the vitamin D content of milk.[6] Yogurts have not historically, nor do they now, contain this level of vitamin D. Requiring this level of vitamin D, even if it were authorized by FDA's GRAS and food additive regulations, could have the unintended consequence of discouraging companies from fortifying yogurt with vitamin D, which would not be consistent with FDA's public health goals or in the interest of consumers.

IDFA believes the inconsistency created by the final yogurt standard with the GRAS and food additive regulations for vitamin D was inadvertent and could be corrected by a technical amendment to the regulation to provide for 10% DV vitamin D per RACC. We note that IDFA's 2009 comments to FDA on the proposed rule asked FDA to require a level of "not less than 25% Daily Value per Reference Amount Customarily Consumed" when vitamin D is added to yogurt. The final rule used this exact language. However, since those 2009 comments, the RACC for yogurt has decreased from 225 g to 170 g and the DV for vitamin D has increased from 400 IU (10 mcg) to 20 mcg. With these two changes, the amount of vitamin D represented by "25% DV per RACC" increased from 2.5 mcg per 225 g – equivalent to 1.89 mcg per 170 mcg – to 5 mcg per 170 g yogurt. This increase meant that requiring at least 25% DV for vitamin D increases the amount added above the limits set by FDA's GRAS regulation for vitamin D in 21 CFR 184.1950, creating a situation where it is impossible to comply with both regulations.

As a result of this conflict, the outcome of the new vitamin D provision will be that instead of increasing the amount of vitamin D added to yogurts, the amount of vitamin D will be decreased because it will no longer be added to yogurts. Under the final standard of identity, a yogurt may only contain added vitamin D if it contains 25%DV per RACC – a level higher than that authorized under FDA's food safety regulations. So, companies will no longer be able to add vitamin D to yogurts. This outcome would run contrary to the agency's public health goals of increasing consumption of shortfall nutrients like vitamin D, consistent with the 2020-2025 Dietary Guidelines for Americans

Modifying the vitamin D level in the yogurt standard to align with 10% of the Daily Value for vitamin D (2 mcg per 170 g RACC of yogurt) would align with 21 CFR 130.10 and also align with the current enforcement discretion provided for a "healthy" claim. In the guidance permitting some variation from certain requirements of the "healthy" claim definition, FDA allowed for food products that contained at least 10% DV of vitamin D to make the claim, as long as they also met the other claim requirements. In the guidance, FDA indicated that the requirement for foods labeled as "healthy" to contain a beneficial nutrient would ensure that these "foods provid[e] a good or excellent source of nutrients for which there had been public health concern." Vitamin D is a nutrient that has been identified as a public health concern due to underconsumption by the current and previous Dietary Guidelines for Americans. By permitting vitamin D addition at a minimum level of 10% DV, this allows for the addition of a significant amount of an under-consumed nutrient, in line with both the Dietary Guidelines for Americans and the healthy nutrient content claim.

We understand FDA has received a food additive petition asking the agency to revise the food additive regulations to increase the amount of vitamin D3 in yogurt under 21 CFR 172.380.5[6] Even if that food additive petition is granted, further changes would still be needed to the vitamin D provisions in the yogurt standard of identity. As discussed above, we believe the level of 10% DV per RACC is more consistent with the minimum level of vitamin D consumers would expect in a yogurt with added vitamin

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[6] According to USDA's Food Data Central, whole milk with added vitamin D contains 2.39 mcg vitamin D per 1 cup RACC/serving. FDA's final yogurt standard requires at least 5 mcg vitamin D per 170 g RACC – nearly twice the level in milk.

D. If the food additive petition is granted, however, its granting would be consistent with the revised language we are asking for under the yogurt standard of identity, under which the 10% DV per RACC standard would be a minimum, but higher levels that may be authorized in the future under the food additive regulations would be permitted.

As discussed below, if FDA does not modify the yogurt standard of identity as suggested, then we request a hearing to determine the level of vitamin D in yogurt consistent with consumer expectation and the basic nature and essential characteristics of yogurt.

Proposed Permanent Resolution:
IDFA recommends that FDA amend the standard of identity to require that yogurts with added vitamin D contain a minimum of 10% of the Daily Value of Vitamin D per 170 g RACC. Specifically, the provision would be amended to read:

> "If added, vitamin D must be present in such quantity that the food contains not less than 10 percent Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practices."

This amount correlates to 2 mcg per 170 g per RACC, which is within the limit in the GRAS regulation, while providing enough to qualify for a "good source of vitamin D" claim.[7] This amount is also consistent with IDFA's original comments to FDA on the 2009 proposed rule, where we asked FDA to require yogurt with added vitamin D to contain at least 25% DV vitamin D per RACC. Under the "old" RACC for yogurt and DV for vitamin D in place at that time, this amount was equal to 2.5 mcg per 225 g per RACC, or 1.89 mcg per 170 g – very close to the 2 mcg per 170 g standard that we are now requesting, but slightly higher to allow the product to qualify as a "good source" of vitamin D under the new daily value.

We believe FDA could make this change by issuing a technical amendment to the final yogurt standard. A technical amendment, without a further round of notice and comment rulemaking, is appropriate under the "good cause" exception to the Administrative Procedure Act (APA) when the issue is a technical one that involves little or no agency discretion.[8] Because the GRAS and food additive regulations do not permit the addition of vitamin D to yogurt at the levels provided for under the final yogurt standard, a technical amendment to the final yogurt standard is needed for consistency between regulatory requirements. Correcting this issue involves little or no agency discretion because the level of 2 mcg per 170 g RACC is very close to the level that we believe FDA intended to provide for of 1.88 mcg per 170 g – i.e., the level that was previously "25% DV per RACC" under the old RACC for yogurt and DV for vitamin D.

Request for Hearing:
In the alternative, in the event FDA does not modify the regulation in this way by issuing a technical amendment, IDFA requests a hearing on the amount of vitamin D in yogurt that would be consistent with consumer expectations and the basic nature and characteristics of yogurt that contains added vitamin D, and aligned with current regulatory limitations. IDFA would present evidence on the current

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[7] We note that requiring an amount of vitamin D such as 20% DV per RACC – enough to qualify as an "excellent" source of vitamin D – would still be higher than the amount authorized by the current GRAS regulation for use in yogurts.

[8] 5 U.S.C. § 553(b)(3)(B).

food additive and GRAS regulatory restrictions on adding vitamin D to yogurts; the amount of vitamin D found in yogurt, both historically and today; and the amount of vitamin D found in other dairy products such as milk. The evidence would include marketplace examples and, where available, sales data. This information would help demonstrate the amount of vitamin D that is expected in, or characteristic of, yogurts with added vitamin D.

OBJECTION 4

Provision:

> (a) *Description*. ". . . Yogurt, before the addition of bulky flavoring ingredients, contains not less than 3.25 percent milkfat. . ."

Objection and Proposed Stay:
IDFA objects to the requirement that yogurt contain not less than 3.25% milkfat. Retaining the 3.25% minimum milkfat requirement does not protect the basic nature and essential characteristics of yogurt, nor does it reflect current industry practices. FDA should stay the requirement in 21 CFR 131.200(a) insofar as it requires yogurt, before the addition of bulky flavoring ingredients, to contain not less than 3.25% milkfat.

Grounds for Objection:
IDFA's position is that the 3.25% minimum milkfat requirement is not consistent with the basic nature and essential characteristics of yogurt and does not promote honesty and fair dealing in the interest of consumers. As discussed below, milkfat does not contribute to the basic nature and essential characteristics of yogurt, and the 3.25% minimum milkfat requirement creates naming anomalies (resulting in products that are neither yogurt nor yogurt named by a nutrient content claim) and restricts innovation and the use of flavoring ingredients that contribute to total fat content such as coconut and cacao. Relative nutrient content claims related to the total fat content in a yogurt should simply be based on a comparative standard "yogurt" containing *greater than 3 g* of total fat per RACC in the finished product.

We understand that FDA's basis for requiring a minimum milkfat content is that "Allowing fat from nondairy ingredients to count towards the minimum fat level deviates from the basic nature and essential characteristics of yogurt as other types of nondairy fats or oils could contribute to variances in the taste, texture, color, or aroma of yogurt." We disagree and are prepared to present evidence in support of our position.

<u>Milkfat does not Contribute to the Defining Characteristics of Yogurt and Consequently No Minimum Milkfat Requirement is Needed</u>

IDFA incorporates by cross reference the discussion in Objection 2 explaining that milkfat is not an essential characteristic of yogurt. Although yogurt made with milkfat indeed has volatile fatty acids and other compounds that contribute to flavor and aroma, virtually none of these are derived from milkfat fermentation or lipolysis due to ST and LB, but are instead present due to proteolysis by the starter cultures and other thermotolerant bacteria from the raw milk itself that remain after pasteurization (*see Appendix 6*; Tamime and Robinson at page 578). These distinct flavor and aroma compounds, along with the lack of carbon dioxide and ethanol, help distinguish yogurt from other fermented milks (e.g., kefir, kumis). Importantly, milkfat does not need to be present in the fermented dairy ingredients to contribute to the basic and essential characteristics of yogurt. Therefore, elimination of the percent milkfat requirement would not cheapen or dilute the food "yogurt."

In addition, low milkfat and non milkfat yogurts account for the vast majority of yogurt sold, which under the current standard of identity, contain less than 3.25% milkfat. The yogurt most consumers consume today, therefore, is not characterized by its milkfat, but by the flavor and aroma compounds described above. Moreover, the predominance and popularity of lowfat and nonfat yogurts containing less than 3.25% milkfat further supports that yogurts containing less than 3.25% milkfat are not considered inferior products, primarily because they are not replaced by inferior or cheaper substitutes.

Notably, the current Codex standard does not include a minimum milkfat requirement for yogurt or any of the other products covered under the standard.[9]

We also note that FDA's 2009 proposal not to apply the nutritional equivalency requirements under §130.10 to low and nonfat yogurts with regard to vitamin A restoration levels in yogurt made with whole milk appears to acknowledge that yogurt generally is not considered a nutritional replacement for whole milk. This demonstrates that there is no need to link the minimum milkfat contents of these products and further supports the removal of a minimum milkfat requirement as an outdated requirement. Unlike with milk and cream, the presence of milkfat is not an essential, *distinguishing* characteristic of yogurt compared to other fermented dairy products or milk products generally.

<u>Eliminating the Minimum Milkfat Requirement Aligns with the Nutrition Labeling and Education Act and Promotes Public Health</u>

Eliminating the 3.25% minimum milkfat requirement and replacing it with a minimum 3 g total fat per RACC requirement for yogurt will promote honesty and fair dealing in the interest of consumers. It will maintain current yogurt options for consumers, accommodate the development of lower fat options, and allow for innovative products that deliver taste and flavoring components from ingredients such as coconut, nuts, and cacao.

There are two concerns with respect to the minimum milkfat requirement and how it restricts healthier, innovative products for consumers. First, the minimum milkfat requirement results in products that are in "no-man's-land" when their fat content is greater than 3 g per RACC but less than 5.25 g per RACC. The following table demonstrates how a 3.25% minimum milkfat requirement results in a category of products that due to their fat content are not standardized yogurt and thus cannot use the name "yogurt."

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9 Codex Standard for Fermented Milks – Codex Standard 243-2003. Codex Alimentarius Commission, FAO, Rome, IT.

NAME	TOTAL FAT content of finished food per 6 oz/170 g RACC
Fat Free Yogurt	<0.5 g
Low Fat Yogurt	≥ 0.5 g to ≤ 3 g
Reduced Fat Yogurt	>3 g to <4.14375 g
NOT POSSIBLE	≥ 4.14375 g to <5.525 g
Yogurt	≥ 5.525g

Second, the minimum milkfat requirement prohibits manufacturers from offering low fat yogurt products with bulky flavorings containing fat. As previously mentioned, the vast majority of yogurts currently on the market are either lowfat or nonfat yogurt. IDFA is aware of several yogurt manufacturers who have developed products that, before the addition of bulky flavors, the yogurt would meet the nutrient content claims of "low fat" or "no fat," but when bulky flavoring ingredients are added to the yogurt that contain fat other than milkfat, such as chocolate, nuts, coconut, etc., the finished food is above the threshold of 3 grams or less of fat per RACC and cannot qualify for a "low fat" claim. These products also cannot be positioned as "yogurt" because they do not satisfy the minimum 3.25% milkfat requirement before the addition of bulky flavors.

In both cases, consumers are denied access to healthier, lower fat products due to the minimum milkfat requirement. Indeed, a minimum milkfat requirement of 3.25% is inconsistent with the 2020-2025 *Dietary Guidelines for Americans* recommendations to reduce the consumption of saturated fat and ensure that no more than 10% of daily calories come from saturated fat. IDFA's proposed resolution of establishing a minimum total fat content of >3.0 g per 6 oz/170 g would results in lower fat levels in yogurt and be more aligned with Federal nutrition guidelines.

Regarding FDAs concern that other non-dairy fats and oils may be added, which would detract from the basic nature and essential character of yogurt, we disagree with this assertion. Non-dairy fats and oils are not part of the allowed optional ingredients. If a fat source is not part of a flavoring ingredient (e.g., coconut flakes, cacao, etc.), it may not be added.

Labeling Ensures Transparency Regarding Milkfat

Even without a minimum milkfat requirement, the ingredient statement for the product will list dairy ingredients in accordance with their individual standards of identity, including milk, cream, and skim milk. Therefore, the consumer can rely on these declarations, along with the Nutrition Facts Panel, if they are interested in knowing what went into the finished product and its macronutrient composition. In addition, yogurts that are fat free, low fat, or reduced fat, will be labeled accordingly.

Moreover, IDFA would be willing to support a requirement that the percent milkfat in the product be declared on the label. This would allow consumers to understand the amount of total fat derived from milk when flavoring ingredients may also be contributing to total fat content. Currently, yogurt manufacturers can and do voluntarily make such statements, e.g., "5% milkfat," which allows consumers to select higher milkfat products when so desired (e.g., for mouthfeel and/or taste characteristics provided).

Proposed Permanent Resolution:
FDA should eliminate the 3.25% milkfat minimum requirement for the yogurt white mass, prior to the addition of bulky flavoring ingredients, while retaining the 8.25% minimum milk solids not fat

requirement. Instead of a percent milkfat requirement, FDA should establish in the standard a minimum total fat content of >3.0 g per 6 oz/170 g RACC.

Request for a Hearing:
IDFA requests a hearing on the factual issues of whether (1) a 3.25% milkfat minimum is critical to the basic nature and characteristics of yogurt and (2) whether fat/oils from nondairy ingredients, particularly flavoring ingredients, could contribute to variances in the taste, texture, color or aroma of yogurt and is inconsistent with the basic nature and essential characteristics of the food. If this request is granted, IDFA would present evidence demonstrating that milkfat is not critical to the basic nature and characteristics of yogurt, in large part because the yogurt cultures do not act on the milkfat during the culturing process. We also would present evidence on the other factors that we believe are most critical to the basic characteristics of yogurt. This information would include testimony by experts in yogurt production and presentation of scientific publications by subject matter experts demonstrating the results of sensory and analytical chemistry research conducted that has identified the specific compounds that contribute most to the *unique* flavors and aromas of yogurt and how they are derived predominantly through lactose fermentation. [10] In addition, we would present evidence demonstrating consumer acceptance and preference for lower fat yogurt products and why a yogurt standard aligned with nutrient content claim regulations and a minimum of >3 g of total fat per RACC promotes honesty and fair dealing in the interest of consumers. We would present evidence demonstrating that total fat is of greater significance to consumers when choosing yogurt products. We also would demonstrate that removal of the 3.25% minimum milkfat requirement and replacement with a total fat content will enable the development of greater options for consumers, including products with varying and lower fat content, as well as products with flavors from ingredients that inherently contain fat, such as nuts, coconut, and cacao. In addition, we will present evidence demonstrating how the ingredient statement and a potential statement on the label regarding percent milkfat will ensure transparency regarding milkfat content. Finally, we will present evidence, such as product examples and sales volumes, demonstrating that fat from nondairy flavoring ingredients is consistent with the basic nature and essential characteristics of many flavored yogurts on the market today and accepted by consumers.

OBJECTION 5

Provision:

(d) *Other optional ingredients*. (2) Nutritive carbohydrate sweeteners

Objection and Proposed Stay:

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[10] Including the evidence presented and summarized in the following authoritative publications:
- Routray, W. & Mishra, H.N. "Scientific and Technical Aspects of Yogurt Aroma and Taste: A Review," *Comprehensive Reviews in Food Science and Food Safety*, 10(4): 208-220, 2011. (*See Appendix 4*)
- Chandan, R.C., & Kilara, A. (Editors). *Manufacturing Yogurt and Fermented Milks, Second Edition*. John Wiley and Sons. 2013. https://doi.org/10.1002/9781118481301 (*See Appendix 5*)
- A.Y. Tamime, R.K. Robinson, Chapter 7 - Biochemistry of fermentation, Editors: A.Y. Tamime, R.K. Robinson, In Woodhead Publishing Series in Food Science, Technology and Nutrition, Tamime and Robinson's Yoghurt (Third Edition), Woodhead Publishing, 2007. (*See Appendix 6*)

IDFA objects to the exclusion of safe and suitable "non-nutritive sweeteners" from paragraph (d)(2) as an *Other optional ingredient* and the limitation of their use to only those instances where the product bears an expressed nutrient content claim as part of the product name, such as "reduced calorie yogurt" or "reduced sugar yogurt", under § 130.10.

We ask that FDA stay this provision insofar as it would restrict the ability to use non-nutritive sweeteners in a yogurt unless the product is labeled with a nutrient content claim such as reduced calorie or reduced sugar under 21 CFR § 130.10.

Grounds for Objection:
IDFA asserts that the final standard of identity should have permitted any safe and suitable sweetener, including non-nutritive sweeteners, as allowed under the 2009 proposed rule, without a requirement to modify the name of the food. The use of non-nutritive sweeteners is consistent with the basic nature of a sweetened yogurt, as shaped by consumer expectations over the past ten years that this practice has been allowed, without a corresponding requirement to use a nutrient content claim in the name of the food. The new limitations on the use of non-nutritive sweeteners are also unreasonable because they are not aligned with FDA's goals through its standards modernization initiative and Nutrition Innovation Strategy, nor with the public health goal of reducing added sugars intake consistent with the *2020-2025 Dietary Guidelines for Americans*. The use of non-nutritive sweeteners is beneficial to consumers because it allows for reductions in added sugars, regardless of whether those levels rise to the amount needed to qualify for a claim such as "reduced sugar."

More specifically, there are two bases for our objection: 1) FDA has not provided a factual basis demonstrating that nutritive carbohydrate sweeteners, to the exclusion of non-nutritive sweeteners, are part of the basic nature and essential characteristics of sweetened yogurt, and that a yogurt sweetened with non-nutritive sweeteners is a "different" food that must be named accordingly, and 2) the restrictions on non-nutritive sweeteners are inconsistent with other existing FDA regulations and policies.

<u>Nutritive Carbohydrate Sweeteners are Not Characteristic of Sweetened Yogurts, to the Exclusion of Non-Nutritive Sweeteners</u>

By declining to allow safe and suitable non-nutritive sweeteners in "yogurt," and instead allowing only nutritive carbohydrate sweeteners, unless a food is named in a way that differentiates it from "yogurt", FDA is concluding that nutritive carbohydrate sweeteners are a basic and characterizing ingredient of sweetened yogurt. Indeed, FDA states in the final rule, "products containing nonnutritive sweeteners… are not the standardized food 'yogurt' and are different standardized foods (e.g., 'reduced calorie yogurt')".[11]

This is simply not the case and is not supported by any information FDA has provided. In fact, for more than a decade, FDA has issued enforcement discretion to allow yogurts containing non-nutritive sweeteners as an optional ingredient, without a requirement that the food be named using a nutrient content claim as part of the statement of identity such as "reduced calorie yogurt".[12] These products are

[11] 86 Fed. Reg. at 31128.

[12] The 2009 proposed rule allowed safe and suitable sweeteners as an optional ingredient, without a requirement to name the product under § 130.10, and FDA exercised enforcement discretion for products

commonly found on the marketplace today, and have been for years. (*See Appendix 7* for several current examples.) We are aware of no information suggesting that consumers have been confused or misled by this practice.

Further, in the 2009 proposed rule, FDA tentatively concluded that yogurts could be sweetened with non-nutritive sweeteners – without any requirement that the product be labeled under 130.10. FDA stated that this allowance "introduces flexibility in the manufacture of yogurt *without adversely affecting the basic nature and essential characteristics of yogurt*."[13] We are not aware of any information on the record that would justify a change in this conclusion. To the contrary, we believe the use of non-nutritive sweeteners continues to be consistent with consumer expectations for "yogurt", as shaped by more than a decade of common practice since FDA originally reached the conclusion above in 2009.

<u>Inconsistency with FDA's Requirements for Other Foods and Stated Policy Goals</u>

The new limitations on non-nutritive sweeteners in yogurt are inconsistent with FDA's requirements for other products, including other standardized dairy products, as well as with the agency's public health goals. As an initial matter, there is no broad requirement or policy that would require all food products made with a non-nutritive sweetener to be named using an appropriate nutrient content claim.[14] There are numerous food items, including other standardized dairy products, that may contain non-nutritive sweeteners without being required to be named using a nutrient content claim. For example, the ice cream standard permits "safe and suitable" sweeteners, without a requirement to name the ice cream under § 130.10.[15] We are not aware of any relevant differences between yogurt and ice cream that would mean that only a "reduced calorie" or "reduced sugar" yogurt may contain non-nutritive sweeteners, whereas an ice cream containing such a sweetener can simply be labeled as "ice cream." If anything, ice cream is a food for which sweetness is *more* important to the basic nature of the food compared to yogurt. After all, there are numerous plain/unsweetened yogurts available on the market – comprising roughly 15% of yogurt sales[16] – but unsweetened ice cream does not exist. And yet, ice cream may contain non-nutritive sweeteners without being labeled as a "different standardized food."

In the new final yogurt standard, FDA explained that allowing non-nutritive sweeteners in yogurt without a nutrient content claim as part of the product name would be inconsistent with FDA's regulatory framework under § 130.10. FDA stated:

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complying with the 2009 proposed rule. Proposed § 131.200(d)(2) allowing any safe and suitable "sweeteners"; *see also* 74 Fed. Reg. at 2455 ("Pending issuance of a final rule amending the existing standard of identity for yogurt and revoking the existing lowfat and nonfat yogurt standards of identity, FDA intends to consider the exercise of its enforcement discretion on a case-by-case basis when yogurt products are in compliance with the standard of identity proposed in this proposed rule and when the labeling of such products is not otherwise false or misleading").

13 74 Fed. Reg. at 2452 (emphasis added).

14 For example, such a requirement is not found in the rules for nutrient content claims related to sugar content (21 CFR 101.60) when the product contains a non-nutritive sweetener; nor is it found in the food additive regulations for non-nutritive sweeteners such as aspartame (21 CFR 172.804), acesulfame potassium (21 CFR 172.800), neotame (21 CFR 172.829) or sucralose (21 CFR 172.831).

15 21 CFR 135.110(a)(1).

16 Plain yogurt comprises 15.4% of all Refrigerated Yogurt dollar volume according to Nielson connect, standard "plain" characteristic. (Last 52 weeks ending 5/22/21).

> If we were to amend § 131.200(d)(2) to refer to ‘‘sweeteners,’’ then both nutritive carbohydrate sweeteners and nonnutritive sweeteners would be optional ingredients under the yogurt standard. Consequently, manufacturers could use nonnutritive sweeteners in yogurt to reduce calories without making a nutrient content claim. This is not what we had intended under the regulatory framework of § 130.10 after NLEA was enacted. [17]

We disagree with FDA's assertion that the use of nonnutritive sweeteners in standardized products without the use of nutrient content claims is inconsistent with § 130.10. In fact, the same day that FDA published its regulatory framework under 21 CFR 130.10, FDA also published a proposed rule updating the ice cream standard. This proposed, later finalized, standard of identity for ice cream permitted any safe and suitable sweeteners *without* a requirement to modify the name of the food using a nutrient content claim.[18] Declaration of non-nutritive sweeteners on the Principal Display Panel was required when the ice cream standard was initially updated, but FDA phased out this requirement after three years, finding it would no longer be of value to consumers.[19] FDA explained that "labeling to distinguish ice cream products sweetened with alternative sweeteners from those sweetened with nutritive carbohydrate sweeteners will not be necessary after consumers have become aware of the fact that some ice cream products are made with nutritive carbohydrate sweeteners, and other with alternative sweeteners, and have had a period of time to become familiar with such foods."[20] FDA found that "3 years is an adequate amount of time for people to become aware that 'ice cream' may be made with either nutritive carbohydrate sweeteners or alternative sweeteners, and thus that it is necessary to check the ingredient list."[21]

Here, consumers have had 10 years to become aware that yogurt is commonly made with non-nutritive sweeteners. Although the use of non-nutritive sweeteners has not been required to be identified on the PDP, in the past decade there has been a proliferation of many light and other innovative yogurts made with non-nutritive sweeteners. Further, consumer understanding and use of food labels has changed dramatically since the 1990s, when FDA believed that ice cream should identify the use of a non-nutritive sweetener for some period until consumers became aware of the practice. This was more than 25 years ago, and today's consumer is significantly more familiar with non-nutritive sweeteners. After all, non-nutritive sweeteners were relatively new in the 1990s, but have now been around for decades. Many manufacturers make labeling and advertising claims about the specific non-nutritive sweeteners used in food products. And consumers often have preferences for specific non-nutritive sweeteners. Further, today's consumers are much more familiar with reading ingredient lists. At the time the ice cream rule was issued, standardized foods had not historically been required to bear ingredient labeling, so consumers would not have known to check there.

Requiring a nutrient content claim such as "reduced sugar" or "reduced calorie" also does not inform consumers that a non-nutritive sweetener is used. There are numerous ways to reduce sugar or calories in a yogurt, including reducing fat or lactose levels, decreasing sugar and fruit addition without adding additional sweeteners, and others. Regardless of whether a nutrient content claim is required, or is not required, consumers will rely on the ingredient statement to identify non-nutritive sweeteners. The

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17 86 Fed. Reg at 31127.
18 58 Fed. Reg. 520, 527 (Jan. 6, 1993).
19 21 CFR 135.110(f)(7)(1994); 59 Fed. Reg. 47072, 47079 (Sept. 14, 1994).
20 59 Fed. Reg. at 47074.
21 *Id.*

nutrient content claim requirement therefore does not promote honesty and fair dealing in the interest of consumers.

Nor are the new restrictions on the use of non-nutritive sweeteners in yogurt in the public health interests of consumers. The restrictions are inconsistent with FDA's stated public policy goals under the Nutrition Innovation Strategy, including FDA's food standards modernization initiative, and other public health goals related to added sugars. FDA stated in the preamble to the final yogurt standard that requiring yogurts with non-nutritive sweeteners to be named under § 130.10, but not requiring a statement declaring the presence of non-nutritive sweeteners in the name of the food, would "address comments concerning the presence and disclosure of artificial sweeteners while also providing manufacturers flexibility to make modified yogurt products with nonnutritive sweeteners."[22] We respectfully disagree.

The ability to use non-nutritive sweeteners in a yogurt only if the food is named under §130.10 does not provide sufficient flexibility to yogurt manufacturers. It restricts the use of nonnutritive sweeteners to only those yogurts that qualify for a nutrient content claim for calories or sugar, essentially those products that contain at least 25% fewer calories or 25% less sugar than an appropriate reference food.[23] Other claims such as "no added sugar" would require even lower levels of added sugars than a "reduced sugar" claim. Products that use a blend of sweeteners that results in a 10 or 15% reduction in sugars or calories cannot bear the claim "reduced sugar" or "reduced calorie" and therefore would need to either (1) be named using a non-standardized term other than "yogurt" or alternatively, (2) be sweetened only with nutritive carbohydrate sweeteners.

The new requirement that a yogurt with non-nutritive sweeteners must comply with § 130.10 would unnecessarily restrict innovation and would fail to promote healthful foods. We believe this result is inconsistent with the FDA's Nutrition Innovation Strategy, which, as relevant here, aims to:

- "reduce the burden of chronic disease [including obesity] through improved nutrition";
- Modernize the food standards of identity by "maintain[ing] the basic nature and nutritional integrity of products while allowing industry flexibility for innovation to produce more healthful foods"; and
- Modernize the requirements for food labeling claims in a way that "encourage[s] the food industry to reformulate products to improve their healthy qualities".[24]

If FDA were to allow the use of non-nutritive sweeteners in yogurt without requiring compliance with § 130.10, this would encourage development of more lower sugar yogurts, even if they do not ultimately meet the 25% less sugar/calories threshold needed to make a nutrient content claim. Reduction of added sugars in yogurts would help to further FDA's goals related to improved nutrition, development of more healthful foods, and lessening the burden of obesity.

Further, the *Dietary Guidelines for Americans 2020-2025* encourage consumers to limit their added sugars intake. A requirement that would restrict the ability of yogurt manufacturers to innovate with lower sugar products that may not meet the 25% less threshold for a reduced calorie/sugar claim, would run contrary to this public health goal of reducing added sugars in foods and diets. For these reasons, the restrictions on the use of non-nutritive sweeteners in yogurt are inconsistent with existing FDA

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22 86 Fed. Reg. at 31128.

23 21 CFR 101.60(b)(4) and (c)(5).

24 See https://www.fda.gov/food/food-labeling-nutrition/fda-nutrition-innovation-strategy.

requirements and policies. We urge FDA to stay the current restrictions on non-nutritive sweeteners, and adopt the provisions in the 2009 proposed rule that allowed the use of any safe and suitable sweetener in yogurt without a corresponding labeling requirement.

Proposed Permanent Resolution:
IDFA proposes that FDA should strike "Nutritive carbohydrate sweeteners" from (d)(2) and replace it with "Sweeteners," consistent with the 2009 proposed rule.[25]

Request for Hearing:
If FDA declines to modify the final rule as recommended, IDFA requests a hearing on the issue of whether the use of safe and suitable non-nutritive sweeteners is consistent with the basic nature or essential characteristics of sweetened "yogurt" or whether this is a "different food" that needs to be named accordingly under § 130.10 (e.g., "reduced calorie yogurt"). Stated differently, the question for resolution at a hearing is whether the use of nutritive carbohydrate sweeteners, to the exclusion of non-nutritive carbohydrate sweeteners, are part of the basic nature or essential characteristics of sweetened yogurt. Products sweetened with non-nutritive sweeteners have been marketed for more than a decade under FDA enforcement discretion and we are aware of no information on the record supporting that without a term such as "reduced calorie" or "reduced sugar" in the name of the yogurt, such products are misleading to consumers or otherwise inconsistent with the basic nature of yogurt.

If a hearing is granted, IDFA would present evidence of the yogurts currently on the marketplace, many of them having been available for years, that contain non-nutritive sweeteners without using a nutrient content claim such as reduced calorie or reduced sugar in the statement of identity. We would present evidence on consumer familiarity with non-nutritive sweeteners, ingredient lists, and other relevant information. IDFA would also present evidence related to the safety of non-nutritive sweeteners, how the use of non-nutritive sweeteners allows for reductions in total and added sugars. Finally, we would provide information and examples on how claims such as reduced calorie/reduced sugar do not necessarily indicate the use of a non-nutritive sweetener. This information, collectively, would help show that non-nutritive sweeteners are consistent with consumer expectations for a sweetened yogurt without a need to use a nutrient content claim such as reduced calorie/reduced sugar in the name of the food.

SUBJECT MATTER EXPERTS TO TESTIFY AT HEARING, IF ONE IS GRANTED

As noted under each Objection above, IDFA will provide experts to provide testimony and present information further supporting our grounds for objection in each case. A list of experts is provided in *Appendix 8* attached.

CONCLUSION

Overall, IDFA's position and NYA's citizen petition[26] aimed at having a standard that reflects what consumers are eating – fundamentally, a dairy product fermented with ST and LB, with a minimum titratable acidity of 0.6 or pH of 4.6 within 24 hours after filling, independent of milkfat content, to cover

[25] 74 Fed. Reg. at 2443 (Jan. 15, 2009).
[26] Docket No. FDA-2000-P-0126, formerly Docket No. 2000P-0685

all types of yogurts, including vat-set and cup-set yogurts. The wide range of consumer preferences for yogurts of different flavors, protein levels, sugar/sweetener content and milkfat content is clearly apparent by simply looking at the variety on grocery store shelves today. FDA's action to favorably resolve IDFA's objections above is critical to ensuring manufacturers can continue to produce the many varieties of products currently on the market as well as pursue innovations that address the constantly changing consumer expectations and needs, within reasonable limits to maintain the true basic and essential characteristics of "yogurt" that distinguish it from other dairy products.

We thank FDA for its work to modernize the yogurt standard of identity and consideration of these objections and requests for hearing. We look forward to working with the agency on potential revisions to the final rule, and to address some of the key factual issues underlying the yogurt standard.

Respectfully submitted,

Michael Dykes, DVM
President and Chief Executive Officer
International Dairy Foods Association

Attachments

Appendix 1

Swanson, K. & Buchanan, Robert & Cole, Martin & Cordier, J.-L & Flowers, R. & Gorris, Leon & Taniwaki, Marta & Tompkin, R. & Zwietering, Marcel. (2011). Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance. Springer.

Such products are usually home-made or are limited to local or regional distribution. Control over such pathogens may be enhanced through the stringent requirements described in Sect. 23.2; however, absolute control using such techniques may not be possible.

Most fermented milk is manufactured using milk heated to temperatures of up to 90°C for several minutes. Spore formers such as *B. cereus* or *C. perfringens* may survive this process; however, germination and outgrowth is controlled through fermentative acidification that produces a rapid pH drop below levels that permit growth of these microorganisms. Fermentation, and resulting acid production, is considered as a control measure for all fermented milk. It is therefore essential to avoid inhibition of fermentation caused by the presence of inhibitory substances such as antibiotics or phages, which may significantly delay the drop of pH below an established limit. Screening of milk using rapid tests is routinely used to detect and reject raw milk containing antibiotics before it enters the process.

Recontamination of the fermented milk with pathogens through the addition of ingredients such as pasteurized fruit concentrates or pulps, heat treated pastes or syrups, nuts, chocolate, or natural or artificial flavors is usually a minor problem due to the nature of these ingredients and the fact that they are added to the already acidified base.

23.8.1.2 Spoilage and Controls

Due to the low pH of the fermented milks, microbiological spoilage is restricted to acid tolerant microorganisms, mainly yeasts and molds (Ledenbach and Marshall 2009). Products manufactured with raw milk have a shorter shelf life because spoilage microorganisms may be present in the milk used. Control measures to avoid or minimize spoilage issues are based on the application of GHP, with a focus on hygienic design of manufacturing lines, hygienic measures applied during handling of packaging material, the appropriate protection of exposed product, in particular during the filling operation, etc.

Refrigeration may extend the storage period but cannot completely inhibit cold tolerant yeasts and molds. Control focuses on GHP procedures to avoid introduction of these spoilage microorganisms from the environment into products, particularly those made from heat treated milk, and on use of high quality ingredients. Ingredients such as fruit pulps or concentrates are prone to harbor yeasts or molds, and this is best controlled through supplier acceptance programs and the application of GHP during handling of the fruit containers. For more details on fruit pulps or concentrates, refer to Chap. 13.

23.8.2 *Microbial Data*

Table 23.6 summarizes useful testing for fermented milk. Refer to the text for important details related to specific recommendations.

23.8.2.1 Critical Ingredients

Raw milk can be considered the most critical ingredient and the initial microbiota depends on the hygiene practices from production to use by the manufacturer of fermented milk. Details on controls for raw milk are described in Sect. 23.2.

Fruit concentrates or pulps may introduce yeasts and molds if not properly managed. See Chap. 13, for additional information.

From:	Walker, Stephen
To:	John Allan
Subject:	RE: Cup-set yogurt questions re: 2019 NCIMS proposal 111
Date:	Wednesday, March 10, 2021 6:02:04 PM
Attachments:	image001.png

John,

Sorry for the long delay in getting back to you on this, this issue has not been a high priority.

We've discussed this and at this time we do not intend to pursue a proposal to change the current requirements. The ambiguity on culturing time has been there a long time and we don't have any data to suggest anyone is taking advantage of the ambiguity to manufacture adulterated products.

I'm not aware of anyone else considering it, but if some other party were to propose changes we would decide whether to support it based on the data that was presented. But again, that seems highly unlikely to happen.

Hope you and your family are healthy and happy in these strange times.

Regards,

Steve

Stephen P. Walker, Ph.D., P.E.
Consumer Safety Officer – Agricultural Engineer

Center for Food Safety and Applied Nutrition
Office of Food Safety, Division of Dairy, Egg, and Meat Products
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FDA U.S. FOOD & DRUG ADMINISTRATION

From: Walker, Stephen
Sent: Wednesday, October 14, 2020 9:30 AM
To: John Allan <JAllan@idfa.org>
Cc: Metz, Monica <Monica.Metz@fda.hhs.gov>; Sims, Steven T <Steven.Sims@fda.hhs.gov>
Subject: RE: Cup-set yogurt questions re: 2019 NCIMS proposal 111

John,

Thanks for this data, I really appreciate it. It seems like there probably is a way to select a reasonable time limit for culturing, although I need to go back and review Kathy Glass' data on safety to see if there are any clues as to whether the limit should be 12, 24, or ???.

I will discuss further with my FDA colleagues as to if and how we want to move forward in closing this loophole in the PMO.

Regards,

-Steve

Stephen P. Walker, Ph.D., P.E.
Agricultural Engineer

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From: John Allan <JAllan@idfa.org>
Sent: Monday, September 14, 2020 6:04 PM
To: Walker, Stephen <Stephen.Walker@fda.hhs.gov>
Cc: Metz, Monica <Monica.Metz@fda.hhs.gov>; Sims, Steven T <Steven.Sims@fda.hhs.gov>
Subject: RE: Cup-set yogurt questions re: 2019 NCIMS proposal 111

Steve,
Below are the numbers we have gathered from several companies currently making cup-set yogurts of varying sizes. Container size is a key factor in establishing the parameters as it impacts cooling rate, especially packed on pallets and placed in refrigerated warehouses. We are including the extremes reported from each company, which may be across different size containers, but as time to develop pH is most critical, you can see 10 hrs. is the maximum. Please let me know if you would like to set up a call with me and perhaps some of our members to discuss and answer any questions.

Regards,
John

JOHN ALLAN, M.S.
Vice President, Regulatory Affairs and International Standards
International Dairy Foods Association

	Company A	Company B	Company C

Filling Temp (C/F); lowest reported	43.3/110	36.7/98	40.5/105
Filling pH	6.7	6.7	6.6
Holding Temp (C/F); highest reported	44.4/112	38.3/101	46.1/115
Time to reach pH 4.8 (hrs); max reported	10	8	8
Temp when pH 4.8 is reached	43.3/110	36.7/98	35/95
Time to cool to 7 C (hrs); longest reported	96	3.5	24

From: Walker, Stephen <Stephen.Walker@fda.hhs.gov>
Sent: Thursday, May 14, 2020 5:05 PM
To: John Allan <JAllan@idfa.org>; Sims, Steven T <Steven.Sims@fda.hhs.gov>
Cc: Metz, Monica <Monica.Metz@fda.hhs.gov>
Subject: RE: Cup-set yogurt questions re: 2019 NCIMS proposal 111

Hi John,

As I remember it, the issue that I raised at NCIMS was that currently there is no limit to the amount of time that yogurt (cup set or vat set) can be in the culturing process. I am not aware of any immediate public health concern but the data from Kathy Glass (and common sense) indicates that lowering the pH relatively quickly is good for food safety. What I need help with, should we decide to address this issue at a future NCIMS, is to define what "relatively quickly" is. I'm not aware of any data that directly addresses this issue, so I think a good place to start would be to try to define what outside limits of current industry practice are and use that as a starting point.

I don't see this as a high-priority public heath issue, but it seems like a loophole that we should close.

-Steve

Stephen P. Walker, Ph.D., P.E.
Consumer Safety Officer – Agricultural Engineer

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U.S. FOOD & DRUG ADMINISTRATION

From: John Allan <JAllan@idfa.org>
Sent: Friday, May 8, 2020 8:57 AM
To: Walker, Stephen <Stephen.Walker@fda.hhs.gov>; Sims, Steven T <Steven.Sims@fda.hhs.gov>
Cc: Metz, Monica <Monica.Metz@fda.hhs.gov>
Subject: Cup-set yogurt questions re: 2019 NCIMS proposal 111

Good morning,
In response to questions you raised last year at NCIMS with regard to proposal #111 on cup-set yogurt production parameters, I have been working with industry to pull together information around holding temperatures after culturing, cooling times to reach 45F after the break pH is reached and other details. I wanted to circle back with you to ask for any specific questions you may have to be sure we can provide you with the correct information about common industry practices.

I would be happy to arrange a brief call to discuss, if you would like.

Thanks,
John

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IDFA
INTERNATIONAL
DAIRY FOODS
ASSOCIATION℠

October 8, 2018

Division of Dockets Management (HFA-305)
Food and Drug Administration
5630 Fishers Lane, rm. 1061
Rockville, MD 20852

Re: Docket No. FDA-2000-P-0126; Milk and Cream Products and Yogurt Products; Petition to Revoke Standards for Lowfat Yogurts and Nonfat Yogurt and to Amend the Standards for Yogurt and Cultured Milk; Proposed Rule

Docket No. FDA-2018-N-2381; Multi-Year Nutrition Innovation Strategy; Public Meeting; Request for Comments

Dear Sir or Madam:

As noted in its request for comments on the agency's Multi-Year Nutrition Innovation Strategy, the Food and Drug Administration (FDA) has expressed interest in modernizing the standards of identity to provide more flexibility for the development of healthier products, while making sure consumers have accurate information about these food products. Therefore, the International Dairy Foods Association (IDFA) is writing to urge FDA to prioritize finalizing its 2009 proposed rule modernizing the existing Federal standards of identity for yogurt by including this in its Unified Agenda.

IDFA, located in Washington, D.C., represents the nation's dairy manufacturing and marketing industry, which supports nearly 3 million jobs, generates more than $39 billion in direct wages and has an overall economic impact of more than $200 billion. IDFA is the umbrella organization for the Milk Industry Foundation (MIF), the National Cheese Institute (NCI) and the International Ice Cream Association (IICA). Our members range from large multinational organizations to single-plant companies. Together they represent more than 85 percent of the milk, cultured products, cheese, ice cream and frozen desserts produced and marketed in the United States and sold throughout the world. Our diverse membership includes numerous food retailers, suppliers and companies that offer infant formula and a wide variety of milk-derived ingredients. IDFA can be found at www.idfa.org.

Existing standards for nonfat yogurt, lowfat yogurt, and yogurt are outdated and need modernization to reflect and accommodate new processing methods and technologies for food ingredients, as well as current consumer preferences and marketing trends toward healthier products. This critical need supports the government's longstanding goal in making food standards easier to establish, use, and reflect current trends. Modernization of the U.S. food standards has indeed been a goal for FDA and the U.S. Department of Agriculture for twenty years. In 1995, the two agencies began a process of reviewing the existing food standards to determine if there was a need to modernize, or even eliminate some or all standards, with the publishing of an advanced notice of proposed rulemaking [60 FR 67492, December 29, 1995 (FDA) [1], and 61 FR 47453, September 9, 1996 (USDA)]. Then, in 2005, the agencies published the proposed rule "Food Standards; General Principles and Food Standards Modernization" (Docket No. 1995N–0294)[2], which defined principles that would "better promote honesty and fair dealing in the interest of consumers and protect the public, allow for technological advances in food production, be consistent with international food standards to the extent feasible, and be *clear, simple, and easy to use* [emphasis

1/ http://www.gpo.gov/fdsys/pkg/FR-1995-12-29/pdf/95-31492.pdf
2/ http://www.gpo.gov/fdsys/pkg/FR-2005-05-20/pdf/05-9958.pdf

added] for both manufacturers and the agencies that enforce compliance with the standards." This is critical work that needs to be accomplished by the agencies and we continue to support its completion.

Since FDA published the 2009 proposed rule revoking the existing yogurt standards of identity and replacing them with a single, modernized standard, IDFA has provided the agency written comments on several occasions, the latest being this past May. These past comments can all be found attached below. As the industry has continued to grow and the marketplace has evolved, so too have IDFA's positions. As FDA looks to move forward in issuing a final rule, IDFA wanted to take this opportunity to briefly summarize our current positions, as follows:

- FDA should eliminate the 3.25% milkfat minimum requirement for the yogurt white mass, prior to the addition of bulky flavoring ingredients, while retaining the 8.25% minimum milk solids requirement, and only require that nutrient content claims related to total fat content be based on a comparative "yogurt" containing *greater than 3 g* of total fat per RACC in the finished product. Removing the milkfat requirement will allow for the introduction of new, reduced fat yogurt options into the market that would not be permitted under the current and proposed standards. We continue to believe there is no justification for including a minimum milkfat requirement for yogurt and that FDA can incorporate this change into the final rule without the need to delay finalization. This is a practical, sensible approach that will provide clarity for consumers and a greater variety of lower fat yogurt options.
- Permit reconstituted forms of cream, milk, partially skimmed milk, and skim milk as basic ingredients and rename the heading "basic dairy ingredients" instead of "optional dairy ingredients."
- Expand the list of basic dairy ingredients to include ultra-filtered (UF) milk (and resulting dried products, e.g., milk protein concentrate and isolate) and skim milk powder (SMP) (*i.e.,* protein-standardized nonfat dry milk).
- Require that yogurts have a minimum titratable acidity of not less than 0.6 percent expressed as lactic acid, measured in the white mass of the yogurt or a maximum pH of 4.6 or lower within 24 hour after filling, measured on the finished product.
- The use of any safe and suitable sweeteners should be allowed in yogurt. We also agree that there should be no requirement to declare non-nutritive sweeteners as part of the name of the food.
- Milk-derived ingredients should be permitted to be added after culturing if the dairy ingredients are pasteurized, in light of the stringent requirements of the Pasteurized Milk Ordinance and the Current Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventive Controls for Human Food final rule, which help further ensure these ingredients are safe.
- Vitamin addition:
  Since the publication of the proposed rule, FDA enacted revisions of the nutrition facts label that included updating Daily Values (DV) and Reference Daily Intakes (RDI) for nutrients based on current dietary recommendations. This included changes to the DV for vitamin A, from 5,000 IU (1500 mcg RAE) to 900 mcg RAE, and vitamin D, from 400 IU (10 mcg) to 20 mcg per day. Also, the FDA enacted a change for serving sizes of foods that can reasonably be consumed at one eating occasion that changed the serving size of yogurt from 225 grams to 170 grams. Based on these modifications to nutrition labeling, IDFA recommends that vitamin addition for yogurt be as follows:
    1. If added, vitamin A shall be present in such quantity that the food contains not less than 10% Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practice.
    2. If added, vitamin D shall be present in such quantity that the food contains not less than 10% Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practices.

To conclude, IDFA asks FDA to work expeditiously to modernize the yogurt standard of identity by finalizing the 2009 proposed rule taking into account the above recommendations and any additional comments that may be provided by our members individually. IDFA looks forward to continuing to work collaboratively with the agency to promote clarity for industry, consumers and government buyers, and ensure that the standard of identity does not unduly limit innovation or conflict with consumer preferences and expectations for yogurt. Please do not hesitate to contact us if you have any questions.

Respectfully submitted,

John T. Allan, III., MS
Vice President of Regulatory Affairs & International Standards

Cc: Douglas Balentine, CFSAN/ONFL
Felicia Billingslea, CFSAN/ONFL
John Sheehan, CFSAN/OFS
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INTERNATIONAL DAIRY FOODS ASSOCIATION SM

May 9, 2018

Division of Dockets Management (HFA-305)
Food and Drug Administration
5630 Fishers Lane, rm. 1061
Rockville, MD 20852

Re: Docket No. FDA-2000-P-0126; Milk and Cream Products and Yogurt Products; Petition to Revoke Standards for Lowfat Yogurts and Nonfat Yogurt and to Amend the Standards for Yogurt and Cultured Milk; Proposed Rule

Dear Sir or Madam:

The International Dairy Foods Association (IDFA), Washington, D.C., represents the nation's dairy manufacturing and marketing industry, which supports nearly 3 million jobs, generates more than $39 billion in direct wages and has an overall economic impact of more than $200 billion. IDFA is the umbrella organization for the Milk Industry Foundation (MIF), the National Cheese Institute (NCI) and the International Ice Cream Association (IICA).

Our members range from large multinational organizations to single-plant companies. Together they represent more than 85 percent of the milk, cultured products, cheese, ice cream and frozen desserts produced and marketed in the United States and sold throughout the world. Our diverse membership includes numerous food retailers, suppliers and companies that offer infant formula and a wide variety of milk-derived ingredients. IDFA can be found at www.idfa.org.

IDFA is writing to renew its support for the elimination of the 3.25% minimum milkfat requirement for yogurt, prior to the addition of bulky flavoring ingredients, and creation of a requirement that "yogurt" contain a minimum of 3 grams (g) of total fat per Reference Amount Customarily Consumed (RACC).

As we previously discussed in our February 2015 comments, this change is needed to modernize the yogurt standard of identity to reflect and accommodate new processing methods and technologies used to produce base ingredients. 1/ Moreover, this change would advance FDA's recently announced goal of fostering the development of healthier food options by modernizing standards of identity to address current barriers to the development of healthier products. 2/ Indeed,

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1/ IDFA submitted comments on the proposed rule on February 20, 2015 and April 29, 2009 and is attaching and incorporating these comments by reference.
2/ *See* "Healthy Innovation, Safer Families: FDA's 2018 Strategic Policy Roadmap," at 15 (Jan. 2018), available at https://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/Reports/UCM592001.pdf.

FDA Commissioner Scott Gottlieb, M.D., just recently identified the yogurt standard of identity as an example of food standards FDA is reevaluating to support innovation of healthier products. 3/ Revising the standard of identity for yogurt to eliminate the 3.25% minimum milkfat requirement in favor of a minimum 3.0 g total fat per RACC requirement also is consistent with FDA's directive under Executive Order 13777 to identify outdated or ineffective regulations and repeal, replace, or modify them as necessary. 4/

FDA Should Eliminate the 3.25% Minimum Milkfat Requirement and Implement a Minimum 3g Total Fat Per RACC Requirement for Yogurt

IDFA recommends that FDA eliminate the 3.25% minimum milkfat requirement for yogurt and instead implement a 3 g total fat per RACC requirement. Under this proposal, the Nutrition Labeling and Education Act (NLEA) structure for "lowfat," "nonfat," and "reduced fat" claims would prevail, without the complication of a minimum milkfat requirement. A minimum milkfat requirement is not necessary and eliminating it here would promote public health by ensuring that current lowfat yogurts remain on the market and removing barriers to the development of new, lower fat yogurts. This change would facilitate the development of healthier products, consistent with FDA's 2018 Strategic Policy Roadmap, and also advance the goals of Executive Order 13777 by revising an outdated regulation.

- *Milkfat is Not the Defining Characteristic of Yogurt and Consequently No Minimum Milkfat Requirement is Needed*

The current 3.25% minimum was initially proposed by FDA, in its 1977 proposed rule, to align "yogurt", "lowfat yogurt" and "nonfat yogurt" with the standards of identity for "milk", "lowfat milk" and "nonfat milk," but the agency provided no reasoning behind this proposal from a product identity or legal perspective. At the time, FDA requested comments on this specific proposal and even suggested that if an appreciable amount of "yogurt" was not being sold on the market, that the agency would publish a final rule renaming the proposed "lowfat yogurt" as "yogurt", eliminating the minimum 3.25% milkfat requirement and requiring that percent milkfat simply be declared on the container in increments of one-half percent, essentially allowing two categories—"yogurt" and "nonfat yogurt," with "yogurt" covering a broad range of milkfat contents. 42 Fed. Reg. 29919, 29920 (June 10, 1977).

Modern yogurt production involves complex formulations, using a range of dairy ingredients, and sophisticated processing methods, even for just plain, unflavored yogurt. The ingredient statement will list dairy ingredients in accordance with their individual standards of identity, including milk, cream, and skim milk. Therefore, the consumer can rely on these declarations, along with the Nutrition Facts Panel, if they are interested in knowing what went into the finished product and its macronutrient composition.

From a purely food standards perspective, a 3.25% minimum milkfat requirement is not an essential characterizing component of yogurt. In general, the purpose of minimum amounts in food standards is to protect the integrity of the product category and prevent the substitution of inferior ingredients. Although this is a worthwhile goal, the minimum milkfat requirement for yogurt does not serve this purpose. Reducing the milkfat content does not cheapen or dilute the yogurt, because a minimum level of milkfat is not a defining characteristic of yogurt, unlike other dairy foods such as milk, cream,

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3/ Reducing the Burden of Chronic Disease, Remarks before the National Food Policy Conference (Mar. 29, 2018), available at https://bit.ly/2GUHmET.

4/ *See* Executive Order 13777 of February 24, 2017: Enforcing the Regulatory Agenda, 82 Fed. Reg. 12285 (Mar. 1, 2017), available at https://www.gpo.gov/fdsys/pkg/FR-2017-03-01/pdf/2017-04107.pdf.

or ice cream. Instead, reducing the milkfat content of yogurt merely allows for a lower fat version of the product. 5/

The elimination of a minimum milkfat requirement would return the focus of the standard of identity to the *true* defining characteristic of yogurt—its characterizing flavor and aroma compounds derived from carbohydrate fermentation by *Lactobacillus delbrueckii* subsp., *bulgaricus* and *Streptococcus thermophilus* (e.g., acetaldehyde and other carbonyl compounds) and, to a lesser extent, proteolysis. These distinct flavor and aroma compounds, along with the lack of carbon dioxide and ethanol, help distinguish yogurt from other fermented milks (e.g., kefir, kumis). Notably, the current Codex standard does not include a minimum milkfat requirement for yogurt or any of the other products covered under the standard. 6/

In addition, lowfat and nonfat yogurt account for the vast majority (86%) of yogurt sold through the second quarter for 2017, which under the current standard of identity contains less than 3.25% milkfat. 7/ The yogurt most consumers consume today, therefore, is not characterized by its milkfat, but by the flavor and aroma compounds described above. Moreover, the predominance and popularity of lowfat and nonfat yogurts containing less than 3.25% milkfat further supports that yogurts containing less than 3.25% milkfat are not considered inferior products, primarily because they are not replaced by inferior or cheaper substitutes.

- *Eliminating the Minimum Milkfat Requirement Promotes Public Health, Consistent with FDA's Policy Objectives*

Eliminating the 3.25% minimum milkfat requirement and replacing it with a minimum 3 g total fat per RACC requirement for yogurt also will promote public health by maintaining current yogurt options for consumers and accommodating the development of lower fat options. This 3 g minimum per RACC would serve as the reference value when making fat content claims for products with lower total fat content.

As previously mentioned, the vast majority of yogurts currently on the market are either lowfat or nonfat yogurt. These yogurts conform to the current standards of identity for lowfat and nonfat yogurts, which require milkfat contents of 2.0-0.5% and less than 0.5%, respectively. In the past, prior to the FDA's proposed rule, most yogurts were flavored primarily with fruits, which contained no additional fat. However, one of the factors that is helping to drive the yogurt market's unprecedented growth of 113% since 2001, is new and innovative flavors of yogurt that contain other sources of fat in the ingredients. IDFA is aware of several yogurt manufacturers who have developed products that, before the addition of bulky flavors, the yogurt would meet the nutrient content claims of "lowfat" or "nonfat," per NLEA, but when bulky flavoring ingredients are added to the yogurt that contain fat other than milkfat, such as chocolate, nuts, coconut, etc., the finished food is above the threshold of 3 grams or less of fat per RACC to qualify for the "lowfat" claim. These products also cannot be positioned as "yogurt" because they do not satisfy the minimum milkfat 3.25% milkfat requirement before the addition of bulky flavors. Therefore, under the current proposal, a product such as

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5/ Indeed, FDA's 2009 proposal not to apply the nutritional equivalency requirements under §130.10 to low and nonfat yogurts with regard to vitamin A restoration levels in yogurt made with whole milk appears to acknowledge that yogurt generally is not considered a nutritional replacement for whole milk, which demonstrates that there is no need to link the minimum milkfat contents of these products and further supports the removal of a minimum milkfat requirement as an outdated requirement.

6/ Codex STAN 243-2003, available at http://www.fao.org/fao-who-codexalimentarius/codex-texts/list-standards/en/

7/ IRI Custom DMI Market Advantage Database coconut "yogurt," where the lowfat yogurt is mixed with coconut pieces, could not be marketed because there would be no allowed fat designation between low fat and full fat. 8/

Thus, without the elimination of the 3.25% minimum milkfat requirement, FDA's proposed standard would substantially reduce the number of yogurts available to consumers, particularly in the lowfat and reduced fat categories, thereby reducing the availability of lower fat food choices. In this way, it would be imprudent to allow the food standard for yogurt to work contrary to the NLEA framework for lower fat claims. Thus, eliminating the minimum milkfat requirement would pave the way for manufacturers to develop new product formulations with lower total fat contents, and thereby accommodate the creation of new, lower fat yogurt varieties.

This reevaluation of the yogurt standard of identity to expand healthy food options for consumers is precisely the type of action called for in FDA's 2018 Strategic Policy Roadmap. One of FDA's proposed action items to achieve the goal of expanding healthy food options is the modernization of standards of identity to address barriers to the development of healthier products. Eliminating the 3.25% minimum milkfat requirement would do just that by allowing for the continued market presence and development of new yogurts that contain less than 3.25% milkfat. Indeed, as noted above, FDA Commissioner Scott Gottlieb, M.D., identified the yogurt standard of identity as an example of food standards FDA is reevaluating to support innovation.

Moreover, eliminating the minimum milkfat requirement would advance FDA's directive under Executive Order 13777, which tasks each agency with identifying outdated, unnecessary, or ineffective regulations for repeal, replacement, or modification. As previously discussed, a 3.25% minimum milkfat requirement is not an essential characterizing ingredient for yogurt, and the current Codex standard recognizes this. Accordingly, there is no need for the 3.25% minimum milkfat requirement, and replacing it with a minimum 3 g total fat per RACC standard would therefore further FDA's satisfaction of its obligations under Executive Order 13777.

A New Proposed Rule Is Not Necessary Because Eliminating the Minimum 3.25% Milkfat Content Is a Logical Outgrowth of the Original Proposed Rule

Granting IDFA's request to eliminate the 3.25% minimum milkfat requirement in the yogurt standard of identity and replace it with a requirement that standard yogurt contain a minimum of 3 g of total fat per RACC of the finished product is a logical outgrowth of FDA's proposed rule; accordingly, FDA may grant the request without issuing a new proposed rule.

The Administrative Procedures Act (APA) requires that when an agency wishes to promulgate a rule, it must publish notice of the rule in the *Federal Register* and then give interested parties an opportunity to comment. 5 U.S.C. § 553. The *Federal Register* notice must contain "either the terms or substance of the proposed rule or a description of the subjects and issues involved." *Id.* § 553(b)(3). When deciding whether a final rule adopted by a federal agency is so different from the proposed rule that a new period of notice and comment on the final rule is required, courts have applied the "logical outgrowth" test.

Under the "logical outgrowth" test, an agency satisfies the APA's notice requirement when the final rule constitutes a "logical outgrowth" of the proposed rule. The D.C. Circuit has held that "[a] rule is deemed a logical outgrowth if interested parties 'should have anticipated' that the change was possible, and thus reasonably should have filed their comments on the subject during the notice-and-comment period." *Northeast Md. Waste Disposal Auth. v. EPA,* 358 F.3d 936, 952

8/ For your reference, attached to these comments is a chart detailing lowfat yogurts currently on the market, which would no longer be able to be called "yogurt" because they contain less than 3.25% milkfat.

(D.C.Cir.2004) (quoting *City of Waukesha v. EPA,* 320 F.3d 228, 245 (D.C.Cir.2003)). According to the court, "[t]his means that a final rule will be deemed the logical outgrowth of the proposed rule if a new round of notice and comment would not provide commentators with 'their first occasion to offer new and different criticisms which the agency might find convincing.'" *Fertilizer Inst. v. EPA,* 935 F.2d 1303, 1311 (D.C.Cir.1991) (quoting *United Steelworkers of Am. v. Marshall,* 647 F.2d 1189, 1225 (D.C.Cir.1980)).

As applied to the rulemaking proceedings for the yogurt standard of identity, eliminating the 3.25% minimum milkfat requirement is a logical outgrowth of the proposed rule because the public has been presented with—and has taken advantage of—multiple opportunities to provide support for or against maintaining the requirement, including the specific proposal to replace the standard with a minimum 3 g total fat per RACC standard. The various opportunities to comment on the inclusion or elimination of a minimum milkfat requirement included the following:

- **1977 Proposed Rule:** FDA proposed the minimum 3.25% milkfat content for "yogurt" but requested comment on "the production or sale of 'yogurt' in order to determine the need for standards of identity for both 'yogurt' and 'lowfat yogurt' and foreshadowed the final rule could include a lower threshold if comments indicated that an appreciable amount of "yogurt" as defined in the proposed standard was not being sold. 42 Fed. Reg. 29919, 29920 (June 10, 1977).

- **1982 Final Rule and Stay of Effective Date:** FDA received a request that the standard be amended so that the minimum milkfat requirement apply only to optional dairy ingredients. In response to these comments, FDA stated that while Section 131.200 provides for the use of other optional dairy ingredients to increase the milk solids not fat content of yogurt to 8.25 percent or above, it was never intended and does not provide for a proportionate decrease in the minimum milkfat content of yogurt. However, FDA stayed the requirement to allow for further deliberation, including a public hearing, on whether the minimum milkfat standard should apply before or after the addition of optional sources of milk solids not fat, and permitted objections to the stay of the requirement for a one-month period. 47 Fed. Reg. 41519, 41521 (Sept. 21, 1982).

- **2003 ANPRM:** In its 2003 ANPRM, FDA published and sought comment on the National Yogurt Association's proposed standard of identity for yogurt, which would eliminate the minimum 3.25% minimum milkfat requirement in lieu of a minimum 3.0 g total fat per RACC requirement. 68 Fed. Reg. 39873, 39874 (July 3, 2003).

- **2009 Proposed Rule:** FDA reported that it had received comments supporting retaining the current 3.25% minimum milkfat requirement. The agency noted that NYA's recommended minimum fat content of 3.0 g per RACC would equate to lowering the minimum milkfat content to about 1.3 percent. FDA said it agreed with NYA that it is appropriate to revise the existing lowfat and nonfat standards to conform with the nutrient content claims for "lowfat" and "non fat," but said NYA did not provide a justification for lowering the minimum fat content of yogurt that is simply named yogurt and does not include a nutrient content claim related to its fat content. On this basis, FDA said it was maintaining the current minimum 3.25% milkfat requirement. FDA also reiterated its comment from the 1982 Final Rule that the use of optional dairy ingredients to increase the milk solids not fat levels above 8.25% was not intended to provide for a proportionate decrease in the minimum 3.25% milkfat content. Importantly, FDA requested comment on the "need for and appropriateness of (1) A minimum milkfat content of 3.25 percent in yogurt; (2) a minimum milk solids not fat content of 8.25 percent, and (3) the application of these two compositional requirements prior to the addition of bulky flavoring ingredients." 74 Fed. Reg. 2443, 2448 (Jan. 15, 2009).

FDA thus has provided at least four opportunities for the public to provide comment on the need for a minimum milkfat requirement, including express notice to the public that it had been proposed to the agency that the requirement be eliminated in lieu of a minimum 3.0 g total fat per RACC requirement. A new proposed rule removing the requirement therefore "would not provide commentators with 'their first occasion to offer new and different criticisms'" on eliminating the requirement, and therefore is not necessary. *Fertilizer Inst. v. EPA*, 935 F.2d at 1311. Moreover, because of these ample opportunities to comment on this issue, a final rule eliminating the requirement would not be "bootstrapping" notice from IDFA's 2015 comments supporting NYA's proposed elimination of the requirement. *See id*. at 1312.

Importantly, the elimination of the 3.25% minimum milkfat requirement would be a logical outgrowth of the proposed rule, because FDA expressly requested comments on the appropriateness of a minimum milkfat requirement in the proposed rule. The D.C. Circuit has held repeatedly that a "final rule represents a logical outgrowth where the NPRM expressly asked for comments on a particular issue or otherwise made clear that the agency was contemplating a particular change." *Int'l Union, United Mine Workers of Am. v. Mine Safety and Health Admin.*, 626 F.3d 84, 96 (D.C. Cir. 2010) (citing *CSX Transp., Inc. v. STB*, 584 F.3d 1076,1081 (D.C. Cir. 2009); *see also City of Portland v. EPA*, 507 F.3d 706, 715 (D.C. Cir. 2007). In the 2009 Proposed Rule, FDA expressly noted its decision to maintain the 3.25% minimum milkfat requirement, despite the NYA petition, but asked that the public comment specifically on the appropriateness of a minimum milkfat content of 3.25%. 74 Fed. Reg. at 2448. FDA thus signaled that it was open to reconsidering the 3.25% minimum milkfat requirement by stating its present position on NYA's proposal and seeking comment from the public on the issue.

Moreover, because it provided the public with adequate notice that it was deliberating the minimum milkfat requirement, FDA is not prohibited from changing its position on the appropriate minimum milkfat requirement in its final rule. To demonstrate this point, the D.C. Circuit upheld a Federal Communications Commission (FCC) final rule in which the agency took a substantially different position than it had in its proposed rule. *Agape Church, Inc. v. FCC*, 738 F.3d 397 (D.C. Cir. 2013). Much like the process IDFA proposes FDA follow, the FCC initially proposed to extend the so-called "Viewability Rule" that was in place to ensure consumers with analog equipment have access to certain television signals, sought comment on the extension in the preamble to the proposed rule, and then adopted a final rule that reversed course by allowing the Viewability Rule to lapse in lieu of a different approach to ensuring access to customers with analog equipment. *Id*. at 404. Though the final action taken was not something the FCC had expressly proposed, the court held that it constituted a logical outgrowth of the proposal because the FCC had sought comment on the extension or lapse of the Viewability Rule in the proposed rule. *Id*. at 412.

Indeed, as explained by the Seventh Circuit, "courts have upheld final rules which differed from proposals in the following significant respects: outright reversal of the agency's initial position; elimination of compliance options contained in an NPR; collapsing, or further subdividing, distinct categories of regulated entities established in a proposed rule; exempting certain entities from the coverage of final rules; or altering the method of calculating or measuring a quantity relevant to a party's obligations under the rule." *American Medical Ass'n v. United States*, 887 F.2d 760, 768 (7th Cir. 1989) (citing *Natural Resources Defense Council v. EPA,* 824 F.2d 1258, 1283–84 (1st Cir.1987); *American Transfer & Storage Co. v. ICC,* 719 F.2d 1283, 1303 (5th Cir.1983); *Small Refiner Lead Phase–Down Task Force v. EPA,* 705 F.2d 506, 547–48 (D.C.Cir.1983); *Connecticut Light & Power Co. v. NRC,* 673 F.2d 525, 532–34 (D.C. Cir.), *cert. denied,* 459 U.S. 835 (1982); *Daniel Int'l Corp. v. OSHA,* 656 F.2d 925, 931–32 (4th Cir.1981); *Pennzoil Co. v. FERC,* 645 F.2d 360, 371–72 (5th Cir.1981), *cert. denied,* 454 U.S. 1142 (1982); *Consolidation Coal Co. v. Costle,* 604 F.2d 239, 246–49 (4th Cir.1979), *rev'd on other grounds sub nom. EPA v. National Crushed Stone Ass'n,* 449 U.S. 64 (1980); *BASF Wyandotte Corp. v. Costle,* 598 F.2d 637, 642–44 (1st Cir.1979), *cert. denied sub nom. Eli Lilly & Co. v. Costle,* 444 U.S. 1096

(1980); *American Iron & Steel Inst. v. EPA,* 568 F.2d 284, 293–94 (3d Cir.1977); *South Terminal Corp. v. EPA,* 504 F.2d 646, 658–59 (1st Cir.1974); *Abington Memorial Hosp. v. Heckler,* 576 F. Supp. 1081, 1085 (E.D.Pa.1983), *district court's opinion adopted,* 750 F.2d 242, 243 (3d Cir.1984), *cert. denied,* 474 U.S. 863 (1985)). FDA is similarly entitled to reverse its opinion on the yogurt standard identity where, as in previous cases, it has satisfied the APA's notice requirement.

In sum, FDA has provided ample notice to the public regarding the possibility of eliminating the 3.25% minimum milkfat requirement in the yogurt standard of identity, and the agency may reverse its opinion on this issue without issuing a new proposed rule.

Summary and Conclusion

In summary, IDFA requests that FDA eliminate the 3.25% minimum milkfat requirement in the yogurt standard of identity, and instead apply a minimum 3 g total fat per RACC requirement. There is no need to include a minimum milkfat requirement, and eliminating it will allow for the introduction of new, lower fat yogurt options into the market. The elimination of the 3.25% minimum milkfat requirement is a logical outgrowth of the proposed rule, because FDA provided the public with multiple opportunities to comment on the need for such a requirement, including NYA's proposal to remove the requirement and replace it with a 3 g total fat per RACC requirement. Accordingly, there is no need for FDA to issue a new proposed rule implementing this change.

*   *   *

Respectfully submitted,

John T. Allan, III., MS
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DAIRY FOODS
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February 20, 2015

Division of Dockets Management (HFA-305)
Food and Drug Administration
5630 Fishers Lane, rm. 1061
Rockville, MD 20852

Re: Docket No. FDA-2000-P-0126; Milk and Cream Products and Yogurt Products; Petition to Revoke Standards for Lowfat Yogurts and Nonfat Yogurt and to Amend the Standards for Yogurt and Cultured Milk; Proposed Rule

Dear Sir or Madam:

The International Dairy Foods Association (IDFA), Washington, D.C., represents the nation's dairy manufacturing and marketing industries and their suppliers, with a membership of 550 companies within a $125-billion a year industry. IDFA is composed of three constituent organizations: the Milk Industry Foundation (MIF), the National Cheese Institute (NCI) and the International Ice Cream Association (IICA). IDFA's nearly 200 dairy processing members run nearly 600 plant operations, and range from large multi-national organizations to single-plant companies. Together these organizations represent more than 85 percent of the milk, cultured products, cheese, ice cream, and frozen desserts produced and marketed in the United States.

IDFA is writing to urge the Food and Drug Administration (FDA) to move forward with finalizing the 2009 proposed rule to update the existing Federal standards of identity for yogurt, and to provide comments on advances in the dairy industry and slight changes to our thinking since we submitted our original comments on the proposed rule in April 2009 (*See* Appendix A).[1]

Existing standards for nonfat yogurt, lowfat yogurt, and yogurt are outdated and need modernization to reflect and accommodate new processing methods and technologies for food ingredients, as well as current consumer preferences and marketing trends. This critical need supports the government's longstanding goal in making food standards easier to establish, use, and reflect current trends. Modernization of the U.S. food standards has indeed been a goal for FDA and the U.S. Department of Agriculture for twenty years. In 1995, the two agencies began a process of reviewing the existing food standards to determine if there was a need to modernize, or even eliminate some or all standards, with the publishing of an advanced notice of proposed rulemaking [60 FR 67492, December 29, 1995 (FDA)[2], and 61 FR 47453, September 9, 1996 (USDA)]. Then, in 2005, the agencies published the proposed rule "Food Standards; General Principles and Food Standards Modernization" (Docket No. 1995N–0294)[3], which defined principles that would "better promote honesty and fair dealing in the interest of consumers and protect the public, allow for technological advances in food production, be consistent with international food standards to the extent feasible, and be *clear, simple, and easy to use* [emphasis added] for both manufacturers and the agencies that enforce compliance with the standards." This is

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1/ IDFA submitted comments on the proposed rule on April 29, 2009 and is hereby attaching and incorporating these comments by reference.
2/ http://www.gpo.gov/fdsys/pkg/FR-1995-12-29/pdf/95-31492.pdf
3/ http://www.gpo.gov/fdsys/pkg/FR-2005-05-20/pdf/05-9958.pdf

critical work that needs to be accomplished by the agencies and we continue to support its completion. To that end, we are providing the essential support for an updated yogurt standard of identity.

In the comments that follow, we explain the continuing need for a modernized yogurt standard. We also provide details on some of the innovative technologies and ingredients that should be accommodated and other changes that we would like to see incorporated into the revised regulation that were not directly addressed in previous comments.

We recognize that the comment period closed some time ago. However, since that time, new developments have occurred that are germane to the issues being considered by the agency. We believe the agency has the discretion to accept late comments. We understand that these comments will be posted in the public docket to assure transparency.

A Lack of Regulatory Clarity and Consistency Harms Industry and Misleads Consumers

The yogurt standard of identity is in great need of modernization. First, the provisions of the current standard of identity cannot be found in a single place. The existing standards were codified by a 1981 final rule, of which several provisions were stayed indefinitely in 1982.[4] The stay remains in effect to this date, meaning that the codified language does not represent the version of the standard that is currently in effect. In 2009, FDA published a proposed rule that would consolidate the yogurt standards into a single regulation and make other changes consistent with the 1982 stay. FDA indicated in the proposed rule it "intends to consider the exercise of its enforcement discretion on a case-by-case basis when yogurt products are in compliance with the standard of identity proposed in this proposed rule and when the labeling of such products is not otherwise false or misleading."[5] Thus, FDA permits a manufacturer to market yogurt under either the codified 1981 standard, as modified by the 1982 stay, or under the proposed 2009 standard.

Since 2009, there have been many newcomers to the U.S. yogurt market. Due to the numerous stays currently in place and the existence of a proposed rule not yet in final form, it can be very challenging for these companies to gain a clear understanding of how to make yogurt in compliance with FDA regulations. This situation obviously creates confusion and could lead to the marketing of products that do not conform to the current standard of identity, which could not only be confusing for consumers, but also for government buyers of products. For example, USDA's Agricultural Marketing Service's (AMS) Commercial Item Descriptions (purchase specifications) and other food purchase and standard-setting activities under the authority of the AMS depend on clear and consistent FDA standards, which do not exist in the case of yogurt.

In fact, some yogurt manufacturers have had to defend lawsuits due to the confusion over the current standard, as stayed, and the proposed standard.[6] This is an unnecessary cost and burden to manufacturers and may not have occurred if FDA had finalized the revisions to the standard in a timely fashion. Indeed, one such case was dismissed on primary jurisdiction grounds with Judge Susan Richard Nelson of the U.S. District Court for the District of Minnesota stating that the agency's current standard of identity for yogurt, the stayed 1982 limitations, the Agency's subsequent public statements about the standard, and the 2009 Proposed Rule "do not constitute a model of clarity."[7]

4/ 46 Fed. Reg. 9924 (Jan. 30, 1981); 47 Fed. Reg. 41519, 41519 (Sept. 21, 1982).

5/ 74 Fed. Reg. at 2455.

6/ *See, e.g., Taradejna v. General Mills Inc.*, Case No. 12-cv-993 (D. Minn. Dec. 10, 2012) (dismissing on primary jurisdiction grounds the plaintiff's claims that Yoplait Greek yogurt is misbranded because it contains milk protein concentrate); *Smith v. Cabot Creamery Cooperative, Inc.*, Case No. 12-4591 (N.D. Cal. Feb. 25, 2013) (dismissing a challenge to the use of milk protein concentrate and whey protein concentrate in yogurt); *Conroy v. The Dannon Company*, Inc., Case No. 7:12-cv-06901 (S.D.N.Y. May 9, 2013) (dismissing a putative class action lawsuit alleging that the use of water, milk protein concentrate, and other ingredients is prohibited under the standard of identity for yogurt).

7/ *Taradejna v. General Mills Inc.*

Further underscoring the need for a final standard is that the current regulations still allow for a "Lowfat yogurt" that does not align with the nutrient content claim definition for "Low fat" in 21 CFR § 101.62(b)(2). Under the nutrient content claim regulation, in order to be labeled as "Low fat" a food must have 3 grams or less of fat per reference amount customarily consumed (RACC). In contrast, under the current yogurt standard, products with between 0.5 to 2% milk fat before the addition of bulky flavors (or the equivalent of 1.13 to 4.5 g fat on a per 225 g RACC basis) qualify as low fat. The same type of inconsistency exists for "Nonfat yogurt" under the current standard and the "fat free" or "nonfat" nutrient content claim definition in § 101.62(b)(1).

The 2009 proposal would combine the three yogurt standards into a single standard for "yogurt" and allow lower-fat versions of yogurt to be produced under the provisions of 21 CFR § 130.10, covering modified standardized foods. This change would subject yogurts to the nutrient content claim regulations for "Low fat" and "fat free," thus achieving consistency in claims for yogurts and other foods. In order to promote consistency and consumer understanding, IDFA asks FDA to act to finalize this proposed change.

Furthermore, since FDA has agreed in the proposed rule to move to the 21 CFR § 101.62 method of recognizing the total fat content in yogurt, versus the current standards based solely on milkfat content, we see no real need to require a minimum *milkfat* content. Although IDFA has supported it in the past, our recommendation would be to eliminate the 3.25% milkfat minimum requirement for the yogurt white mass, prior to the addition of bulky flavoring ingredients, and only require that "yogurt" contain greater than 3 g of total fat per reference amount customarily consumed (RACC) of the finished product.

In the 2009 proposed rule, FDA argued in support of maintaining this minimum milkfat requirement; however, looking all the way back to the original 1977 proposed rule[8] and 1981 final rule[9] first establishing the existing yogurt standards, FDA has never demonstrated an underlying, principle need to have a milkfat minimum as a characterizing component of yogurt in the first place. In the 1977 proposal, FDA based its milkfat minimums off of the milk, lowfat milk and nonfat milk standards in existence at the time, along with consideration of the Codex Alimentarius' draft standards for yogurt that were being developed, which included milkfat minimums; however, no consideration was given as to why a milkfat minimum should be included in such a standard.

Furthermore, in its 2009 proposal, FDA proposed not to apply the nutritional equivalency requirements under § 130.10 to low and nonfat yogurts with regard to vitamin A restoration to levels in yogurt made with whole milk. This suggests that FDA, at least indirectly, recognized that yogurt is not generally considered as a replacement for whole milk, from a nutritional standpoint, which further argues for removal of the milkfat minimum requirement.

Our recommended revisions would align with the agency's proposed food standard modernization principles, which state that a food standard should describe the *basic nature* of the food, reflect the *essential characteristics* of the food and should contain *clear* and *easily understood requirements* to facilitate compliance by food manufacturers. These proposed changes are very relevant for the types of products that are already in the marketplace today and will provide clearer communication to consumers and clearer requirements for manufacturers.

For example, from a clarity-in-labeling standpoint, if a fat-free yogurt "white mass" has flavoring ingredients added that contain fat other than milkfat, such as chocolate, nuts, coconut, etc., using the proposed SOI, the name of the food on the front panel would be "fat-free yogurt," but the nutrition facts panel may have 5 or more grams of fat per RACC. This is no longer a fat free product or even a low fat product. To claim fat free on the front panel would be deceiving. However, with the requirement of "yogurt" to have a minimum of 3.25% milkfat, this product could not be labeled as "yogurt" either. IDFA is proposing that the product be labeled based on the finished product's total fat content. The ingredient listing would communicate the type of milk used to create the finished product (i.e., whole, reduced fat, low fat or fat-free milk) and the total fat would be declared in the Nutrition Facts Panel.

8/ 42 Fed Reg 29919 (June 10, 1977); Cultured and Acidified Buttermilk, Yogurts, Cultured and Acidified Milks, and Eggnog; Proposal to Establish New Identity Standards; Proposed Rule

9 46 Fed Reg 9924 (Jan. 30, 1981); Cultured and Acidified Milks, Cultured and Acidified Buttermilks, Yogurts, and Eggnog; Standards of Identity; Final Rule

As another example, FDA is proposing that before the addition of bulky flavoring ingredients, the "white mass" that is cultured and fermented must contain at least 3.25% milkfat and at least 8.25% milk solids not fat. If IDFA's request to allow the addition of cream (and other pasteurized, safe and suitable milk-derived ingredients) after fermentation is accepted, this added cream would apparently not be required to be considered in arriving at the 3.25% minimum milkfat prior to culturing/fermentation; however, the fat declared on the Nutrition Facts panel will include all fat (dairy and non-dairy fat/lipids) in the finished product. This scenario would also create a confusing and inconsistent set of parameters for labeling fat content not in line with FDA's modernization principles.

From an essential characterization standpoint, it is important to note the well-established scientific recognition that the predominant, characterizing flavor and aroma compounds of yogurt are derived not from lipids/fats, but from carbohydrate fermentation by *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* (e.g., acetaldehyde and other carbonyl compounds) and, to a lesser extent, proteolysis.[10] These distinct flavor/aroma compounds, along with the lack of CO_2 and ethanol, are what help distinguish yogurt from other fermented milks, including kefir, kumis, etc. Alignment with Codex standards is another of FDA's food standard modernization principles, so it should also be noted that the current Codex Alimentarius Standard for Fermented Milks, finalized in 2003, which includes yogurt, does not include minimum milkfat levels (only maximums) for yogurt or any of the other products covered under the standard, in contrast with the original Codex Standards for yogurt noted above.[11] Furthermore, the vast majority of yogurt sold in the U.S. market today is either low or non-fat. Therefore, it should be concluded that the proposed minimum milkfat level does not serve a role in defining the basic nature and essential characteristics of the final fermented product.

However, manufacturers still need a baseline level for what constitutes a "regular" yogurt, but only for the purposes of making the determination of what a "reduced fat" yogurt would be in a given circumstance. Low and nonfat claims would be based off of ≤ 3 g and ≤ 0.5 g, respectively, which is consistent with all other foods. We, therefore, recommend that the milkfat requirement of 3.25% in the proposed rule be removed for yogurt and a "regular" yogurt be permitted to be any product with a *total* fat content greater than 3 g per RACC, as illustrated below:

(Omitted text is struck and added text is underlined.)

§ 131.200 Yogurt.

(a) *Description*. Yogurt is the food produced by culturing one or more of the basic dairy ingredients specified in paragraph (b) of this section and any of the optional dairy ingredients specified in paragraph (c) of this section with a characterizing bacterial culture that contains the lactic acid-producing bacteria, *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*. The ingredients specified in paragraphs (b) and (c) of this section shall be pasteurized or ultra-pasteurized, and may be added prior to the addition of the characterizing bacterial culture and after culturing. One or more of the other optional ingredients specified in paragraph (d) of this section may also be added. The food may be homogenized. Yogurt may be heat-treated after culturing to extend the shelf life of the food. Yogurt, before the addition of bulky flavoring ingredients, contains ~~not less than 3.25 percent milkfat and~~ not less than 8.25 percent milk solids not fat and has either a titratable acidity of not less than 0.7 percent expressed as lactic acid or a pH of 4.6 or lower. Yogurt, after the addition of ingredients specified in (b), (c) and (d) of this section, shall contain greater than 3 grams of fat per reference amount customarily consumed. Yogurt that is not heat-treated after culturing may contain a minimum level of live and active cultures of 10^7 colony-forming units per gram (CFU/g) at the time of manufacture with a reasonable expectation of 10^6 CFU/g through the manufacturer's assigned shelf life of the product.

(b) . . .

10/ *See,* Tamime, AY and Robinson, RK. 1999. Yoghurt Science and Technology, 2nd edition. Woodhead Publishing, Cambridge, England (U.K.). Chapter 7. Biochemistry of Fermentation. pp. 443-444.

11/ Codex Standard 243-2003, available here: http://www.codexalimentarius.org/

Lastly, finalizing the rule as soon as possible could assist companies in synchronizing any label changes dictated by the revised standard of identity with those changes required by FDA's efforts to update the nutrition labeling and serving size requirements. On March 3, 2014, FDA proposed changes to the regulations for the Nutrition Facts panel and reference amounts customarily consumed that would require significant revisions to yogurt labels (as well as to all packaged foods bearing nutrition labeling).[12] To the extent the yogurt standards of identity are modified using an implementation timeline similar to that for the nutrition labeling revisions, companies could revise yogurt labels much more efficiently by making a single set of changes in response to both sets of requirements. FDA has previously recognized the value in establishing a uniform compliance date for food labeling regulations to minimize the economic impact of label changes, and we ask the agency to take the same approach here.[13]

For these reasons, we urge FDA to move as expeditiously as possible to issue the long-awaited final rule and modernize the yogurt standards.

A Yogurt Standard Should Reflect Emerging Technologies and Dairy Ingredients

The dairy industry is rapidly developing new dairy ingredients and processing technologies that should be accommodated in an updated yogurt standard. For example, new processing advances in filtration and centrifugal separation are being used to manufacture specialized yogurts like "Greek Yogurt." We request that FDA amend the standard to reflect these changes by (1) expanding the list of basic dairy ingredients to include ultrafiltered (UF) milk (and resulting dried products, e.g., milk protein concentrate and isolate) and skim milk powder (SMP) (*i.e.,* protein-standardized nonfat dry milk); (2) finalizing the various proposed provisions that are currently stayed, such as the provision that would allow for safe and suitable optional dairy ingredients, including the addition of pasteurized, safe and suitable, milk-derived ingredients after culturing; and (3) clarifying that not all yogurts that are heated after culturing should indicate such treatment on the label, if the live and active culture counts remain above the required minimum level FDA has proposed.

In its 2005 proposed food standard modernization principles, the agency acknowledged the need for food standards to "permit flexibility in food technology . . . so long as that technology does not alter the basic nature or essential characteristics, or adversely affect the nutritional quality or safety, of the food." Each of our requested changes would maintain the basic nature of yogurt and ensure food safety.

First, we request that FDA expand the list of basic dairy ingredients. Under the proposed rule, FDA would include the following as basic dairy ingredients: cream, milk, partially skimmed milk, skim milk, or the reconstituted versions of these ingredients. In proposing to permit reconstituted forms of cream, milk, partially skimmed milk, and skim milk as basic dairy ingredients, FDA recognized that there is no evidence that the use of these ingredients has an adverse effect on yogurt quality or safety; and that this allowance would be consistent with other FDA standards for dairy foods.[14] We believe that these same considerations also apply to SMP and UF milk.

SMP should be permitted as a basic dairy ingredient because it is nearly identical to skim milk but for the removal of water and the standardization of the protein. Given that FDA permits both skim milk and reconstituted skim milk as basic dairy ingredients, there is no reason to not also permit the use of skim milk powder in the same category. With respect to ultrafiltered milk, FDA has proposed to permit this ingredient in standardized cheeses and cheese products.[15] Similarly, allowing for UF milk in yogurts would preserve the basic identity of yogurt and would be consistent with FDA's position on the use of this

12/ 79 Fed. Reg. 11880 (Mar. 3, 2014); 79 Fed. Reg. 11990 (Mar. 3, 2014).
13/ *See, e.g.,* 77 Fed. Reg. 70885 (Nov. 28, 2012) (establishing a uniform compliance date for food labeling regulations issued between January 1, 2013 and December 31, 2014).
14/ 74 Fed. Reg. at 2450.
15/ 70 Fed. Reg. 60751 (Oct. 19, 2005).

ingredient in other standardized dairy foods. We therefore request that the agency expand the list of basic dairy ingredients to include both skim milk powder and ultrafiltered milk.[16]

Second, we ask FDA to finalize the various proposed provisions that are currently stayed, and on which IDFA provided comments in April 29, 2009, such as the provision to allow for optional dairy ingredients, defined as "other safe and suitable milk-derived ingredients" to "increase the nonfat solids content of the foods, provided that the ratio of protein to total nonfat solids of the food, and the protein efficiency ratio of all protein present shall not be decreased as a result of adding such ingredients." The industry has developed a number of new dairy ingredients such as whey protein isolate, and specialized whey proteins that serve a functional purpose with mouth feel, texture and nutritional properties. FDA should finalize the 2009 proposed rule to affirm that these ingredients are permitted as optional dairy ingredients. Furthermore, as requested in our 2009 comments, IDFA urges FDA to allow the use of pasteurized, safe and suitable, milk-derived ingredients after culturing.

Third, supplementary to the comments provided in IDFA's original comments to the 2009 proposed rule, we note that there are new and emerging technologies and techniques involving thermalization or minimal heating of yogurts, below the temperature required for pasteurization. These technologies and techniques are used for purposes other than extending shelf life – such as for enhancing the sensory profile of a product or for acidity purposes. So long as yogurt products subject to such thermalization or heating contain live and active yogurt cultures (resulting from the inoculum used for fermentation) in the amount FDA proposed (a minimum of 10^7 colony-forming units per gram (CFU/g) at the time of manufacture), it would be inappropriate for these products to be required to carry labeling indicating the product was heat treated or does not contain live and active cultures.

Summary and Conclusion

In summary, IDFA requests that FDA:

- Eliminate the 3.25% milkfat minimum requirement for the yogurt white mass, prior to the addition of bulky flavoring ingredients, and only require that "yogurt" contain greater than 3 g of total fat per RACC of the finished product;
- Establish a compliance timeline for the final yogurt standard of identity rule aligned with that of the nutrition labeling revisions;
- Expand the list of basic dairy ingredients to include ultrafiltered milk (and resulting products) and skim milk powder;
- Finalize the various proposed provisions that are currently stayed, such as the provision that would allow for safe and suitable optional dairy ingredients, including the addition of pasteurized, safe and suitable, milk-derived ingredients after culturing; and
- Clarify that not all yogurts that are heated after culturing require indication of such treatment on the label.

To conclude, IDFA asks FDA to work expeditiously to modernize the yogurt standard of identity by finalizing the 2009 proposed rule taking into account the above recommendations, along with our 2009 comments. IDFA appreciates the opportunity to provide the foregoing comments and we look forward to

16/ Note that in contrast to our position with respect to the use of UF milk in cheese, we are not requesting an exemption from ingredient labeling here. We maintain our position that an exemption from ingredient labeling for cheese is appropriate because, in cheesemaking, ultrafiltration is used to accomplish virtually the same effect as whey syneresis (i.e., removal of whey constituents). UF milk retentate is practically indistinguishable, from a compositional standpoint, from curdled milk following syneresis. Further, labeling UF milk in cheese would be impracticable, result in deception, and result in unfair competition. Thus, an exemption from ingredient labeling is warranted under FFDCA Section 403(i) with respect to cheese. *See* our comments to Docket No. 2000P-0586 -- Cheeses and Related Cheese Products; Proposal to Permit the Use of Ultrafiltered Milk. In contrast, when used in making yogurt, UF milk is an optional means of increasing the protein level in the finished product, and as such should be declared on the label.

continuing to work collaboratively with the agency to promote clarity for industry, consumers and government buyers and ensure that the standard of identity does not unduly limit innovation or conflict with consumer preferences and expectations for yogurt.

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Respectfully submitted,

John T. Allan, III., MS
Vice President of Regulatory Affairs & International Standards

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Attachment

International Dairy Foods Association
Milk Industry Foundation
National Cheese Institute
International Ice Cream Association

April 29, 2009

The Division of Dockets Management
(HFA-305)
Food and Drug Administration
5630 Fishers Lane
Room 1061
Rockville, MD 20857

Submitted electronically to http://www.fda.gov/dockets/ecomments

Re: Docket No. FDA-2000-P-0126 Milk and Cream Products and Yogurt Products; Petition to Revoke Standards for Lowfat Yogurts and Nonfat Yogurt and to Amend the Standards for Yogurt and Cultured Milk. (Proposed Rule)

Dear Sir/Madam:

The International Dairy Foods Association (IDFA) and one of its constituent organizations, the Milk Industry Foundation (MIF) appreciate the opportunity to provide comments to the Proposed Rule to revise the standards of identity for yogurt. The MIF represents 105 member companies that process, distribute and market approximately eighty-five percent of U.S. fluid milk, yogurts, cottage cheese, sour cream, soft cheeses, eggnog, creams, dairy dressing and dips, as well as bottled water, juices and juice drinks.

IDFA strongly supports the Food and Drug Administration's (FDA) actions to move forward with updating the existing Federal standards of identity for yogurt by publishing a Proposed Rule in the *Federal Register* on January 15, 2009 (Docket No. FDA-2000-P-0126). Existing standards for nonfat yogurt, lowfat yogurt and yogurt are outdated and need revision to reflect and accommodate new technology for food ingredients and processing methods as well as current consumer preferences. IDFA has worked with our members that represent the yogurt industry to formulate consensus on the numerous proposed amendments to the standard for yogurt and we are pleased to transmit those positions to you today.

IDFA continues to support the fundamental concepts requested by the National Yogurt Association's petition to establish a new yogurt standard to replace the three existing and fragmented standards for yogurt, lowfat yogurt and nonfat yogurt. The MIF believes it is in the best interest of both yogurt manufacturers and consumers for FDA to modernize these standards to reflect food labeling changes that were enacted with the Nutrition Labeling and Education Act (NLEA) of 1990, as well as to codify provisions in the standard for the use of optional dairy ingredients that were stayed by FDA in 1982. Revising the yogurt standards is important to allow manufacturers flexibility with technology advances, industry practices and consumer preferences.

Listed below are IDFA's responses to the proposed amendments to the yogurt standards:

a. Milkfat and milk solids not fat content of yogurt.
IDFA supports FDA's proposed requirements that yogurt have a minimum milkfat content of 3.25 percent and a minimum milk solids not fat content of 8.25 percent before the addition of bulky flavoring ingredients. The concept of having a single standard for yogurt is consistent with other dairy standards such as milk, cottage cheese and ice cream. Product nomenclature depicting a specific fat level of the yogurt would utilize the Nutrition Labeling Education Act (NLEA) nutrient content claims. NLEA food labeling allows for products that have less than 3 grams of fat per reference amount commonly consumed (RACC) to be labeled as "low fat" and yogurt with less than 0.5 grams of fat per RACC to be named "non fat" "fat free" or other permitted nutrient claim synonyms. The yogurt industry realizes that this change will cause reformulation and relabeling of some products currently existing in the market that meet the existing standard of identity for "low fat yogurt" (0.5 - 2 % milk fat before addition of bulky flavoring) that do not qualify to use the "low fat" nutrient content claim (less than 3 grams of fat per 8 ounce serving/ 225g = .0133 or less than 1.33% milk fat).

IDFA believes that it is important for FDA to clarify the reference food that will be used to determine the relative nutrient content claim "reduced fat yogurt" For other foods the reference food for relative claims is a similar food in same product category, which may be based on either; a current data base, the average of top national brands, an appropriate market leader, a competitors product, or the manufacturer's own brand. However, the yogurt proposal states that the fat level of regular yogurt will be measured prior to the addition of bulky flavorings, which after addition could lower the fat level of the final product to 3.25%. Therefore, IDFA requests that the reduced fat claim be based off either existing products in the marketplace in which the average fat would be not less than 3.25% or if an appropriate marketplace product is not available, be based off of a plain yogurt which is 3.25% fat. Plain yogurt is also know as the "white mass portion" of the final yogurt which includes the "basic dairy ingredients" and "optional dairy ingredients" and may include "other optional ingredients"' such as stabilizers, emulsifiers and sweeteners which have been fermented together.

Additionally, IDFA believes that the change in the language from "bulky flavors" (as used in the current yogurt standard) to "bulky flavorings ingredients" should not be interpreted in a manner that changes the current yogurt industry's understanding of this term. IDFA recommends that FDA either retain the term "bulky flavors" as used in the existing yogurt standards, or clarify that the change to using the term "bulky flavoring ingredients" does not alter the industry's understanding of the definition "bulky flavors." IDFA would welcome the opportunity to meet with the Agency to share the industry's views on the current use of bulky flavors.

As FDA noted, this approach will require low fat and nonfat yogurt to now be fortified with vitamin A, to restore nutrients lost with the removal of fat so the lower fat products are not nutritionally inferior to the full fat reference product. It is important to note that fortification of vitamin A to lower fat yogurt will have a significant economic impact resulting not only for the need for additional vitamin fortification equipment, but also the cost of relabeling for all low fat and nonfat types of yogurt to declare vitamin A in the ingredient declaration of the foods. IDFA noticed that FDA acknowledged that this change would potentially result in significant relabeling, reformulation, and equipment costs to manufacturers. However the analysis of economic impact appears to only include the costs of vitamin fortification equipment and fails to account for the majority of labeling that will need to be changed.

The yogurt category is dominated by sales of lower fat versions of yogurt. Retail supermarket sales data from Information Resources Inc in 2008 found that 93% (1420 million pounds) of branded spoonable yogurt sold was low fat or fat free yogurt, and only 6.6% (100 million pounds) was regular fat yogurt. Total spoonable yogurt sales (including both branded and private label) volume grew 17.3% from 1,625 million pounds in 2003 to 1900 million pounds in 2008. Furthermore the growth in yogurt sales is attributed to increased sales of lower fat versions of low fat and fat free yogurt. Data for branded spoonable yogurts showed that the 2008 sales volume of regular fat yogurt declined by 35 % from 2007, while sales of fat-free varieties of yogurt increased by 17.4 % from 2007.

As sales of low fat yogurt account for more than 90% of total yogurt sales, IDFA is requesting that FDA provide a two year implementation date for these label changes that is consistent with the Uniform Compliance date for label changes. This timetable will provide sufficient time for processors to deplete existing packaging inventory, reformulate products to the new fat levels, install fortification equipment, make the necessary label changes.

b. Acidity of yogurt.

IDFA agrees with FDA that both minimum titratable acidity and maximum pH are appropriate acidity measurements for yogurt. IDFA's earlier comments recommended titratable acidity, however we now recognize that pH is a valuable analytical tool once other ingredients are added to the yogurt. Ingredients added to yogurt such as fruits and flavorings imparting colors to the food can interfere with detecting the visual color change endpoint used in titratable acidity measurement. IDFA believes that a minimum titratable acidity of 0.7 % is too high for some yogurt products that use novel flavorings like chocolate or delicate fruit flavors that can be overshadowed by tart, acidic yogurt. We recommend that the new standard set a level not less than 0.6% titratable acidity in the "white mass portion" (see definitions of white mass and bulky flavoring ingredients above).

The slight reduction in the required level of titratable acidity from not less than 0.7% to 0.6% is necessary to produce yogurt products that meet consumer expectations of a delicate creamy and tart yogurt taste which is not too acidic or sour and does not need to have higher levels of added sweeteners to counteract the acidity. Establishing the level at 0.6% titratable acidity will also align the U.S. standards with the Codex Standard of Fermented Milk.

IDFA also believes that the requirement of a maximum pH of 4.6 needs to be specific to the amount of elapsed time since filling the yogurt in the final package. This is requested in light of modifications made to the Pasteurized Milk Ordinance at the 2005 National Conference on Interstate Milk Shipments (NCIMS) that specified the time and temperature of yogurt during cooling based on an initial pH of 4.8 or below at filling and with a pH of 4.6 or below within 24 hours of filling. It is clear from pathogen challenge study data reviewed by FDA related to the NCIMS that yogurt is safe when the product is 4.6 or lower within 24 hours of filling.

Based on the comments provided above, IDFA proposes that section 131.200(a) be modified to require that yogurts have a minimum titratable acidity of not less than 0.6 percent expressed as lactic acid, measured in the white mass of the yogurt or a maximum pH of 4.6 or lower within 24 hour after filling, measured on the finished product.

c. Live and active cultures in yogurt

IDFA believes that the growing popularity of yogurt is based on consumer awareness that it is a healthy and nutritious food providing a good source of calcium and protein. The characterizing lactic cultures of yogurt *Lactobacillus delbrueckii* subspecies *bulgaricus* and *Streptococcus thermophilus,* which impart the delicate acidic flavor and creamy thick texture during the fermentation of the inherent lactose in the milk ingredients, also have an added benefit in lowering the lactose content of the final food. Consumers now associate the benefits of consuming yogurt with live and active cultures in the food. IDFA and our members agree that live and active cultures are an essential characteristic of yogurt that consumers expect. IDFA members are now in agreement that the proposed standard for yogurt should be revised, consistent with the NYA Citizen Petition, to require all yogurts to contain a minimum level of live and active cultures 10^7 colony-forming units per gram (CFU/g) at the time of manufacture with a reasonable expectation of 10^6 CFU/g through the product's shelf life.

In addition, manufacturers may test their yogurt products to demonstrate that the products, under proper distribution and storage conditions, would be expected to contain at least 10^6 CFU/g of live and active cultures through the manufacturer's designated code life for the product. IDFA asserts that only the requirement for yogurt to contain a minimum level of live and active cultures 10^7 colony-forming units per gram (CFU/g) at the time of manufacture should be applied as regulatory enforcement of adherence to the standard.

IDFA members would like to express their concerns with accuracy and repeatability of testing methods used for enumeration of yogurt cultures. Testing conducted by industry and at outside laboratories has found variation between different testing methods and lack of repeatability between duplicate samples. IDFA recommends that for accuracy and repeatability the International Standard IOS 7889/ IDF 177 Yogurt - Enumeration of Characteristic microorganisms - colony count technique at 37 C method be used to determine the level of live and active cultures rather than the aerobic plate count. Additionally, enumeration of yogurt cultures for regulatory enforcement purposes should be conducted on samples collected from the manufacturing facility and tested within 24 hours to ensure integrity of the sample and provide for a uniform time of analysis.

Additionally, IDFA recommends clarification by FDA that a proposed change to require a minimum of 10^{7} CFU/g live and active characterizing cultures, will not be applied to non-standard products that use yogurt as an ingredient such as "frozen yogurt," "yogurt coated cereals" or "dried yogurt powders." IDFA believes that these foods, which do not meet the standard of identity for yogurt, but use yogurt as an ingredient should be able to continue using the appropriately descriptive term "yogurt" as part of the food's statement of identity on the label. We feel that it is critical for FDA to address this matter in the preamble of the final rule.

d. Heat treatment of yogurt after culturing

Based on IDFA's position that yogurt must contain a specific level of live and active cultures, the revised yogurt standards no longer need to maintain the current labeling descriptor "heat-treated after culturing" for yogurt that undergoes heat treatment after the culturing process. Heat-treated yogurt products which do not contain live and active cultures should be prohibited from being labeled "yogurt" and such products should be labeled with some other descriptive or fanciful name. Furthermore, IDFA believes that consumers may not understand the current mandatory label statement “heat-treated after culturing." If FDA nonetheless continues to permit heat-treated products to be labeled “yogurt,” IDFA recommends that FDA require such products to be labeled with the phrase “does not contain live and active cultures” in close proximity to the name of the food on the principal display panel.

e. Use of reconstituted milk forms as basic dairy ingredients

IDFA members support FDA's proposal to revise Sec. 131.200 to permit reconstituted forms of cream, milk, partially skimmed milk, and skim milk as basic ingredients and rename the heading "basic dairy ingredients" instead of "optional dairy ingredients." As discussed in 1981, fluid milks supplies may be disproportionately low in southern states and other regions and could inflate the price of yogurt in that area if reconstituted milk ingredients were excluded. This issue is still relevant today. These dairy ingredients both in liquid, dry and reconstituted forms have been used historically during the stayed provision to produce safe and high quality yogurt products.

f. Use of safe and suitable milk-derived ingredients as optional dairy ingredients

IDFA fundamentally supports the use of all types of safe and suitable milk derived ingredients in yogurts such as whey protein, milk protein concentrates, caseinates, milk fractions, and lactalbumins as basic milk ingredients contributing to the minimum required 8.25% nonfat solids. However, we realize the use of these ingredients can be accomplished using FDA's existing framework of regulations that permits flexibility for the use of ingredients that are needed to achieve a nutrient content claim or when such ingredient serves a function as an emulsifier or stabilizer in the food. As a result IDFA is neutral on the proposed definition that limits the use of other safe and suitable milk-derived ingredients as "optional dairy ingredients" used to increase the nonfat solids content of the food.

g. Use of safe and suitable cultures in addition to the characterizing bacterial cultures

FDA's proposal to explicitly state that use of other optional safe and suitable bacterial cultures for yogurt is provided for in the standards is strongly supported by IDFA. The continued growth of the yogurt category is in part due to additional probiotic cultures that are added to compliment the characterizing yogurt cultures. This change will provide clarity to the standard.

h. Use of sweeteners

IDFA welcomed FDA's conclusion to provide for the use of any safe and suitable sweetening ingredients, in lieu of the current allowance for certain nutritive carbohydrate sweeteners. We agree that this modification introduces flexibility in the manufacture of yogurt without adversely affecting the basic nature and essential characteristics of yogurt. IDFA fully supports the changes proposed to provide for the use of any safe and suitable sweeteners in yogurt and accordingly to replace the term "nutritive carbohydrate sweetener'" with "sweetener(s)". We also agree that consumers will seek information about the type of sweetening ingredients used by reading the ingredient statement for yogurt as they do with other foods. Therefore, there should be no requirement to require declaration of non-nutritive sweeteners, when used as part of the name of the food.

i. Use of safe and suitable emulsifiers in yogurt.

IDFA supports FDA's proposed change to the yogurt standards that would allow for safe and suitable emulsifiers. Emulsifiers are commonly used in dairy products and including provisions for use of emulsifiers in yogurt will allow for more opportunities in product development to formulate products that meet consumer's expectations of a creamy uniform texture.

j. Use of safe and suitable preservatives in yogurt.

IDFA supports permitting the use of safe and suitable preservatives as optional ingredients in the manufacture of yogurt. The industry believes it is necessary and appropriate to permit the use of safe and suitable preservatives in the manufacture of all types of **y**ogurt and the use should not be solely limited to yogurts that are heat-treated after culturing.

k. Use of optional milk-derived ingredients after pasteurization and culturing

IDFA respectfully requests that FDA reconsider its decision not to permit the addition of milk derived ingredients after pasteurization and culturing. IDFA fully supports the NYA proposal that requested milk-derived ingredients should be permitted to be added after culturing if the dairy ingredients are pasteurized and handled in a manner to prevent post-pasteurization contamination. Permitting the use of such pasteurized dairy ingredients after culturing is similar to the practice of adding pasteurized cottage cheese dressing to cottage cheese curd to produce the cottage cheese. Furthermore IDFA believes that the use of adding pasteurized milk ingredients after pasteurization and culturing will provide for innovation in product formulation without compromising the safety of the final product.

l. Use of whey protein concentrates as a basic ingredient
Initially, IDFA asserted that reconstituted dairy ingredients, whey protein concentrate (WPC) and whey protein isolate (WPI) should be allowed as standard dairy ingredients for yogurt. We continue to believe that the use of WPC or WPI contributes in the formulation of yogurt both functionally as a stabilizer, and nutritionally to provide a higher quality of protein than milk. However, IDFA does not oppose FDA's proposal that limits the use of whey and whey ingredients to "other optional ingredients."

m. Percent dairy ingredients
IDFA agrees with FDA's proposal to not require a minimum of 51 percent dairy ingredients in yogurt. We believe there is no need to ensure a minimum amount of dairy ingredients as the proposed yogurt standard requires the basic ingredients of yogurt to be either milk or certain milk-derived ingredients and that the yogurt must contain a minimum amount milk solids non fat.

n. Use of any safe and suitable ingredient for nutritional or functional purposes
See IDFA comments in section f.

o. Methods of analysis
As noted above in section c, IDFA members have concerns with accuracy and repeatability of testing methods used for enumeration of yogurt cultures. Methods such as the "aerobic plate count methods described in Chapter 3 of FDA's Bacteriological Analytical Manual" that are appropriate for the enumeration of aerobic bacteria are not suitable and reliable for detection of characterizing yogurt cultures or the other optional cultures that may be added. Therefore, IDFA recommends using the International Standard IOS 7889/ IDF 177 Yogurt - Enumeration of Characteristic microorganisms - colony count technique at 37 C method to determine the level of live and active cultures rather than the aerobic plate count.

p. Vitamins and minerals as optional ingredients
IDFA understands FDA's proposal to align the optional fortification of vitamin A and D in yogurt with nutrient content claims used for other foods. However, IDFA requests that the provisions for vitamin A and/or vitamin D fortification be retained in terms of the required amounts and the nomenclature section of the current yogurt standards. We request this not be changed based on the long standing practice that permits and defines vitamin A and D fortification in yogurt and all other milk and milk product standards. If voluntary nutrient content claims are made for added minerals or vitamins other than vitamins A and D, such claims would be required to follow the appropriate regulations as they relate to level and labeling requirements.

IDFA asserts that changing the framework for labeling yogurts fortified with vitamin A and/or D to the requirements of relative nutrient content claims would result in additional labeling of comparative statements and quantitative information that is not currently required for milk or other milk products. This change could result in consumer confusion. Flexibility and uniformity can be best achieved if FDA were to consider retaining the current provisions for optional vitamin A and/or D and the specific nomenclature provided in the standard for labeling with a slight modification. We recommend that in the sections for vitamins A and D the amounts should be based on a percentage of the recommended Daily Value rather than a specific level per quart. We also suggest that the yogurt standards be further amended in the section for vitamin D to include the words "not less than" before the level of vitamin D." Those changes will permit adding higher levels of vitamin D if warranted in the future by recommendations of the Institute of Medicine's (IOM) Committee and allow flexibility to align addition of vitamins A and D with any updates of the Daily Values or Recommended Daily Intakes.

Specifically IDFA suggests the following language be used:

(b) Vitamin addition (optional).
(1) If added, vitamin A shall be present in such quantity that the food contains not less than 10% Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practice.

(2) If added, vitamin D shall be present in such quantity that the food contains not less than 25% Daily Value per Reference Amount Commonly Consumed (RACC) thereof, within limits of current good manufacturing practices

Conclusion:

IDFA and our members that manufacture yogurt agree there is a need for updating the existing yogurt standard to permit the use of new technologies as to ingredients and processing techniques, product development and consumer benefits. In general, IDFA members support the NYA petition which would establish a new yogurt standard to replace the currently existing three fragmented standards for yogurt, lowfat yogurt and nonfat yogurt. The revised standard will reflect food labeling changes that were enacted with the Nutrition Labeling and Education Act (NLEA) of 1990, as well as codify provisions in the standard for the use of optional dairy ingredients that were stayed by FDA in 1982. Modernizing the yogurt standards is important to allow manufacturers flexibility with technology advances and industry practices.

As mentioned in our detailed comments above, IDFA urges the yogurt proposal be revised to require all yogurts to contain a minimum level of live and active cultures 10^7 colony-forming units per gram (CFU/g) at the time of manufacture. Heat-treated yogurt products which do not contain live and active cultures at the required level should be prohibited from being labeled "yogurt" and such products should be labeled with some other descriptive or fanciful name. As a result the revised yogurt standards no longer need to maintain the current labeling descriptor "heat-treated after culturing" for yogurt that undergoes heat treatment after the culturing process.

We strongly urge FDA to move forward swiftly with publishing a final rule to modernize the standard of identity for yogurt. However due to the financial burdens of label changes, discarding obsolete packaging inventory and installing vitamin fortification equipment required by this new standard, we ask that FDA provide for an appropriate time period for implementation of at least two years. Our staff looks forward to providing the Agency with more detailed and comprehensive information that it may need to act, and answer any questions you have.

Respectfully submitted,

Cary Frye

Cary Frye
Vice President,
Regulatory Affairs

Example:	Lowfat Yogurt with fat in the fruit prep	Lowfat Yogurt with 2% milkfat, HIGHER fruit prep/sugar	Lowfat Yogurt with 2% milkfat, LOW fruit prep/sugar	Lowfat Yogurt with 2% milkfat, Plain	Lowfat Yogurt with 1.5% milkfat, high fat toppings in a side car	Nonfat Yogurt with 0% milkfat, with flavor and fruit, includes secondary food (cracker, pretzels) in overcap	Nonfat yogurt (0% Milkfat) with Toppings that contain some fat in a side car Single Column Format	Double Column Format
Flavor Name	Coconut Lowfat Yogurt	Peach Greek Lowfat Yogurt 2% Milkfat	Greek Strawberry Lowfat Yogurt 2% Milkfat		Raspberry Lowfat Yogurt 1.5% Milkfat with Chocolate Chips and Almonds	Greek Banana Nonfat Yogurt with Graham Bites		
Name of the Food under the Current SOI	LOWFAT YOGURT VITAMINS A & D 1 ½ % MILKFAT	GREEK LOWFAT YOGURT VITAMIN D ADDED 2% MILKFAT	GREEK LOWFAT YOGURT VITAMIN D ADDED 2% MILKFAT	LOWFAT YOGURT 2% MILKFAT	RASPBERRY FLAVORED LOWFAT YOGURT WITH CHOCOLATE CHIPS AND ALMONDS 1.5% MILKFAT VITAMINS A & D	BANANA GREEK NONFAT YOGURT VITAMIN D ADDED WITH GRAHAM BITES	NONFAT YOGURT WITH TOPPINGS – VITAMIN D ADDED	
Nutrition Facts Panel	Nutrition Facts Serving Size 1 container (170g) Servings Per Container 1 Amount Per Serving Calories 160 Calories from Fat 30 % Daily Value* Total Fat 3g 5% Saturated Fat 2.5g 13% Trans Fat 0g Cholesterol 10mg 3% Sodium 110mg 5% Total Carbohydrate 27g 9% Dietary Fiber 0g 0% Sugars 20g Protein 6g 12% Vitamin A 15% • Vitamin C 0% Calcium 20% • Iron 0% Vitamin D 20% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 container (150g) Servings Per Container 1 Amount Per Serving Calories 150 Calories from Fat 25 % Daily Value* Total Fat 2.5g 4% Saturated Fat 2g 10% Trans Fat 0g Cholesterol 10mg 3% Sodium 70mg 3% Total Carbohydrate 20g 7% Dietary Fiber 0g 0% Sugars 16g Protein 11g 22% Vitamin A 6% • Vitamin C 0% Calcium 10% • Iron 0% Vitamin D 20% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 container (150g) Servings Per Container 1 Amount Per Serving Calories 130 Calories from Fat 25 % Daily Value* Total Fat 3g 5% Saturated Fat 1.5g 8% Trans Fat 0g Cholesterol 20mg 7% Sodium 70mg 3% Total Carbohydrate 10g 3% Dietary Fiber 0g 0% Sugars 9g Protein 15g 30% Vitamin A 10% • Vitamin C 4% Calcium 15% • Iron 0% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 container (150g) Servings Per Container 1 Amount Per Serving Calories 120 Calories from Fat 30 % Daily Value* Total Fat 3g 5% Saturated Fat 2.5g 13% Trans Fat 0g Cholesterol 15mg 5% Sodium 50mg 2% Total Carbohydrate 6g 2% Dietary Fiber 0g 0% Sugars 6g Protein 15g 30% Vitamin A 2% • Vitamin C 0% Calcium 15% • Iron 0% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 container (150g) Servings Per Container 1 Amount Per Serving Calories 200 Calories from Fat 70 % Daily Value* Total Fat 8g 12% Saturated Fat 2.5g 13% Trans Fat 0g Cholesterol 10mg 3% Sodium 115mg 5% Total Carbohydrate 26g 9% Dietary Fiber 1g 4% Sugars 19g Protein 8g 16% Vitamin A 15% • Vitamin C 0% Calcium 20% • Iron 4% Vitamin D 15% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 container (131g) Servings Per Container 1 Amount Per Serving Calories 230 Calories from Fat 35 % Daily Value* Total Fat 4g 6% Saturated Fat 3g 15% Trans Fat 0g Cholesterol 0mg 0% Sodium 350mg 15% Total Carbohydrate 38g 13% Dietary Fiber 1g 4% Sugars 16g Protein 10g 20% Vitamin A 4% • Vitamin C 0% Calcium 8% • Iron 8% Vitamin D 10% *Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs. Calories 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2400mg 2400mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g	Nutrition Facts Serving Size 1 Container (141g) Calories 170 Calories from Fat 25 *Percent Daily Values (DV) are based on a 2,000 calorie diet. Amount/Serving %DV* Total Fat 3g 5% Saturated Fat 2g 10% *Trans* Fat 0g Cholesterol 5mg 2% Sodium 75mg 3% Amount/Serving %DV* Total Carbohydrate 25g 8% Dietary Fiber 1g 4% Sugars 21g Protein 11g 22% Vitamin A 0% • Vitamin C 0% • Calcium 15 % • Iron 4% • Vitamin D 10% INGREDIENTS: NONFAT YOGURT: CULTURED GRADE A NON FAT MILK, SUGAR, WATER, BANANAS, FOOD STARCH - MODIFIED, NATURAL FLAVORS, LOCUST BEAN GUM, MALIC ACID, POTASSIUM SORBATE (TO PRESERVE FRESHNESS), ANNATTO EXTRACT (FOR COLOR), VITAMIN D3. TOPPING: DARK CHOCOLATE (SUGAR, UNSWEETENED CHOCOLATE, COCOA BUTTER, SOY LECITHIN, VANILLA EXTRACT), GRAHAM CRACKER (UNENRICHED WHEAT FLOUR, SUGAR, LIQUID POLYDEXTROSE, CANOLA OIL, WATER, WHEAT BRAN AND WHEAT GERM DERIVED FROM WHITE WHEAT, HONEY, NATURAL FLAVOR, SALT, BAKING SODA, SOY LECITHIN), PEANUT BUTTER CHIPS (SUGAR, PALM KERNEL OIL, PARTIALLY DEFATTED PEANUT FLOUR, NONFAT DRY MILK POWDER, SALT, SOY LECITHIN).	Nutrition Facts Serving Size 1 container (141g) Servings Per Package 6 Yogurt Only / with Topping Amount Per Serving Calories 110 / 170 Calories from Fat 0 / 25 % Daily Value* / % Daily Value* Total Fat 0g 0% / 3g 5% Saturated Fat 0g 0% / 2g 10% *Trans* Fat 0g / 0g Cholesterol 5mg 2% / 5mg 2% Sodium 40mg 2% / 75mg 3% Total Carbohydrate 18g 6% / 27g 9% Dietary Fiber 0g 0% / 1g 4% Sugars 17g / 23g Protein 10g 20% / 11g 22% Vitamin A 0% / 0% Vitamin C 0% / 0% Calcium 10% / 15% Iron 0% / 4% Vitamin D 15% / 15% *Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs. Calories: 2,000 2,500 Total Fat Less than 65g 80g Sat Fat Less than 20g 25g Cholesterol Less than 300mg 300mg Sodium Less than 2,400mg 2,400mg Potassium 3,500mg 3,500mg Total Carbohydrate 300g 375g Dietary Fiber 25g 30g Protein 50g 65g INGREDIENTS: NONFAT YOGURT: CULTURED GRADE A NON FAT MILK, SUGAR, WATER, FOOD STARCH - MODIFIED, NATURAL FLAVORS, MALIC ACID, POTASSIUM SORBATE (TO PRESERVE FRESHNESS), SODIUM CITRATE, VITAMIN D3. TOPPING: DARK CHOCOLATE (SUGAR, UNSWEETENED CHOCOLATE, COCOA BUTTER, SOY LECITHIN, VANILLA EXTRACT), GRAHAM CRACKER (UNENRICHED WHEAT FLOUR, SUGAR, LIQUID POLYDEXTROSE, CANOLA OIL, WATER, WHEAT BRAN AND WHEAT GERM DERIVED FROM WHITE WHEAT, HONEY, NATURAL FLAVOR, SALT, BAKING SODA, SOY LECITHIN), PEANUT BUTTER CHIPS (SUGAR, PALM KERNEL OIL, PARTIALLY DEFATTED PEANUT FLOUR, NONFAT DRY MILK POWDER, SALT, SOY LECITHIN).
Current SOI Rationale	• Milkfat is at 1 1/2% before the addition of bulky flavors • Total Fat labels at 3 g • 3.109 actual (or per 6 oz NLR RACC) • 4.145 per current 8 oz RACC	• Milkfat is at 2% before addition of bulky flavors. • Total fat labels at 2.5g o 2.582 actual in 5.3 oz o 2.92 actual (or per 6 oz NLR RACC) could potentially be Low Fat with NLR o 4.145 per current 8oz RACC	• Milkfat is at 2% before addition of bulky flavors. • Total fat labels at 3g o 2.8g actual in 5.3 oz o 3.17g actual (or per 6 oz NLR RACC) o 4.23g per current 8oz RACC	• Milkfat is at 2% o 2g/100g or normal 5.3 oz tub = 2.5g o 3.4g per 6 oz (NLR) o 4.5g per 8 oz (current) • Vitamin addition optional	• Milkfat is at 1.5% before inclusion of particulates. • Yogurt portion is about 135g; would label singularly at 1.5g fat o Yogurt portion meets Low Fat NLEA requirements at either 6oz (NLR) or 8oz (current). • Total fat labels at 8g.	• Milkfat is at 0%, includes addition of flavor / fruit • Yogurt portion about 113g; would label singularly at 0g fat o Would meet Fat Free NLEA requirements at either 6oz (NLR) or 8oz (current) • Due to secondary food, total serving fat labels at 4g	• Same product shown above in a single column format and a two column format • Single column format would have nutrition for total product only • Double column format: first column for yogurt and second column for total product • Total fat o 3 g for 5 oz serving o 3.6 g for 6 oz RACC (NLR) o 4.8 g for 8 oz RACC (current)	
Name of the food and rationale under proposed SOI:	• Product cannot be called Low Fat per NLEA guidelines as it is over 3g of total fat per RACC. • Product cannot be called yogurt as there is not 3.25% milkfat before addition of flavors. • There is potential to claim Reduced-Fat, but this requires comparison language. What is the comparison product? • The additional fat is from coconut particulates and coconut cream. • Particulates are not in a separate compartment / side car. The consumer cannot separate; therefore, there is not a possibility to label yogurt AND yogurt with coconut	• Product cannot be called Low Fat per NLEA guidelines as it is over 3g of total fat per RACC (until NLR). • Product cannot be called yogurt as there is not 3.25% milkfat before addition of flavors. • Could this potentially impact sugar reduction efforts? Decreasing sugar would decrease sugar to fat ratios. An increase in fat would take away Low Fat claim ability.	• Product cannot be called Low Fat per NLEA guidelines as it is over 3g of total fat per RACC. • Product cannot be called yogurt as there is not 3.25% milkfat before addition of flavors. • Companies would need to increase sugar/prep OR protein to displace fat to meet nutrient content claim for Low Fat.	• Product cannot be called Low Fat per NLEA guidelines as it is over 3g of total fat per serving with either a 6 oz or 8 oz RACC. • Product cannot be called yogurt as there is not 3.25% milkfat.	• Overall product cannot be called Low Fat per NLEA guidelines as it is over 3g of total fat per RACC (6 oz RACC) • Product cannot be called yogurt as there is not 3.25% milkfat before addition of flavors. • Space limitations on small packages prevent dual NFP (showing yogurt and total product)	• Product cannot be called Nonfat (or Fat Free) per NLEA guidelines as it is over 3g of total fat per serving. • Product cannot be called yogurt as there is less than 0.5% milkfat in yogurt portion of the food. • Labelling as separate components still does not allow LOW FAT in name of food per NLEA guidelines. • Product cannot be called yogurt as there is not 3.25% milkfat before addition of flavors. o Space limitations on small packages for dual NFP	• Overall product may not be called Nonfat/Fat free per NLEA guidelines since it is 3.6g fat per RACC (6 oz for yogurt) • Product cannot be called yogurt since not 3.25% milkfat (under 0.5% milkfat in yogurt portion of food) • Dual columns may be shown on multipacks where space is available • Space limitations on small packages prevent dual NFP	
Proposed Solution:	**Label total fat in compliance with NLEA:** • Fat Free/Nonfat Yogurt - <0.5 g fat per RACC • Low Fat Yogurt - 3g fat or less • Yogurt - >3g fat Remove the requirement of 3.25% milkfat for full fat to eliminate the gap for labeling fat				**Continue to label the yogurt on FOP according to the fat rules in NLEA** Example: "Fat Free yogurt with chocolate chips and almonds" Show overall fat in the nutrition facts panel (either in a single or dual column format)			

Comprehensive REVIEWS in Food Science and Food Safety

Scientific and Technical Aspects of Yogurt Aroma and Taste: A Review

Winny Routray and Hari N. Mishra

Abstract: Yogurt is a basic dairy product that has been consumed for centuries as a part of the diet, even when its beneficial effects were neither fully known nor scientifically proven. With time, yogurt has been continuously modified to obtain a product with better appeal and nutritional effects. The flavor components of yogurt are affected because of these modifications. The present review article is focused on the influence of the different parameters and modifications on aroma and taste components of yogurt. Extensive work has been done to explore the effect of chemical components as well as the microbial, processing, and storage aspects. The popularity of yogurt as a food component depends mainly on its sensory characteristics, of which aroma and taste are most important. This review also outlines the effects of the different modifications attempted in the composition of yogurt.

Introduction

With the development of processing technologies and the growing competition in the food market, the urge to provide nutritious food with appealing flavor properties has increased. Fermented food products have been around for thousands of years and have played an important part in human diet. Yogurt is one of the popular fermented milk products having different names and forms (Kurmann and others 1992; Tamime and Robinson 2007). It is a mixture of milk (whole, low-fat, or nonfat) and even cream fermented by a culture of lactic acid-producing bacteria, *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*. Other bacteria may be added to the culture. The generalized process of yogurt production is summarized in Figure 1. Yogurt generally contains at least 3.25% milk fat and 8.25% solids not fat. Yogurt can be low fat (0.5% to 2% milk fat) or nonfat (less than 0.5% milk fat), which is more preferred because of health concerns. The popularity of yogurt is due to various health claims and therapeutic values. Along with these, the flavor of yogurt has played an important role in increasing its consumer demand, on which this review will concentrate. Sweeteners (for example, sugar, honey, and aspartame), flavorings (for example, vanilla and coffee), and other ingredients (for example, fruits, preserves, and stabilizers such as gelatine to improve the textural property) are added that modify the flavor of yogurt. Some of the fruits and fruit flavors currently used are summarized in Table 1. The aroma, body, and taste of yogurt and other cultured dairy products can vary depending on the type of culture and milk, amount of milk fat and nonfat milk solids, fermentation process, and temperature used.

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As there are many compounds and other factors affecting the overall yogurt aroma, the study of the effect of different factors on yogurt flavor can help food technologists to make desirable changes to maintain the popularity of yogurt as a diet food in the future.

Importance of Flavor in the Acceptance of Yogurts

Flavor perception is a complex phenomenon and traditionally flavor consists of odor, taste, and somatosenses, which has been discussed in detail by Reineccius (2006) in "Flavor chemistry and technology." The specialized taste receptor cells (collectively known as taste buds) located in the mouth lead to a combined complex sensation otherwise known as taste. The sensations can be expressed as sweet, sour, salty, bitter, and umami, which can be further divided into different categories of subsensations (Reineccius 2006). Odor is the complex sensation occurring because of the interaction of the volatile food components with the olfactory receptors, whose stimulus can be orthonasal (entrance of the odor stimulus is directly from the nose when one sniffs the food) or retronasal (entrance of the stimulus from the oral cavity when someone eats a food) (Reineccius 2006). Taste and odor are complex phenomena in themselves and the interaction of these with other sensory properties increases the complexity of human perception.

Flavor (taste plus odor) is not only a characteristic property of food that controls consumer acceptance but it is also associated with the feeling of wellbeing. Yogurt is a food that has its own peculiar and popular flavor, which is evident by its constant presence in the list of preferred foods worldwide. As a consequence of increasing consciousness about health and increasing competition in the food market, scientific studies are taking place around the world to obtain new products. Before trying any new food innovation in the market, sensory evaluation either by descriptive methods or methods using different sensory analyzers such as the electronic nose is increasingly encouraged. In this era of functional foods, of which yogurt is an important part, individuals' worries

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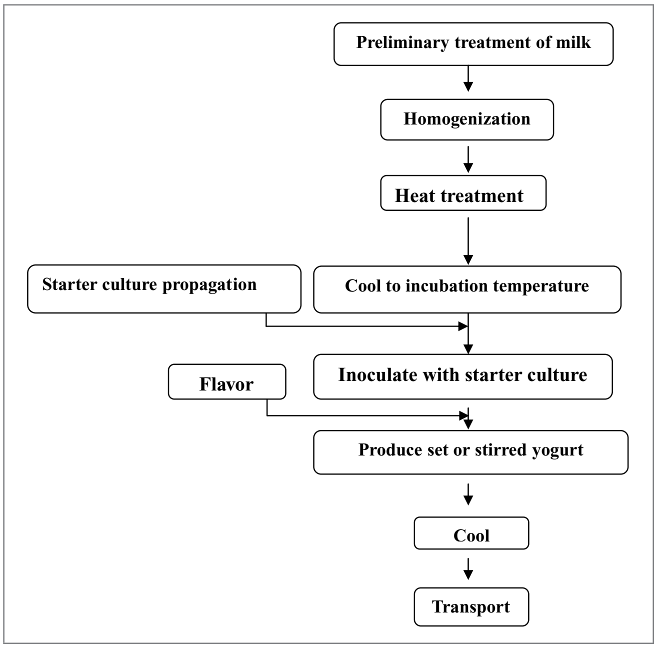

Figure 1–Generalized scheme illustrating the modern method for the production of yogurt.

regarding the new technologies used and the modernity of the processes might influence the acceptance of the food products (Devcich and others 2007). As will be discussed in later sections, there are many factors affecting flavor formation, flavor release, and perception, so mentioning the different constituents and treatments while marketing might have a significant effect on liking and purchase probability (Johansen and others 2010). In the case of yogurt, information regarding low fat content has been found to reduce consumer expectations regarding sensory qualities, but the presence of all types of yogurt in the market with varying fat contents implies that there are many types of consumers and there is demand for all types of products. However, there is one common point of concern on which all researchers concentrate, whenever they modify any food product they have in mind, the ultimate flavor and related sensory properties.

Table 1–Fruits and fruit flavors currently used in yogurt.

I	**Single**		
	Apricot	Apple	
	Black cherry	Bramble (artic)	
	Black currant	Cranberry	
	Mandarin	Damson	
	Peach	Elderberry	
	Pineapple	Grape	
	Raspberry	Guanabana	
	Strawberry	Guava	
	Banana	Kiwi	
	Bilberry	Kokum	
	Blackberry	Lime	
	Gooseberry	Loganberry	
	Grapefruit	Mango	
	Lemon	Papaya	
	Melon	Passion fruit	
	Orange	Pear	
	Plum	Pina colada	
	Prune	Quince	
	Rhubarb	Redcurrant	
	Tangerine	Sapota wortleberry	
II	**Mixed**		
	Fruit cocktail	Apple/raisin	Apple/wortleberry
	Fruit of the forest	Apple/orange	Cherry/elderberry
	Peach/raspberry	Cherry/orange	Grape/figs
	Peach/apricot	Cherry/pineapple	Kiwi/gooseberry
	Raspberry/redcurrant	Mixed citrus	Peach/passion fruit
	Strawberry/kiwi	Pear/banana	Pineapple/coconut
	Strawberry/coconut	Strawberry/blackberry	Raspberry/coconut

Source: Tamime and Robinson 2007.

Aroma Components of Yogurt

The odor and taste of soured milk products are characterized by numerous volatile bacterial metabolites, some of which are by-products of lactic acid fermentation or are produced by other reaction mechanisms. Lactic acid itself is suggested to be one of the major compounds significantly contributing to yogurt flavor (Beshkova and others 1998). More than 90 flavor compounds (Table 2) have been identified so far (Ott and others 1997; Lubbers and others 2004). It has been reported that the aroma and taste of yogurt are mainly because of the presence of nonvolatile or volatile acids and carbonyl compounds, and especially the group of carbonyl compounds is believed to have a significant influence on the final yogurt aroma due to their relatively higher concentrations (Imhof and others 1994; Kaminarides and others 2007). The most important aromatic components are acetaldehyde, acetone, acetoin, and diacetyl in addition to acetic, formic, butanoic, and propanoic acids (Figure 2).

The typical aroma of yogurt is characterized chiefly by acetaldehyde, so it is suggested as a major flavor compound. As reported by Hamdan and others (1971), "Pette and Lolkema (1950) were the first to suggest that acetaldehyde was the most important constituent of yogurt aroma." It was later suggested that "high concentrations of acetaldehyde are necessary to produce a desirable flavor in yogurt" (Hamdan and others 1971). The higher concentration of acetaldehyde (in the range of 5 to 21 ppm) is reported to be due to the low utilization rate of this compound. The lack of alcohol dehydrogenase enzyme in the bacteria, responsible for the conversion of acetaldehyde into ethanol, is suggested to be the reason of low utilization of acetaldehyde (Chaves and others 2002). Some investigators found that atypical and weak flavor resulted from less than 4.0 ppm acetaldehyde (which was considered to be the nonoptimal amount), whereas good flavor resulted when greater than 8.0 ppm of acetaldehyde was produced (Sandine and others 1972). Pathways of production of acetaldehyde have been summarized by Tamime and Robinson (2007), Zourari and others (1992), and Chaves and others (2002). Compounds such as glucose, catechol, glyceraldehydes, and acetylene, amino acids such as threonine and glycine, and DNA can act as the precursors of acetaldehyde. Zourari and others (1992) have emphasized the pathways based on glucose, threonine, and DNA components, whereas Tamime and Robinson (2007) and Chaves and others (2002) have illustrated the different pathways of synthesis of acetaldehyde from different possible precursors. The most important pathway of formation of acetaldehyde is reported to be the breakdown of threonine to acetaldehyde and glycine and the enzyme responsible for the catalysis, threonine aldolase, has been detected in both *Lb. bulgaricus* and *S. thermophilus*. Threonine aldolase activity in *S. thermophilus* is significantly decreased when the growth temperature is increased from 30 to 42 °C (Lees and Jago 1976; Wilkins and others 1986), but in *Lb. bulgaricus* it remains identical. As yogurt is manufactured at higher temperature, it is expected to be mainly produced by *Lb. bulgaricus* (Zourari and others 1992).

Later it was also found that "some yogurt products with low acetaldehyde still have a typical yogurt aroma, suggesting that

Table 2–Aroma components of yogurt.

Nr.	Aroma component	Nr.	Aroma component
1	Acetaldehyde	50	1,3-dimethylbenzene (1,4?)
2	Dimethyl sulfide	51	3-penten-2-one
3	Methylcyclohexane	52	1,3-dimethylbenzene (1,3?)
4	Propanal	53	1-Methylpyrrole
5	2-propanone	54	3-heptanone
6	Furan	55	1-butanol
7	Methyl acetate	56	1-ethyl-4-methylbenzene
8	2-methylfurane	57	1-penten-3-ol
9	Butanal	58	Limonene
10	Ethyl acetate	59	1,4-dimethylbenzene (1,2?)
11	2-butanone	60	2-heptanone
12	Methanol	61	Propylbenzene
13	3-methylbutanal	62	3-methyl-2-butenal
14	Dichloromethane	63	2-pentylfuran
15	Benzene	64	Pyrazine
16	2-propanol	65	Ethenylbenzene
17	Ethanol	66	1-pentanol
18	2-pentanone	67	3-octanone
19	2,3-butanedione	68	2-methyl tetrahydrofuran-3-one
20	Acetonitrile	69	Trimethylbenzene
21	Chloroform	70	Methylpyrazine
22	Toluene	71	Octanal
23	2-butanol	72	3-hydroxy-2-butanone
24	S-methyl thioacetate	73	1-methyl ethenylbenzene
25	1-propyl alcohol	74	3-methyl-2-butenol
26	2,3-pentanedione	75	2-nonanone
27	Dimethyl disulfide	76	2-hydroxy-3-pentanone
28	Butyl acetate	77	Furfural
29	Hexanal	78	1H-pyrrole
30	2-hexanone	79	Benzaldehyde
31	Dimethyl trisulfide	80	2-methylpropanoic acid
32	Acetic acid	81	Butyric acid
33	Propionic acid	82	3-methylbutanoic acid
34	2-methyltetrahydrothiophen-3-one	83	2-dodecanone
35	2-undecanone	84	Benzothiazole
36	2-furanmethanol	85	2-pentadecanone
37	Pentanoic acid	86	Nonanoic acid
38	Hexanoic acid	87	γ-dodecalactone
39	Heptanoic acid	88	Benzoic acid
40	Octanoic acid	89	Methional
41	Decanoic acid	90	(2E)-nonenal
42	δ-dodecalactone	91	Methyl 2-methyl butanoate
43	1-nonen-3-one	92	Ethyl hexanoate
44	2-methyltetrahydrothiophen-3-one	93	Hexyl acetate
45	Guaiacol	94	Diacetyl
46	2-methylthiophene	95	Acetone
47	2-methyl-1-propanyl alcohol	96	Acetoin
48	Ethylbenzene	97	Formic acid
49	Butanoic acid		

Source: Ott and others 1997; Lubbers and others 2004.

acetaldehyde is only one component of yogurt aroma and is not identical with the true yogurt aroma" (Hamdan and others 1971). Lindsay and others (1965) showed that the harsh flavors are caused by overproduction of acetaldehyde in relation to diacetyl.

Despite the controversies over the role of diacetyl in the overall aroma expression of yogurt, diacetyl is one of the other major aroma compounds (GuerraHernández and others 1995; Beshkova and others 1998). *Streptococcus thermophilus* is reported as exclusively responsible for the production of diacetyl by some researchers (Rasic and Kurmann 1978), but others support *Lb. bulgaricus* as the major source of production of diacetyl (Dutta and others 1973; Beshkova and others 1998). Lactose and citrate both act as the precursor of diacetyl which has been illustrated in detail by Nilsson (2008).

Many other compounds were found to contribute to the aroma of the end product, including 2, 3-butanedione, 2, 3-pentanedione, dimethyl sulfide, and benzaldehyde (Imhof and others 1994). Six compounds (1-octen-3-one, 1-nonen-3-one, methional, 2-methyltetrahydrothiophen-3-one, (2E)-nonenal, and guaiacol) with intense odor were found for the first time in yogurt flavor by Ott and others (1997). 1-Nonen-3-one was identified by spectral means for the first time during this study and its low odor threshold justified its impact role in yogurt in spite of its low concentration. It can be observed that acetaldehyde is an important contributor to yogurt aroma but not the sole contributor and the net aromatic effect is the result of the combination of all the aromatic components present.

During the characterization of the sensory properties of traditional acidic and mild, less-acidic yogurts in another study, by a trained panel using a descriptive approach, it was observed that the important flavor differences found between 2 samples of yogurt were mainly due to the differences in the acidity and not due to different concentrations of the 3 aroma compounds, which were acetaldehyde, 2, 3-butanedione, and 2, 3-pentanedione (Ott and others 2000). This observation emphasizes the importance of acidity in yogurt flavor.

Factors Affecting Yogurt Aroma

There are several factors, such as the microbial factors, processing parameters, source of milk, and chemicals and additives used which affect the aromatic properties of yogurt. Some of these important factors are discussed here as they affect the overall yogurt flavor.

Effect of microbial factors

Lactic fermentation is the most important process in the manufacture of sour milk products (including yogurt). The production time and properties of the end product depend on the qualities and activity of the starter culture. Production of some of the carbonyl compounds affecting yogurt flavor, by yogurt starter cultures, is summarized in Table 3. The traditional yogurt culture is comprised of *S. thermophilus* and *Lb. bulgaricus*. It was found by Courtin and Rul (2004) that these 2 microorganisms' association affects the production of volatile molecules involved in flavor development. The 2 microorganisms enter a symbiotic relationship, which means they are mutually beneficial during fermentation (Hamdan and others 1971; Kroger 1976). The optimum souring temperature of yogurt culture is between 42 °C and 44 °C, and incubation takes around 3 h until the desired acidity is achieved. Both microorganisms perform better in symbiosis than if grown separately. Initial pH of the milk favors the faster growth of *Streptococci*. Thereafter, increase in acidity favors the growth of *Lactobacilli* whose optimum pH is below 4.5. Initially, *Lb. bulgaricus* benefits the growth of the *Streptococci* by releasing the amino acids valine, leucine, histidine, and methionine from the milk proteins. For its part, *S. thermophilus* promotes the growth of *Lactobacilli* by creating minute amounts of formic acid. At least in the initial phase, the mutual stimulation of the 2 species in the mixed culture causes more lactic acid and aromatic compounds to be formed faster than would be the case with any of the 2 single cultures. A harsh acid flavor occurs when *Lb. bulgaricus* predominates or when excessive amounts of starter are used (Crawford 1962). Similar observations of higher concentrations of lactic acid and sourness in the presence of symbiotic interaction have been reported by another research group (Masato and others 2008). Additional microorganisms such as yeasts can also be included as probiotics (Lourens-Hattingh and Viljoen 2001) in the culture. For example, alcohol and carbon dioxide produced by yeasts contribute to the refreshing, frothy taste of kefir (Wang and others 2008), koumiss, and leben that

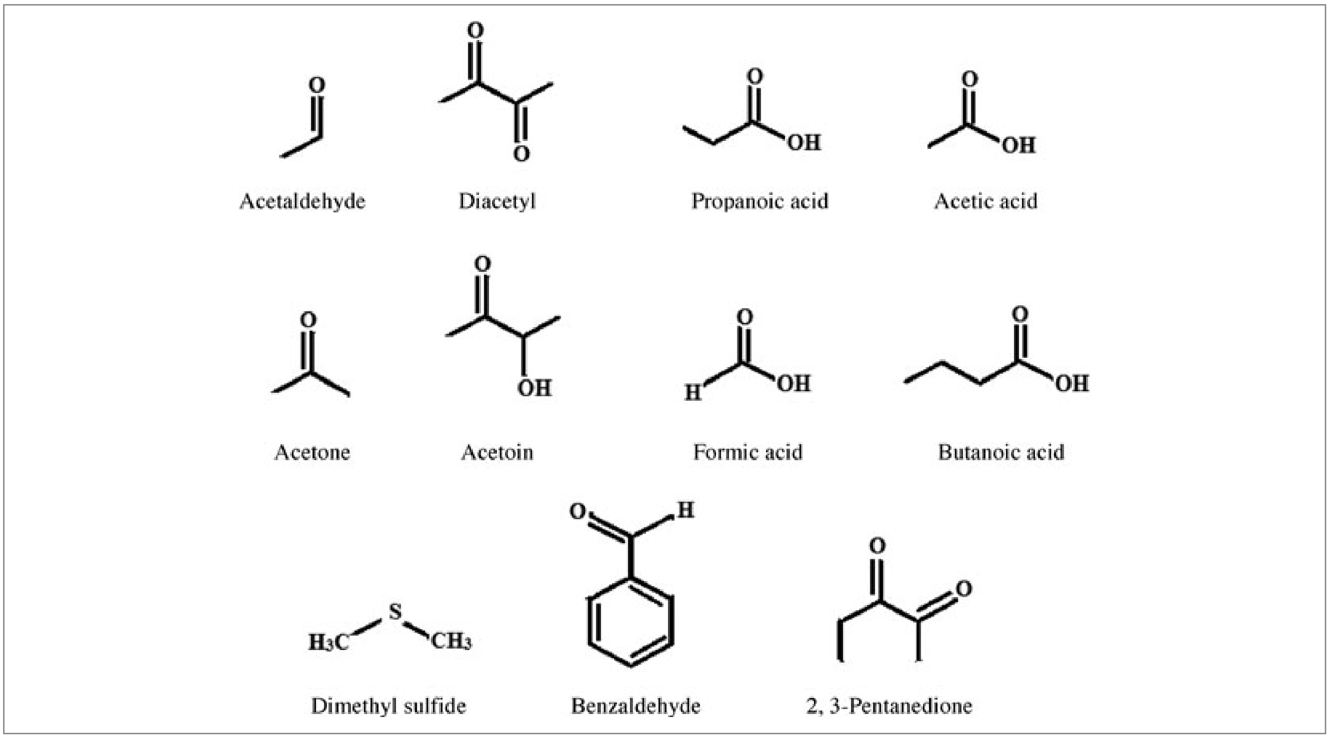

Figure 2–Major aroma compounds present in yogurt.

Table 3–Production of carbonyl compounds (μg/g) by yogurt starter cultures that affect the total overall aromatic property of yogurt.

Organism	Acetaldehyde	Acetone	Acetoin	Diacetyl
S. thermophilus	1.0 to 13.5	0.2 to 5.2	1.5 to 7.0	0.1 to 13.0
Lb. delbruekii subsp. *bulgaricus*	1.4 to 77.5	0.3 to 3.2	Trace to 2.0	0.5 to 13.0
Mixed cultures	2.0 to 41.0	1.3 to 4.0	2.2 to 5.7	0.4 to 0.9

Source: Tamime and Robinson 2007.

might be applied in case of yogurt by controlling optimized process conditions.

The efficiency of the symbiotic activity of *Lb. bulgaricus* and *S. thermophilus* was analyzed in the case of Bulgarian yogurt in terms of the "carbonyl compounds and saturated volatile-free fatty acids" produced. The highest activity of the yogurt cultures during the production process of carbonyl compounds was "during milk coagulation and cooling, up to 7 h." Maximum concentration was reported by 22 to 31 h. In the cooled sample of 22-h starter cultures, concentration of acetaldehyde was highest (1415.0 to 1734.2 μg per 100 g) followed by "diacetyl (165.0 to 202.0 μg per 100 g), acetoin (170.0 to 221.0 μg per 100 g), acetone (66.0 to 75.5 μg per 100 g), ethanol (58.0 μg per 100 g), and butanone-2 (3.6 to 3.8 μg per 100 g)." The thermophilic *Streptococcus* and *Lactobacillus* cultures, and the starter cultures mainly produced "acetic, butyric, and caproic acids" (Beshkova and others 1998).

To increase the production of yogurt aroma compounds, metabolic engineering has been very helpful, which is done by optimizing genetic and regulatory processes in the cells to increase their potential. Chaves and others (2002) studied the process of acetaldehyde production by *S. thermophilus* which was modified by metabolic engineering. There are many pathways of production of acetaldehyde by yogurt bacteria and in this case "reaction for acetaldehyde production catalyzed by serine hydroxymethyltransferase (SHMT)" was given special attention, which is "encoded by the *gly A* gene" and involves the "interconversion of threonine into glycine and acetaldehyde." An increase in acetaldehyde production was observed with supplementation of the growth medium with L-threonine. This implied that acetaldehyde production during fermentation could be correlated to the threonine aldose (TA) activity of SHMT. Inactivation of *glyA* leads to a severe decline of TA activity and subsequently absolute loss of acetaldehyde formation and vice versa. In another study by Ozer and others (2007), microbial transglutaminase (MTGase) was used at varying concentrations from 0 to 0.5 g/L for the treatment of nonfat set yogurt. It showed that the physical and sensory properties of nonfat set yogurt could be improved by incorporating MTGase up to a level of 0.3 g/L. These findings can be used to control and improve acetaldehyde production in fermented (dairy) products with *S. thermophilus* as starter culture. Higher levels of acetaldehyde production (Bongers and others 2005) and higher levels of diacetyl (Hugenholtz and others 2000) in the *Lactococcus lactis* cells can also be achieved by metabolic engineering.

Ozer and Atasoy (2002) studied the biochemical properties of yogurt samples produced by "nonviscous and viscous yogurt starter cultures and viscous cultures with methionine (10 and 30 mg/100 mL milk), threonine (5 and 10 mg/100 mL milk), and β-galactosidase (1 mg/100 mL milk), and with a heat-shocked culture." It was observed that the yogurts produced with the "viscous culture" contained least amounts of acetaldehyde, whereas the highest amount of acetaldehyde was observed in yogurts produced with "nonviscous culture." A significant increase of acetaldehyde level was observed because of the amino acid supplementation, lactose hydrolysis, and heat-shock treatments as compared to the samples inoculated with "viscous culture" only. These factors can be added to the list of other factors affecting the flavor of yogurt.

Several other combinations of microorganisms have been tried for the preparation of drinking yogurt and related beverages that has been summarized by Tamime and Robinson (2007).

Effect of use of different sources of milk

Different sources of milk differ in composition, which after fermentation provide different types of flavored yogurt with different consistencies. The type of milk used in various parts of the world differs with the food habits and popularity of the kinds of milk products consumed. Combinations of many types of milk have been used to obtain different kinds of yogurt.

Sheep and goat milk have been used to prepare yogurt during different studies. Pure goat milk was found to be unsuitable for the production of yogurt as this milk is low in solids and the yogurt produced had "the lowest firmness and significantly inferior organoleptic characteristics" compared to others. However, yogurt prepared from mixtures of goat milk of an Alpine breed and local breeds with sheep milk of the Lacaune breed was of good quality, and with similar organoleptic characteristics (Stelios and Emmanuel 2004). In another set of experiments, microbiological quality and aroma components of yogurt samples produced from long-life goat and cow milk, and also from milk with 2% milk powder, were studied during 9 d of refrigerated storage. Initial acetaldehyde and diacetyl concentrations were higher in the case of yogurt prepared from goat milk than the one from cow milk. The concentration of acetaldehyde in the yogurt decreased during storage time. Control yogurt samples (samples without milk powder) had lower acetaldehyde concentrations than the supplemented samples, and during 9 d of storage; a significant increase in diacetyl content of yogurt samples was noticed (Božanić and others 2003). The yogurt prepared from goat milk was richer in glycine than yogurt prepared from cow milk, but the acetaldehyde content of the goat milk yogurt was found to be lower, which could be explained because of the inhibition of threonine aldolase by glycine (Rysstad and Abrahamsen 1987; Beshkova and others 1998). Buffalo milk is also a popular milk type used for the preparation of yogurt and several combinations of processing parameters have been applied by researchers to obtain desirable yogurt characteristics (Tamime and Robinson 2007). In another study, properties of yogurts prepared from sheep milk with different concentrations of fat (6.6%, 3.8%, 2.3%, or 0.9%, respectively) were analyzed (Kaminarides and others 2007), and it was observed that yogurt prepared with highest fat content received the highest appreciation for flavor and texture. Sixteen volatile compounds were identified and the important volatile flavor compounds on the 2nd day of study were "acetic acid, acetaldehyde, acetone, diacetyl, 2-butanone, 3-hydroxy-2-butanone, and 3-methyl-2-butanone." So to obtain the best flavor, a combination of different types of milk along with the starter culture is very important, but research is going on along with the continuing changes of consumer preferences.

Effect of processing techniques

As styles of yogurt have changed through the ages, processing techniques for yogurt have also changed. Processing techniques such as heat treatment, cooling, pasteurization, and homogenization are important steps in yogurt processing (Figure 1). The heat treatment of yogurt milk is intended primarily to kill pathogenic bacteria, at the same time reduce other microorganisms and inactivate enzymes such as lipase. So, it is advisable to heat the yogurt milk to between 85 and 95 °C. Some of the processing conditions for the manufacture of stirred-type pasteurized/ultra-high temperature yogurt have been summarized by Tamime and Robinson (2007), listing the different combinations of time and temperature of the heat treatments applied to obtain improved shelf life.

Mechanical treatment of yogurt has been found to influence aroma release and perception in the mouth more than the protein composition (Souchon and others 2006). High-pressure applications in yogurt technology can preserve milk intended for the production of yogurt and also preserve the final product. Yogurt preserved by means of high pressure can also be a good carrier of probiotic bacteria (Jankowska and others 2005), improve firmness, and reduce syneresis (Ancos and others 2000; Needs and others 2000). Sensory flavor analysis by Labropoulos and others (1982) of yogurt treated by ultra-high temperature and vat process systems revealed no significant differences, and gas chromatographic analysis of flavor isolates in the yogurts supported these observations of organoleptic analysis. Although in some of the cases, the high-pressure application has been detected to affect flavor. Pressurization at 100 to 300 MPa was found to cause slight changes in the flavor of the yogurts analyzed by Jankowska and his group, whereas pressure treatment at 400 to 1000 MPa resulted in negative changes in the flavor, consistency, and appearance of most of the yogurts under evaluation (Jankowska and others 2008). Similar results were obtained by Serra and others (2009), using ultra high-pressure homogenization at 200 or 300 MPa and at 30 °C or 40 °C to obtain homogenized milk to prepare yogurt, and during storage only slight differences in flavor compounds and yogurt bacteria counts were detected, except in those samples obtained from milk treated at 200 MPa.

Reps and others (2008) studied the effect of higher pressure levels on the properties of yogurt, prepared from milk mixed with stabilizer. It was observed that yogurt prepared from milk with MYO 752 stabilizer (starch, gelatin, pectin) gave the best results in terms of texture and pressurization, out of the 10 selected stabilizers. The number of *Lb. bulgaricus* lowered completely and the number of *S. thermophilus* lowered by 1 to 2 orders of magnitude without any effect on taste and aroma. So, the addition of stabilizers can also change the effect of application of high pressure.

Thermization is another method of treatment of milk, which is similar to pasteurization and uses lower temperature treatment and retains most of the original flavor of the milk. Alakali and others (2008) produced thermized yogurt by fermentation of pasteurized milk using yoghumet (a commercial yogurt culture containing *S. thermophilus* and *Lb. bulgaricus*) and thereafter heating at 65 °C, 75 °C, and 85 °C, for 20 min in each case. The study proved that heating at 85 °C produced acceptable yogurt with longer shelf life (6 wk) at an average room temperature of 35 ± 3 °C compared with those thermized at 75 °C (5 wk) and 65 °C (3 wk) similarly stored. The temperature of storage was room temperature (average 35 °C) and still the samples could be stored for 3 wk. Through storing at refrigeration temperature, storage life can be further increased. So, thermization can also be considered as an alternative for the treatment of the milk to obtain yogurt with longer shelf life, without significantly affecting the flavor.

The availability of fresh milk for the preparation of yogurt in the industry is not always possible. Refrigeration is the common method of storage of milk and CO_2 application can also be helpful. The suitability of milk preserved by refrigeration and CO_2 addition for the manufacture of plain yogurt was evaluated by Gueimonde and others (2003) using 2 commercial strains of *Lb. bulgaricus* and *S. thermophilus*. Yogurts manufactured, after milk pasteurization, from refrigerated CO_2-treated samples (pH 6.15) were compared with 2 different controls made from pasteurized milk, either fresh or refrigerated. The general processes taking place during the production of yogurt, such as multiplication and acidification capacity of the starter as well as the evolution of organic acids, were neither affected by the previous refrigeration and CO_2 treatment of raw milk nor by the residual CO_2 present in the pasteurized milk. However, refrigeration enhanced the production of ethanol and diacetyl and no difference in the sensory properties was detected between yogurts made from CO_2-treated milk and those made from refrigerated control milk throughout cold storage.

The new technologies such as application of high pressure, thermization, and CO_2 treatment can be used for the processing and preservation of the milk source and of yogurt. With proper combination of the different parameters, it can help improve the total processing technique and the shelf life. It also decreases food waste and food industry losses.

Effect of textural properties and stabilizing agents

In yogurt, higher fat content allows longer persistence of volatiles, whereas volatiles reach maximum inhaled air concentration much more quickly in low-fat yogurt. In food products, fats act as structuring materials and their elimination is impossible without finding replacement agents. Fats are also an excellent solvent for flavor compounds, which are mostly hydrophobic. The structure, texture, and flavor perception of food changes with the modification of fat content in food (Tuorila and others 1995; Hess and others 1997; Brauss and others 1999). Absence of fat therefore causes a complete change to the distribution of flavor molecules in a product. Fat replacers/thickeners and their amounts and storage time have been found to have a significant effect on physical, chemical, textural, and sensory properties of strained yogurts (Yazici and Akgun 2004). Fat replacers are first mixed with syrup or fruit preparation which are then mixed with yogurt. Rheological properties of fat-free yogurt are modified by the thickening effects of fat replacers, which has been well studied by many researchers (Ramaswamy and Basak 1992; Barrantes and others 1994). Modification of flavor release by the fat replacers is also well known (Pangborn and Szczesniak 1974); for example, with increasing pectin concentration and gel firmness, a decrease in aroma perception has been observed. Both viscosity and binding of flavor with the food matrix have been found to affect flavor release in case of various solutions with similar viscosity and different types of thickeners (Roberts and others 1996). Similar results were observed by Mälkki and others (1993) with oat gum, guar gum, and carboxymethylcellulose (CMC), and they showed that both the perceptions of flavor and sweeteners were modified by thickeners. In a pectin model gel with sugars, the 3-dimensional network of pectin chains was found to retain aroma compounds (Rega and others 2002; Lubbers and Guichard 2003). It was observed that the concentration of aroma compounds in the headspace of the samples was reduced by the presence of pectin in yogurts. Presence of starch in yogurt was found to induce a significant decrease of aroma compounds in the headspace as observed by Decourcelle and others (2004). It was found that, after swallowing, aroma release and intensity of olfactory perception were stronger in low-viscosity yogurts than in high-viscosity yogurts (Saint-Eve and others 2006b). However, a generalized statement regarding this is not possible, because a significant increase of flavor release was observed on addition of locust bean gum into fat-free stirred yogurt by Decourcelle and others (2004); but the sweeteners and guar gum appeared to have no effect. In this case, rheological parameters were not able to explain the difference of aroma release (which was contradictory to the other cases) and it appeared that, during shear conditions, the composition of fruit preparations has a major role in aroma release (Decourcelle and others 2004). The difference between the different stabilizers regarding the flavor release could be explained because of the difference of interaction of various types of thickeners with the yogurt matrix. So, some combinations of thickeners give a better performance than others. Among the 7 different stabilizers used by Mohammad (2004), which were pectin, guar gum, CMC, carrageenan, sodium alginate, corn starch, and gelatin, at 0.4% levels in buffalo milk with 16.6% total solids, cow milk with 13.5% total solids, and a mixture (1:1) of both having 15.0% total solids, the best result in terms of flavor was obtained with a combination of 0.4% corn starch and 16.6% total solids. The different concentrations of the same stabilizer differ in terms of the effect on the aromatic perception of yogurt also. In a study by Mumtaz and others (2008), it was observed that enrichment of yogurt with xylooligosaccharide (XO) at different levels had different effects. Addition of XO up to 3.5% did not influence taste and overall acceptability, but higher levels contributed to an aftertaste. The treatments, storage intervals, and total solids combined with the thickeners significantly affected the flavor and other properties such as syneresis, body/texture, acidity, and color of the yogurt samples investigated by Mohammad (2004).

As mentioned before, the overall aroma of yogurt is the result of the combined effect of many factors. When combined effects of the thickening agents and other factors such as mechanical treatment are considered, it was found that the final effect was different from the individual effects. The influence of thickening agents (modified starch/pectin mixture of 0 and 7 g/L) along with mechanical treatment (low, medium, and high) on the retention of esters (pentyl acetate and ethyl pentanoate), aldehydes (hexanal and (E)-2-hexenal), and a lactone (gamma-octalactone) in low-fat flavored stirred yogurts was investigated by Kora and others (2004) under equilibrium conditions. It was found that the thickening agent and mechanical treatment had little influence on aroma compound retention in this case. Increasing the dairy protein concentration was observed to have a decreasing effect on aldehyde retention and there was a "salting out" effect of carbohydrates on esters, in the treatment range studied. The sensory effect of thickening agents in this case was suspected to be due to sensory interactions between perceptions rather than physicochemical interactions.

Dairy foods contain a considerable amount of proteins, which not only acts as a nutritional source of protein for the body, but also affects textural properties and aroma perception. Depending on the physicochemical properties of the aroma compounds, olfactory properties may be influenced by protein changes in the matrices. It was demonstrated by Saint-Eve and others (2006a) that the protein composition influenced aroma release only when yogurt exhibited wide variations of complex viscosity. When the influence of flavored yogurt texture, induced by both protein composition and mechanical treatment, was considered, it was noticed that for the same matrix composition, the yogurt complex viscosity influenced both in-nose release and olfactory perception (Souchon and others 2006). The exchange area between yogurt and oral cavity was found to be the main physical mechanism responsible for in-nose release and perception. Another study was carried out by Saint-Eve and others (2006a) to investigate the impact of protein composition, at a constant protein level, on the physicochemical properties of 4% fat flavored stirred yogurt and, more specifically, on the rheological properties, the microstructure, and aroma release. It was shown that enriching yogurt with caseinate generally leads to changes in the microstructure network and caseinate-enriched yogurt has a higher complex viscosity than whey protein-enriched yogurt, which is another important protein additive in the dairy industry. Release of the majority of aroma compounds has been found to be lower in caseinate-enriched yogurt. Physicochemical interaction between aroma compounds and proteins was also quantified during that study. The flavor intensity and the fruity notes were found to be less intense in yogurts with a high caseinate ratio than in those with a low ratio (Saint-Eve and others 2006a). So, individual types of protein seem to have a certain effect, which also varies with the amount. The influence of gel structure on flavor release was also observed in this case and was found to be in agreement with sensory characteristics previously studied for these products. To improve the firmness of yogurts, enzymatic modification of milk proteins can also be applied (Kumar and others 2001). Enzymatic partial hydrolysis opens the protein structure producing hydrophobic and hydrophilic peptides, and when this process is controlled and is carried out prior to inoculation of the starter cultures, it can lead to faster growth of the organisms, and also improvement of yogurt flavor. Nutrease and trypsin immobilized on CM-Sephadex C-50 were used by Kumar and others (2001) to enzymatically modify milk proteins. The milk samples treated with nutrease and trypsin were used to prepare set yogurt. Yogurt prepared from milk treated with trypsin showed either a small or no improvement in textural and sensory properties, whereas yogurt prepared from nutrease-treated milk showed definite improvement (Kumar and others 2001).

To better understand aroma release in relation to yogurt structure and perception, Déléris and others (2007) determined the apparent diffusivity of aroma compounds within complex dairy gels using an experimental diffusion cell. Four aroma compounds (diacetyl, ethyl acetate, ethyl hexanoate, and linalool) were considered whose apparent diffusion coefficients were determined at 7 °C in yogurts, varying in composition and structure. It ranged from 0.07×10^{-10} to 8.91×10^{-10} m^2/s, depending on aroma compounds and on product structure. Yogurt fat content was revealed to have a strong effect on the apparent diffusivity of hydrophobic compounds. Fifteen-fold and 50-fold decreases in the apparent diffusion coefficient of linalool and ethyl hexanoate, respectively, were detected. Protein composition seemed to have a greater effect than that of mechanical treatment in this case. Differences in flavor release, and in perception observed previously, could not be explained completely, because variations in the apparent diffusion coefficient for the considered products were found to be limited. Physicochemical, physiological, and perceptual phenomena might be involved in the complex processes of aroma release and perception (Taylor 2002; Déléris and others 2007) and it can be observed that presence of stabilizers not only affects the total solids content but also the physicochemical properties of yogurt. The mechanical treatment required for each stabilizer varies from each other and higher levels may contribute an aftertaste (as mentioned before), which is also undesirable. Use of texturizing agents is a requirement of the food industry while replacing the fats in different foods, and that creates more challenges for food scientists.

Effect of different added flavors

Different fruit flavors have been used for a long time to increase the flavor characteristics of yogurt (Table 1). Addition of flavors also increases options for consumers, and it helps in marketing yogurt and retaining consumer interest even with changing food habits. Several flavors used in the food industry have been summarized by Tamime and Robinson (2007). The addition of flavor generally increases the sensory acceptance of the yogurt. Honey and apple are some of the flavors that are quite acceptable. During a study by Ghadge and others (2008), addition of various proportions of apple fruit pulp or honey separately to buffalo milk yogurt (prepared with a mixed starter culture containing a 1:1 ratio of *S. thermophilus* and *Lb. bulgaricus*) led to higher sensory effects and in this case yogurt with superior sensory quality was obtained with 10% apple fruit pulp and 5% honey. Similar results showing acceptability have been obtained for strawberry, cherry fruit powder (Kim and others 2009), peach flavor (Santana and others 2006), and soursop (*Annona muricata* L.) flavor (Lutchmedial and others 2004) and for many others.

Strawberry flavor is probably the most popular fruit flavor used in the yogurt industry and several studies have been conducted regarding its effect on the flavor of other compounds and also aroma release. Mei and others (2004) studied how yogurt ingredients affect aroma release in the mouth during eating, and it was observed that aroma release of the ethyl butanoate, (Z)-hex-3-enol, and ethyl 3-methylbutanoate (components of strawberry flavor) was suppressed by sweeteners, with 55 DE high-fructose corn syrup having the greatest effect. Simulation of yogurt with fruit preparation syrup was done to study the discharge of "strawberry flavor compounds at vapor/matrix interfaces in model food systems" (Nongonierma and others 2006). The effects of various parameters including "physicochemical characteristics of the flavor compound, the structure and composition of the matrix, and temperature (4 and 10 °C)" on the release of the flavor compounds were studied. As observed in other cases, "the composition and structure of the matrix" were having an effect on the partitioning of the flavor compounds. In this case, physicochemical interactions with pectin and sucrose slightly increased the retention of the flavor compounds and in the presence of 5% fat, release of flavor was unaffected by "the composition of the dispersing medium." An increase from 4 to 10 °C, which was one of the factors observed led to "increase in the overall amount of flavor released" in this case, which implied that temperature could be an additional factor.

Addition of fruity flavors such as strawberry also helps to overcome many undesired flavors. However, in the case of supplementation of a strawberry-flavored yogurt with an algal oil emulsion by Chee and others (2005), the trained panel could discern a strong fishy flavor in supplemented yogurts even after 22 d of storage. Addition of fruit flavor enhances the popularity of yogurt in general, but the other components present in yogurt affect the effect of the flavor additive also very much. The other fortified components may dominate over the flavor additive and give a different taste and also change the overall acceptability of the product.

Effect of the storage parameters

The concentrations of the flavor compounds acetaldehyde, ethanol, and diacetyl change during storage depending on duration and temperature of storage (Vahčič and Hruškar 2000). Acetaldehyde content was found to decrease at temperature levels of 4 °C, 20 °C, and 37 °C during 25 d of storage and diacetyl and ethanol contents were found to have increased during the study by Vahčič and Hruškar (2000). Sensory quality decreased with duration and was found to be closely related to changes in the contents of aroma compounds that were more pronounced at higher temperatures. No significant change was detected during refrigerated storage at 4 °C and samples were found unsuitable for consumption after 15 d at 37 °C, which implies storage at lower temperature might retard the deterioration process.

There have been studies to find out the reasons of decrease of the acetaldehyde content with an increase of time of storage also. Bills and Day (1966) demonstrated dehydrogenase activity at low storage temperatures by some lactic *Streptococci* and found these organisms reduce acetaldehyde and propionaldehyde but not acetone or butanone. Keenan and Lindsay (1967) reported dehydrogenase activity by *Lactobacillus* species. Since differences as low as 1 ppm acetaldehyde can be detected in milk products, the differences noted in acetaldehyde during storage between cultures are important and must be taken into consideration when selecting yogurt cultures, and those organisms which produce the most acetaldehyde and utilize it slowly during storage should evidently be selected. Hamdan and others (1971) found that acetaldehyde decreased during storage when obtained by Cultures R1 (Hansen's) and 405 (Moseley's), whereas acetaldehyde from Culture 403 (Moseley's) remained constant during 2 wk of storage. When a single strain of *Lb. bulgaricus* and *S. thermophilus* was used, reduction of acetaldehyde was higher as compared to that produced by commercial cultures together. Results from another study using probiotic and plain yogurt purchased from Croatian and Slovenian markets have shown equal changes in the aroma of both types of yogurt, after storing for 25 d at 4 °C and 20 °C, which was so because of the same microorganisms present in both yogurt types (*Lb. bulgaricus* and *S. thermophilus*) having the greatest influence on the aroma, while the addition of other microorganisms had mostly probiotic effects (Hruškar and others 2005).

Storage at 20 °C for 21 d was compared with storage at 30 °C for 3 d (accelerated) during a study of refrigerated storage (10 °C for 91 d) of whole and skimmed flavored set-type yogurt (Salvador and Fiszman 2004). A trained panel and a consumer panel assessed the refrigerated yogurts where trained-panel scores were correlated to instrumental data, and the acceptability data for long storage were studied using consumer criteria. According to the logistic regression of the data from a 50-consumer sensory evaluation, the probability of the whole yogurt being accepted after 91 d at 10 °C was around 40%, whereas for the skimmed yogurt it was only 15%, largely because the skimmed yogurt developed certain negative attributes at an earlier stage of storage than the whole yogurt. Lack of fat seems to affect both the preservation and expression of the flavor compounds, which can make the storage of skimmed yogurt a potential challenge.

Packaging material is also an important criterion that influences food properties. They not only affect the food components, but also the flavor of many food materials. Saint-Eve and others (2008) studied variation of sensory and physicochemical properties of stirred flavored yogurt with varying percentage of fat content (0% and 4%) and packaging material (polystyrene, polypropylene, and glass). They observed that with decreasing fat percentages (0%), the effect of packaging material increased and packaging effect was least for 4% fat yogurt, which implies that a higher percentage of fat in yogurt also helps in resistance against the influence of the packaging material. Low-fat yogurt when stored in glass container displayed least decrease of aroma. Although in terms of least loss of aroma compounds and minimum development of aroma defects, polystyrene seemed preferable for yogurt.

As mentioned before, strawberry is a popular flavor and it has been used by food scientists quite often to analyze aroma release. Lubbers and others (2004) studied the influence of storage on aroma release in headspace gas and also some rheological properties in strawberry-flavored fat-free stirred yogurts. The quantity of flavors in the headspace of products at 28 d of aging was found to be significantly weaker for some flavor compounds (methyl 2-methyl butanoate, ethyl hexanoate, and hexyl acetate) that were chosen for the study. The apparent viscosity of the products significantly increased during the 3 observed periods (7, 14, and 28 d at 10 °C). The composition of the flavored yogurt, proteins, exopolysaccharides, and fruit preparation had a great impact on the release of aroma compounds, which supports the previously observed results. The aroma compound amount in the headspace decreased when the matrix changed from water to yogurt, and with the fruit preparation, the headspace amounts for esters were significantly lower than in water alone, respectively, 23, 27, 29, and 17% less for methyl 2-methylbutanoate, ethyl hexanoate, hexyl acetate, and benzyl acetate. In flavored yogurt, the amount of aroma compounds in the headspace decreased again in comparison with the result obtained with the fruit preparation. Ethyl hexanoate and hexyl acetate presented the higher decreases of 48% and 53%, respectively. It shows that addition of fruit to the yogurts has a different effect on the flavor release than the addition of fruit flavor. The observed difference can be correlated to the change of rheological properties of the yogurt with the addition of fruits and fruit flavors. A decrease in the viscosity of yogurt has been observed with the addition of fruits, which affects the aroma release as well (Lubbers and others 2004). So, yogurts with fruit preparation are generally provided with a thickener which modifies the aroma expression further, because each thickener has its own role in aroma release (Wendin and others 1997;Lubbers and others 2004).

To increase the storage quality of a product, the reduction of water content can be helpful. One of the methods used these days is osmo-dehydro-freezing, which is applied to a variety of fruits and vegetables (Robbers and others 1997; Dermesonlouoglou and others 2007, 2008) where water is removed by osmotic pretreatment without any phase change (Barbanti and others 1994; Dermesonlouoglou and others 2007) and then the product is frozen. The amount of water to be frozen then is less, which helps in minimizing the refrigeration load during freezing (Huxsoll 1982; Dermesonlouoglou and others 2007). Osmo-dehydro-frozen fruits have a lesser water content which when added to yogurt also decreases the comparative amount of water which could be added while adding the fresh fruits. This can make a difference in the final viscosity of the product (as is evident in the previous case), which is related to aroma release and also to storage quality. Vahedi and others (2008) assessed the effect of osmo-dehydro-frozen fruits on various properties of yogurt such as sensory, physical, chemical, and microbiological properties in 2 stages. Its quality during storage was also evaluated. In the 1st stage, the type, percentage, and time of addition (before and after fermentation) of fruit were determined which indicated that "yogurts containing 10% apple or 13% strawberry, and added after fermentation, had better quality as the taste value was higher in strawberry yogurt and texture and mouth feel values were higher in the yogurt with high percentages of fruit." In the 2nd stage, quality evaluation during storage was done. Similar to other cases, storage was found to have "a significant effect on pH, acidity, syneresis, taste, and texture ($P < 0.05$)."

Fortification of Yogurt with Health-Promoting Additives, Benefits, and Their Organoleptic Effect

Yogurt is a popular food product and it can help as a medium to supply nutritive component such as calcium, generally deficient in certain segments of the human population. This idea has been used by many food scientists to fortify yogurt with certain essential nutrients. This part of the review presents some of the cases of fortification of yogurt along with their benefits and drawbacks.

Yogurt is an excellent source of calcium and high-quality protein. But it contains very little iron, which is common among all dairy products (Blanc 1981). The practice of fortification of yogurt with iron is gaining popularity and is expected to help fulfill nutritional needs. An advantage of using dairy foods as the vehicle for supplementing the diet with iron is that people who consume diets of low iron density typically consume more dairy products and those with diets high in iron consume the fewest dairy products. Furthermore, iron-fortified dairy foods have a relatively high iron bioavailability. Lactic acid bacteria do not require iron for growth (Neilands 1974), and iron addition to yogurt may change the balance between lactic acid bacteria and other bacteria that do require iron for growth (Jackson and Lee 1992). According to a study by Hekmat and McMahon (1997), it was found that the oxidized flavor scores of iron-fortified yogurts were slightly higher than control yogurt, and there was no enhancement in metallic, bitter, or other off-flavors. There was no detectable significant difference in the appearance, mouth feel, flavor, or overall quality of fortified and unfortified flavored yogurts, as observed by the consumer panel. It implies that all yogurt samples were appreciated by the consumer panelists signifying yogurt as an appropriate medium for iron fortification.

Along with fortification of yogurt with iron, the addition of calcium to yogurt has also been done. As reported before "plain whole yogurt contains about 120 mg calcium per 100 g" (Pirkul and others 1997). Fortification of yogurt with calcium is expected to be able to address individuals' requirements who are at risk of calcium deficiency related disorders. Even when individuals do not consume large amounts of dairy products to meet their calcium requirements, fortification will supply required amount of calcium in 1 or 2 servings. Fortification of plain low-fat yogurt with calcium gluconate (Fligner and others 1988) is reported to be possible with minor physical and chemical changes and no effect on organoleptic properties of the yogurt (Pirkul and others 1997).

The increasing emphasis on use of natural food additives in diet has promoted the use of honey, which has been gaining interest as a substitute sweetener because of its wholesome image (Chick and others 2001; Ustunol and Gandhi 2001). Low pH (approximately 3.9) and ability to decrease sourness of solutions make it an attractive additive for acidic products such as yogurt. However, combinations of honey with yogurt are comparatively rare (Brown and Kosikowski 1970; Roumyan and others 1996) because it is reported to have "inhibitory effects on lactic starter cultures" (Čurda and Plocková 1995; Roumyan and others 1996). Factors related to antibacterial nature of honey are not completely understood (Taormina and others 2001), and are expected to be because of "high sugar content" limiting water available for proper growth of microorganisms, the "relatively high acidity, the presence of organic acids, and the presence, at low concentrations, of hydrogen peroxide" (Mundo and others 2004). Floral source of the honey is an important factor influencing its antimicrobial characteristics (Molan 1992). Studies have shown that during storage at 4 °C, the characteristic microorganisms (that is, *S. thermophilus* and *Lb. bulgaricus*) in yogurt are not significantly affected by the presence of honey at 1.0% to 5.0% (w/v) (Varga 2006). pH and lactic acid levels of the final products were found unaffected by honey, and it highly improved the sensory characteristics of the final product, with approximately 3.0% (w/v) of honey, without having a negative effect on the lactic acid bacteria.

By-products, rich in fiber and bioactive compounds, contribute about 50% of the total weight in the asparagus processing industry, which emphasizes their potential contribution in human nutrition. In a recent study, yogurts were enriched with fiber obtained from the nonedible part of asparagus shoots and fiber obtained from all methods of processing was found equally prospective for yogurt enrichment (Sanz and others 2008).

Fortification of nonfat yogurt with whey protein isolate (WPI) has also been tried (Isleten and Karagul-Yuceer 2006) and fortification of yogurt with sodium caseinate (NaCn) and yogurt texture improver (TI) has been done. It was observed that yogurt with WPI did not have desirable sensory properties and the descriptive panel indicated that yogurt with WPI had the lowest fermented flavor attribute. In general, yogurt fortified with NaCn and TI displayed better physical and sensory properties than did the control (nonfat yogurt made from reconstituted skim milk powder [SMP] fortified with SMP) and WPI-fortified yogurt and consumer acceptability for the flavor was the same for all. Mistry and Hassan (1992) studied the effects of high milk protein powder (containing 84% milk protein) addition on the quality of nonfat yogurts and it was found that supplementing skim milk up to 5.6% protein content could produce good-quality nonfat yogurt with the added benefit of extra protein content in the yogurt.

For the last several decades, marine lipids have received growing interest because of their valuable health effects (Nielsen and others 2007). Many studies have demonstrated that eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have a positive effect on myocardial infarction and on immune and eye functions (Schmidt and others 1992; Werkman and Carlson 1996; Marchioli and others 1999) and in neurological diseases, for instance depression and Alzheimer's disease (Morris and others 2003). The healthy image of EPA and DHA and the wide consumption of dairy products such as yogurt support the possibilility of use of yogurt as a vehicle for increasing consumption of fish oil. However, due to the presence of high content of polyunsaturated fatty acids, foods with fish oil are prone to oxidation that might lead to the development of undesirable fishy and rancid off-flavors and may even promote cardiovascular diseases (Das 1993; Jacobsen 1999; Let and others 2003; Shimoni and others 2003). In a separate study (Chee and others 2005), an algal oil emulsion was added to yogurt mix flavored with a strawberry fruit base, to supply 500 mg ω-3 fatty acids per 272-g serving of yogurt. The hydroperoxide content was found to increase during storage and was unaffected by the stage of addition of algal oil emulsion. Even after 22 d of storage, the trained panel could recognize a stronger fishy flavor in supplemented yogurts, but both control and supplemented samples were rated as "moderately liked" by the consumer panel, which supports the option of further analysis in this regard.

Cashew apple serve as a rich source of vitamin C and has been rated as one of the leading indigenous fruits and huge amounts are seen in local markets during harvest season in several countries of South America and Africa (Akinwale 2000). It was used as a nutritional additive in the production of yogurt during a study (Aroyeun 2004), which led to higher vitamin C content than yogurt without the cashew apple additive and commercial plain nonfat yogurt The results obtained from sensory evaluation indicated that the yogurt into which cashew apple had been added "compared favourably" with the reference sample (commercially available Fan Milk yogurt) in terms of all the attributes evaluated, and there was no significant difference. In another study Bartoo and Badrie (2005) analyzed the physicochemical and sensory quality of stirred yogurts prepared from cow milk with added dwarf golden apple (*Spondias cytherea* Sonn.) nectar. Yogurts with golden apple nectar were more appreciated than the control (0% nectar) yogurt in terms of all sensory attributes and were found to develop a buttery odor by 4 wk of storage. A 226-g serving of this yogurt provided a good source of phosphorus and was found rich in protein. As evident fortification with all these valuable and easily available sources has the potential of changing the preference of yogurt market further.

Probiotics, Prebiotics, and Yogurt Aroma

The term probiotic refers to live microorganisms which when administered in sufficient quantities confer a health benefit on the host (FAO/WHO 2001). Yogurt is rich in probiotics which is one of its other beneficial characteristics and some of the food scientists have observed that the presence of probiotics does not affect yogurt flavor or consumer acceptance (Hekmat and Reid 2006). Other than *Lb. bulgaricus* and *S. thermophilus*, several other microorganisms might be added to the yogurt such as *Lb. acidophilus*, *Bifidobacterium lactis*, and *Lb. casei* (Aryana and others 2007a), *Lb. reuteri* and *Lb. rhamnosus* (Hekmat and others 2009). A survey (Krasaekoopt and Tandhanskul 2008) regarding consumer acceptance of yogurt containing probiotics encapsulated in alginate beads coated with chitosan was carried out in Thailand where the acceptance assessment of this product was performed by consumers and the sensory characteristics of products were evaluated using descriptive analysis which indicated that a potential market exists for yogurts containing probiotic beads.

The term prebiotics refers to the nondigestible components present in food that help in the growth of beneficial microorganisms (probiotics) in the digestive system. One of the prebiotic compounds which has been widely used is inulin (Aryana and McGrew 2007; Aryana and others 2007b; Allgeyer and others 2010). Inulin has been found to affect the taste (Guggisberg and others 2009) and sensory property, and consumers have been found to prefer yogurt with inulin more than low-fat yogurt without it (Spiegel and others 1994). Inulin's effect on starter culture fermentation rates, survivability, organic acid concentrations, and degree of proteolysis can also be used to explain its effect on sensory properties (Allgeyer and others 2010). Similar results regarding the positive acceptability of many other prebiotic components have been reported which include fructooligosaccharide (Gonzalez and others 2011) soluble corn fiber, polydextrose (Allgeyer and others 2010), and inulin of different sources.

The interaction effect of prebiotics and probiotics on the final yogurt product is still an unresolved and controversial topic. In some cases, a prebiotic is reported to have a positive effect on the probiotics in terms of growth and survivability (Ozer and others 2005; Aryana and McGrew 2007; Aryana and others 2007b), but in other cases, it does not show any remarkable positive effect (Daniel 2009; Allgeyer and others 2010). But the effects of the probiotics and prebiotics on human health are having a strong impact on the yogurt market and addition of prebiotics and probiotics in proper ways and amounts can increase consumer preference for these products (Allgeyer and others 2010).

Expected Future Trends in Yogurt Sales

Yogurt can be made available in different forms such as drinking yogurt, lactose-hydrolyzed yogurt, strained yogurt, frozen yogurt (with categories soft, hard, or mousse), dried yogurt, bio-yogurt (yogurt made with different live cultures other than the 2 most widely used ones), vegetable oil yogurt, soy yogurt, and chemically acidified yogurt (Tamime and Robinson 2007) and yogurt has always been successful in making people enjoy the products. Ever-growing consumer demand for convenience, combined with a wholesome diet and preference for natural ingredients, has led to growth in the functional beverage market. Current trends and changing consumer needs indicate a great opportunity for innovations and developments in fermented milks. While scientific and clinical evidence is mounting to corroborate the consumer perception of health from fermented milks, the probiotics, prebiotics, synbiotics, and associated ingredients are able to add an attractive dimension to cultured dairy products. The compounds responsible for yogurt aroma can be used as additives. It has been concluded in one study that in the prescribed range, 1-nonen-3-one can be added to food, pharmaceutical, cosmetic, and perfume compositions to flavor the products and to impart aroma, particularly to dairy products and coffee extract. The 1-nonen-3-one can also be combined with other compounds that provide taste and aroma, and the combined compounds can be added to the compositions (Ott and others 2001). The application of yogurt to prepare baked goods such as bread has been patented, which are reported to have improved flavor and other properties that can be obtained by incorporating yogurt in the dough (Hill 1974). Owing to expanding market size of dairy companies, there has been a merging of dairy products and fruit beverage markets with the introduction of "juiceceuticals" such as fruit-yogurt beverages that are typical examples of hybrid dairy products which are able to offer health, flavor, and convenience at the same time. Another potential growth area for fermented milks includes value-added products such as low-calorie, reduced-fat varieties, and those fortified with physiologically active ingredients, including fibers, phytosterols, omega-3-fatty acids, whey-based ingredients, antioxidant vitamins, and isoflavones that provide specific health benefits beyond basic nutrition. Continuous efforts are being made to develop fermented milks containing certain nonconventional food sources such as soybeans and millet and convert them to more acceptable and palatable forms thus producing low-cost, nutritious fermented foods. Use of biopreservatives and certain innovative technologies such as membrane processing, high-pressure processing, and carbonation can lead to milk fermentation under predictable, controllable, and precise conditions to yield hygienic fermented milks of high nutritive value (Khurana and Kanawjia 2007), which can help to further improve the industry and add value.

Conclusion

Yogurt has been present in the human diet in many parts of the world because of acceptance of its taste (along with remarkable beneficial effects). In the case of yogurt, strawberry is known to be the most popular added flavor. With the advancement of technology, it is now common to find different types of flavors such as peach, red fruits, lemon, apple, and so forth. Aroma additions provide various flavor possibilities in the dairy market that has increased the popularity of products such as yogurt, milk drinks, desserts, and others. To satisfy consumer demands, manufactures increasingly propose yogurts with reduced fat content. In order to maintain the same texture, fat is replaced by thickeners and gelling agents. The decrease in fat content and its replacement by texturizing agents can lead to change in the distribution of flavor molecules within the product and to differences in flavor perception. Care should be taken while modifying the aroma components because yogurt is a major source of nutrients for both vegetarians and nonvegetarians. We can deduce from the studies conducted up to now that to have acceptable modifications in yogurt, much work is still to be done, which will be able to maintain the originality of the product, at the same time satisfy ever-changing consumer demands.

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APPENDIX 5

Chandan, R.C., & Kilara, A. (2013). *Manufacturing Yogurt and Fermented Milks, Second Edition*. John Wiley and Sons. https://doi.org/10.1002/9781118481301

assortment of single and complex flavors, for example chocolate and coffee flavors. The selection of starter strains becomes critical in obtaining mildness. To obtain a smooth texture without whey separation, starters containing strains that produce exopolysaccharides (EPS) are necessary, but there is a fine line between the smoothness desired and stringiness or "ropiness." Here too, starter selection and cultural conditions are critical. Use of EPS-producing strains also helps to give yogurt a heavy body that can hold fruit pieces in suspension within the yogurt matrix. Bleaching or fading of the natural hues of fruits and fruit juices is often encountered in fruit yogurts. The bleaching or fading of fruit pigments (anthocyanins) is caused by pH and oxidation/reduction changes introduced by starter bacteria. Starter selection, proper cultural conditions and choice of stabilizers, and fruit preparations are important in controlling the quality of the finished product. The need for viable starter bacteria in the product until the "open date" and the complexity introduced by the inclusion of probiotic strains add another dimension to the difficulties in yogurt fermentation and yogurt systems.

The foregoing illustration with yogurt shows in a nutshell the importance of starter culture and the need for "holistic" analysis of both technological and microbiological aspects in successful fermentations.

6.2 Starter functions

The *primary* starter function is to generate lactic acid by the fermentation of the major sugar in milk or dairy mixes, lactose. The desired rate of acid development depends upon the cultured dairy product, the turnover desired in the manufacturing plant, the starter flora used, the temperature of fermentation, the flavor generation needed in the cultured product (need for balanced growth of the mixed starter flora) and the body characteristics (in terms of EPS generation) desired in the cultured product. As acid accumulates during the fermentation of sugar, the pH progressively decreases. When the pH drops to the isoelectric point of casein, the colloidal dispersion of casein micelles collapses, and the acid casein precipitates, forming the curd. Thus, the acid generated from the fermentation of lactose not only imparts a pleasantly acid flavor to the cultured product but also transforms the starting liquid milk or dairy mix into a semi- to solid curd. Within the solid casein matrix, the whey and other soluble components of milk and milk fat are entrapped. Unless the curd is unduly disrupted by rough handling or excessive pumping, the entrapped components are held fairly intact with the casein network. Excessive acid generation by starter organisms because of uncontrolled fermentation (failure to arrest fermentation by prompt and proper cooling at the desired acid level or improper temperature control during fermentation) will result in the shrinkage of the curd and expulsion of whey and soluble components. Excessive acid concentration also imparts a harsh, acrid flavor and masks the delicate dairy-flavor notes, like diacetyl, desired in cultured buttermilk, sour cream and a few other cultured dairy products.

The acid generated and the gradual lowering of the pH facilitates the efficient transport of citrate present in milk or dairy mixes into the cells of "flavor bacteria," resulting in the formation of the primary flavor compound, diacetyl. Transport of citrate into the cells of flavor bacteria is facilitated by an enzyme, citrate permease, which functions optimally below pH 6.0 (the initial pH of milk is around 6.6, and in dairy mixes pH may range from 6.3 to 6.4).

Another important function of lactic acid is its preservative effect. Undissociated lactic acid is inhibitory to many spoilage and pathogenic bacteria, and the lowered pH is an additional stabilizing factor. In most cultured dairy products, the maximum acidity attained ranges between 1.3 and 1.5%, expressed as lactic acid. To yield 1 pound of lactic acid, 1 pound of lactose is consumed. Milk contains around 4.8% lactose, and to yield 1.5% lactic acid, only about 30% of the total lactose content is consumed, leaving a large portion intact at the end of fermentation.

The *secondary* functions of the starter culture in cultured dairy products include flavor generation, special body and texture production and the elaboration of miscellaneous inhibitory metabolites that impart preservative effects. In cultured buttermilk, dahi, sour cream and related products, a nutmeat-like "buttery" flavor is desirable. Diacetyl is the key compound that imparts a "buttery" flavor. Diacetyl is a diketone, derived by the fermentation of citrate present in milk and dairy mixes. Flavor bacteria included in starters for such products possess the enzymatic pathways required to convert citrate to diacetyl and other closely related reduced derivatives of the diketone. The reduced forms of diacetyl do not possess the desired "buttery" notes prized in the aforementioned cultured dairy products. Flavor bacteria consist of *selected, compatible* strains of *Leuconostoc* spp. and citrate-fermenting *Lactococcus lactis* ssp. *lactis*. Of the two, *Leuconostoc* spp. is preferred over citrate-fermenting *Lactococcus lactis* ssp. *lactis* organisms in cultured-buttermilk and sour-cream starters. The citrate-fermenting lactococci accumulate fairly high concentrations of acetaldehyde, which introduces unwanted harsh, "green, yogurt-like" flavors in cultured buttermilk and sour cream. Dairy *Leuconostoc* spp., on the other hand, scavenge undesirable acetaldehyde, converting the aldehyde to ethanol, which provides a complementary flavor to the overall characteristic flavor bouquet of cultured buttermilk and sour cream. The relatively high alcohol-dehrydrogenase activity of dairy leuconostocs plays a vital part in the scavenging of acetaldehyde. To obtain a characteristic cultured-buttermilk flavor, a balanced ratio of diacetyl to acetaldehyde is necessary. The desirable ratio falls between 3.2 : 1 and 4.4 : 1. In dahi, the presence of slightly higher concentrations of acetaldehyde is not considered a defect. The flavor bacteria are heterofermentative, and from lactose produce fairly high amounts (about 30%) of metabolic end products other than lactic acid. The non-lactic-acid metabolites include acetic acid, ethanol and carbon dioxide. The fermentation of citrate in addition to diacetyl and its reduction products also yields carbon dioxide. Carbon dioxide plays a role in the flavor perception of cultured buttermilk, much like the effervescence or "lift" imparted by carbonation in "soft drinks."

In yogurt, on the other hand, acetaldehyde is a key component in furnishing the desirable "green-apple" flavor. Although for typical plain yogurt a fairly high concentration of acetaldehyde is needed, the present trend, as mentioned earlier, is to select for starter strains that produce low amounts of the aldehyde, to give a mild-flavored yogurt, compatible with the addition of a wide variety of flavors.

In kefir and koumiss, ethyl alcohol and carbon dioxide provide essential flavor notes. The yeasts associated with the kefir grains and the starters used for koumiss generate the necessary alcohol and carbon dioxide. In dahi, in certain areas, a slight "yeastiness" is preferred. Yeasts acquired through chance contamination, and carried over by "back-slopping" practice, are attributable to the "yeastiness" in dahi. The starters used in viili contain a mold, *Geotrichum candidum*, which forms a layer or mat on the surface of the product (aerobic growth). The mold metabolizes lactic acid and induces a "layered mildness" to the product, and also imparts a "musty" aroma. The exact role of molds associated with certain koumiss starters is still undefined.

Starters additionally impart special body and texture characteristics to certain cultured dairy products. In viili and closely related Scandinavian cultured milks, a viscous and ropy or stringy body and texture is caused by EPS-producing strains included in the starters.

2.0	3:2
5.0	2:3

[a]Incubation to 0.85% titratable acidity.

Both incubation temperature and inoculation rate influence the structure and properties of yogurt gel. In general, the conditions favoring faster acid production (higher temperature and higher inoculation rate) tend to produce weak gel and greater whey separation. It appears that weak yogurt gel and syneresis are related to the rearrangement of casein particles in the gel network and the rate of solubilization of colloidal calcium during fermentation (Lee and Lucey, 2004).

11.6 Changes in milk constituents during yogurt production

11.6.1 Biochemical and microbiological changes during fermentation

Conversion of milk base to yogurt is accompanied by intense metabolic activity of the fermenting organisms ST and LB. Yogurt is a unique product in that it supplies the consumer vital nutrients of milk as well as metabolic products of fermentation and abundant quantities of live and active yogurt cultures. As a result of culture growth, transformation of chemical, physical, microbiological, sensory, nutritional and physiological attributes in basic milk medium is noted. Changes during fermentation are profound and many are relevant to the health attributes of yogurt.

11.6.1.1 *Carbohydrate*

The lactose content of yogurt mix is generally around 6%. During fermentation, lactose is the primary carbon source, resulting in an approximately 30% reduction. However, a significant level of lactose (4.2%) remains unutilized. One mole of lactose gives rise to 1 mole of galactose, 2 moles of lactic acid and energy for bacterial growth. Some strains of ST exhibit both β-galactosidase and phospho β-D-galactosidase activity. Therefore, these strains also use a phospho-enolypyruvate-phospho transferase system. Lactose is converted to lactose phosphate, which is hydrolyzed by phospho β-D-galactosidase to galactose-6-phosphate and glucose, which on glycolysis gives lactic acid. Although lactose content is in excess in the fermentation medium, lactic-acid build-up beyond 1.5% acts progressively as an inhibitor to further growth of yogurt bacteria. Normally, the fermentation period is terminated by a temperature drop to 4 °C (39.2 °F). At this temperature, the culture is live but its activity is drastically limited, allowing fairly controlled flavor in marketing channels.

Lactic acid produced by ST is the L(+) isomer, which physiologically is more digestible than the D(−) isomer produced by LB. It seems that the kidneys of small infants are not capable of handling D(−) lactic acid. Yogurt contains both isomers. The L(+) isomer is normally 50–70% of the total lactic acid. A normal consumption level of yogurt does not pose a hazard from D(−) lactic acid but relatively large doses have been implicated in toxicity problems in small infants.

Lactic-acid production results in coagulation of milk, beginning at pH 5.2–5.3, at the point where the casein is first destabilized, and continuing until completion at pH 4.6. During lactic-acid production there is a gradual removal of phosphorus and calcium bound to the stable casein particle as tricalcium phosphate. The texture, body and acid flavor of yogurt owe their origins to lactic acid produced during fermentation.

Small quantities of organoleptic moieties are generated through carbohydrate catabolism, via volatile fatty acids, ethanol, acetoin, acetic acid, butanone, diacetyl and acetaldehyde. Homolactic fermentation in yogurt yields lactic acid as 95% of the fermentation output. Lactic acid acts as a preservative.

11.6.1.2 *Proteins*

Aggregation of whey proteins in yogurt has been observed (Argyle *et al.*, 1976b), which contributes to the consistency of yogurt during storage. Hydrolysis of milk proteins is easily measured by liberation of $-NH_2$ groups during fermentation. LB displays appreciable proteolytic activity in milk (Argyle *et al.*, 1976a; Chandan *et al.*, 1982). In his review, Loones (1989) reported that free amino groups double in yogurt after 24 hours. The proteolysis continues during the shelf-life of yogurt, doubling the free amino group again in 21 days' storage at 7 °C. The major amino acids liberated are proline and glycine. The essential amino acids liberated increase 3.8–3.9-fold during storage of yogurt, indicating that various proteolytic enzymes and peptidases remain active throughout the shelf-life of yogurt. The proteolytic activity of the two yogurt bacteria is moderate but is quite significant in relation to the symbiotic growth of the culture and the production of flavor compounds.

11.6.1.3 *Lipids*

A weak lipase activity results in the liberation of minor amounts of free fatty acid, particularly stearic and oleic acid. Individual esterases and lipases of yogurt bacteria appear to be more active towards short-chain fatty-acid glycerides than towards long-chain substrates (DeMoraes and Chandan, 1982). Since nonfat and low-fat yogurts make up the majority of the yogurt marketed in the USA, lipid hydrolysis contributes little to the product attributes.

11.6.1.4 *Formation of yogurt flavor and aroma compounds*

Lactic acid, acetaldehyde, acetone, diacetyl and other carbonyl compounds produced by fermentation constitute key flavor compounds of yogurt. Acetaldehyde content varies from 4 to 60 ppm in yogurt. Acetone varies from 1.3 to 4.0 ppm, acetoin from 1.3 to 4.0 ppm and diacetyl from 0.1 to 0.3 ppm (Routray and Mishra, 2011). Acetic acid is present in the range of 50–200 ppm. These key compounds are produced by yogurt bacteria. Certain amino acids (threonine, methionine) are known precursors of acetaldehyde. For example, threonine in the presence of threonine aldolase yields glycine and acetaldehyde. Acetaldehyde can arise from glucose, via acetyl CoA, or from nucleic acids, via thymidine of DNA. Diacetyl and acetoin are metabolic products of carbohydrate metabolism in ST. Acetone and butane-2-one may develop in milk during prefermentation processing.

Routray and Mishra (2011) have tabulated 97 aroma compounds in yogurt. Major compounds contributing to yogurt aroma include acetaldehyde, dimethyl sulfide, 2,3-butanedione, 2,3-pentanedione, 2-methylthiophene, 3-methyl-2-butenal, 1-octen-3-one, dimethyl trisulfide, 1-nonen-3-one, acetic acid, methional, (cis,cis)-nonenal, 2-methyl tetrahydrothiophen-3-one, 2-phenyacetaldehyde, 3-methylbutyric acid, caproic acid, guaiacol, benzothiozole and more (Marsili, 2003).

11.6.1.5 *Synthesis of oligosaccharides and polysaccharides*

Both ST and LB are documented in the literature to elaborate different oligosaccharides in yogurt-mix medium (O'Connor *et al.*, 2005). As much as 0.2% (by weight) mucopolysaccharides has been observed in 10 days' storage period. In stirred yogurt, drinking yogurt and reduced-fat yogurt, exo-polysaccharides can contribute a smooth texture, higher viscosity, lower syneresis and better mechanical handling. Excessive shear during pumping destroys much of the textural advantage because the viscosity-imparting function of the muco-polysaccharides is not shear-resistant. Most of the polysaccharides elaborated in yogurt contain glucose and galactose, along with minor quantities of fructose, mannose, arabinose, rhamnose, xylose, arabinose or N-acetylgalactosamine, individually or in combination. Molecular weight is of the order of 0.5–1.0 million Daltons. An intrinsic viscosity in the range of 1.5–4.7 dl/g^{-1} has been reported for exo-polysaccharides of ST and LB (Zourari *et al.*, 1992). The polysaccharides form a network of filaments visible under scanning electron microscope. The bacterial cells are covered by part of the polysaccharide and the filaments bind the cells and milk proteins. Upon shear treatment, the filaments rupture off from the cells, but maintain links with casein micelles. Ropy strains of ST and LB are commercially available. They are especially appropriate for stirred-yogurt production.

It is conceivable that some of the exo-polysaccharides exert a physiological role in human nutrition, due to their chemical structure resembling dietary fiber.

11.6.1.6 *Other metabolites*

Bacteriocins and several other antimicrobial compounds are generated by yogurt organisms. A bacteriocin called bulgarican is produced by LB that has been shown to possess antagonistic property towards the growth of several spoilage bacteria (Reddy *et al.*, 1984). Similarly, *L. acidophilus* produces acidophilin, which is shown to exhibit a wide-spectrum activity against both Gram-positive and Gram-negative bacteria (Shahani *et al.*, 1972). Benzoic acid (15–30 ppm) has been detected in yogurt, and is associated with metabolic activity of the culture (Chandan *et al.*, 1977). These metabolites tend to exert a preservative effect by controlling the growth of contaminating spoilage and pathogenic organisms gaining entry post-fermentation. As a result, the product attains an extension of shelf-life and a reasonable degree of safety from foodborne illness.

11.6.1.7 *Cell mass*

As a consequence of fermentation, yogurt organisms multiply to a count of 10^{8}–10^{10} CFU/g. Yogurt bacteria occupy some 1% of the volume or mass of yogurt. These cells contain cell walls, enzymes, nucleic acids, cellular proteins, lipids and carbohydrates. Lactase or β-galactosidase has been shown to contribute a major health-related property to yogurt.

APPENDIX 6

A.Y. Tamime, R.K. Robinson, Chapter 7 - Biochemistry of fermentation, Editor(s): A.Y. Tamime, R.K. Robinson, In Woodhead Publishing Series in Food Science, Technology and Nutrition, **Tamime and Robinson's Yoghurt** (Third Edition), Woodhead Publishing, 2007. ISBN 9781845692131; https://doi.org/10.1533/9781845692612.535

7.4 Lipid/fat metabolism

7.4.1 Introduction

Acyl glycerols constitute 96–98% of the total milk lipids/fats and the remaining fraction consists of phospholipids, sterols, fat-soluble vitamins (A, D, E and K), fatty acids, waxes and squalene. The lipids are found in the following phases of the milk: the fat globules, the membranes of the fat globules and the milk serum. The proportions of these fractions can vary in relation to such factors as species of mammal, breed, stage of lactation and type of feed (Walstra and Jenness, 1984; Weihrauch, 1988; Fox, 1991; Fox and McSweeny, 2006). The acyl glycerols present in milk are formed by the esterification of the alcohol radicals of the glycerol with one, two or three fatty acids residues to yield mono-, di- or triacylglycerides (triglycerides), respectively. Therefore, in broad terms, the enzymatic hydrolysis of milk lipids takes place at the ester linkages, eventually yielding free fatty acids and glycerol. The enzymes are known as triacylglycerol lipases EC 3.1.1.3 (Anon., 1992) and their mode of action may be specific to certain bonds on the glycerol molecules, that is, similar to the action of the peptidases (see Section 7.3.2). A simplified sequence of lipid hydrolysis is as follows:

$$\text{Triglycerides} \xrightarrow{\text{lipase}} \text{Di-} \xrightarrow{\text{lipase}} \text{Mono-} \xrightarrow{\text{lipase}} \text{Fatty acids} + \text{glycerol}$$

The triacylglycerol lipase enzymes in yoghurt may originate from the starter culture or from microbial contaminants that survived the heat treatment of the milk. Incidentally, the lipases, which occur naturally in milk, are inactivated at ordinary pasteurisation temperatures (Deeth and Fitz-Gerald, 1976). Therefore, any reduction in the percentage of fat, or increase in the level of fatty acids (free or esterified), or increase in the content of volatile fatty acids in yoghurt can be attributed to lipid metabolism by microorganisms, including *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus*. However, before evaluating the role of the different lipases reported to be present in the latter organisms, it is pertinent to look at some factors that can affect the degree of lipolysis.

Fat content of yoghurt

The fat content (g 100 g^{-1}) of yoghurt differs from one country to another according to the existing or proposed standards for the chemical composition of the product, or alternatively in relation to the types of yoghurt produced. There are four broad categories of yoghurt and related products:

- fat-free or < 1,
- >1% and <3%,
- >3% and <4%,
- >4.5% and 10%,

and the degree of lipolysis is likely to be greater in yoghurts with high fat contents.

Homogenisation

The process is carried out on the milk base and is widely practised in the yoghurt industry for two main reasons: first, to reduce the size of the fat globules and thus prevent 'creaming' or fat separation in the milk during incubation, and, second, to improve the viscosity and texture of yoghurt. However, the extent of lipolysis in homogenised milk is much greater than in non-homogenised milk, due, in large measure, to the destruction of the protective layer of the fat globule, that is, the fat globule membrane (Mulder and Walstra, 1974).

Table 7.9 Triacylglycerol lipase activities of the yoghurt starter cultures

Enzyme	Substrate	*S. thermophilus*	*L. delbrueckii* subsp. *bulgaricus*
Tributyrase	Tributyrin	+++[a]	++
Trioleinase	Soy-milk and olive oil		
Glycerol ester hydrolyse	Milk fat	++	
Enterases	Tween 40 and 60 and α-napthyl acetate or butyrate	+	+++
	Triacetin		Tr
Tricaproinase	Tricaproin		+

[a] Owing to different enzyme assay procedures employed, the enzyme activities are expressed as high (+++), medium (++) or low (+).

Tr = Trace.

Data compiled from Morichi *et al.* (1968), Otterholm *et al.* (1968), Angeles and Marth (1971), Formisano *et al.* (1972, 1973, 1974) and Umanskii *et al.* (1974).

Although the hydrolysis of fat by the yoghurt starter cultures occurs only to a limited degree, it may still be enough to contribute towards the flavour of the product. In fact, only Formisano *et al.* (1974) reported any appreciable loss of lipids, namely a decrease of 3.4% in the fat in yoghurt stored for 21 days at 4 °C. This observation has not been noted by other workers.

However, several authors in the 1960s and 1970s detected lipase activity in *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus*, and a list of these enzymes is shown in Table 7.9; the nomenclature of the enzymes is based on the substrate being hydrolysed, rather than on the systematic approach suggested by Anon. (1992). Nevertheless, all these triacylglycerol lipases in the yoghurt bacteria are reported to be located in the cytoplasm, since after cell disruption, very little activity is associated with the cell membrane (see also DeMoraes and Chandan, 1982); the fatty acid composition of dairy starter cultures has been reported by Rezanka *et al.* (1983) and Chand *et al.* (1992). Kalantzopoulos *et al.* (1990a,b) reported esterase activity in both yoghurt organisms and these enzymes were extracted from either the cell wall or the interior of the cell. The percentage of esterase activity was also high in *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus* (Bianchi-Salvadori *et al.*, 1995).

The characterisation of esterase activities of lactobacilli species has been reported by El-Soda *et al.* (1986a,b) and Khalid *et al.* (1990) and could briefly be summarised as follows:

- Enzyme activities using nitrophenyl derivatives of fatty acids were recorded as positive up to 50 °C.
- *P*-nitrophenyl derivatives were hydrolysed faster than the *O*-nitrophenyl derivatives.
- *L. helveticus* and *L. delbrueckii* subsp. *bulgaricus* strains had lower esterase activities than *L. acidophilus* and *L. delbrueckii* subsp. *lactis*.
- The enzymes activities were optimum at pH ~7.0, and at temperatures in the range between 40 and 50 °C.
- Freezing of cells, growth medium (e.g. MRS, sterile skimmed milk or whey-based medium) and stage of growth can influence esterase activities in Lactobacillus species (see also El-Sawah *et al.* 1995; Nadathur *et al.*, 1996).

Liu *et al.* (2001) reported the characteristics of two of the three intracellular esterases identified in *S. thermophilus*:

- The sub-unit molecular masses of esterases I and II were ~34 and ~60 kDa, respectively; indicating that esterase I and II could be a dimer and monomer, respectively.
- Both esterases were inhibited to different degrees in the presence of phenylmethylsulphonyl floride; EDTA, *N*-ethylmaleimide and dithiothreitol strongly inhibited esterase I, but significantly enhanced the activity of esterase II.
- The specificity of these esterases were: (a) esterase I was active on *p*-nitrophenyl esters of C_2–C_{10} fatty acids (FA), while esterase II was also active on *p*-nitrophenyl esters of C_2–C_6 fatty acids (FA); both enzymes were most active with *p*-nitrophenyl butyrate (C_4).
- The K_m values of esterase I on *p*-nitrophenyl esters of C_2–C_8 FA ranged from 6.7 to 0.004 mM, and the corresponding V_{max} values ranged from 8.12 to 1.12 μmol min^{-1} mg^{-1} protein.
- Esterase I was the major enzyme accounting for ~95% of the total esterase activity, and was further characterised as being active against tributyrin (C_4), dicaproin (C_6) and monoglycerides up to C_{14} with maximum activity on monocaprylin (C_8); decreasing the pH (i.e. from 8.0 to 5.5), temperature (i.e. from 37 to 25 °C) or water activity (i.e. from 0.99 to 0.80) considerably reduced the activity of the enzyme, but increasing the salt concentration to 7.5 g 100 ml^{-1} markedly enhanced the activity of esterase I (see also Liu *et al.*, 2004b).

7.4.2 Changes in the level of free and esterified fatty acids

The free and esterified fatty acids of yoghurts made from cow's, sheep's and goat's milk were studied by Rasic and Vucurovic (1973) and Rasic *et al.* (1973), and the changes that occurred are summarised in Table 7.10. From such data, it seems that the increase (or decrease) in the level of free fatty acids in the different types of yoghurt is inconsistent, and this variation probably reflects a difference in behaviour of *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus* in cow's, sheep's and goat's milk (see also Boccignone *et al.*, 1983, 1985).

Table 7.10 Changes in the free fatty acid contents of yoghurt made with milks from different mammals

Fatty acids	Cow	Sheep	Goat
Caprolic	–	I	–
Caprylic	I	I	D
Capric	–	–	–
Lauric	I	I	D
Myristic	I	I	D
C-15	–	D	–
Palmitic	I	D	I
Palmitoleic	–	–	–
Stearic	D	D	–
Oleic	D	D	–
Linoleic	–	–	I

I/D Increase/Decrease by more than 1% compared with milk.
– signifies no change.

Data compiled from Rasic and Vucurovic (1973) and Rasic *et al.* (1973).

In another investigation from another laboratory (Formisano *et al.*, 1974), the reported change in the free fatty acids in yoghurt was somewhat simplified, in that there was a liberation of long chain fatty acids into the product and the final pattern did not change significantly during cold storage. However, fermentation of full-fat milk with *S. thermophilus*, *L. delbrueckii* subsp. *bulgaricus* or *L. acidophilus* resulted in different effects on milk lipids. According to Rao and Reddy (1984) the changes were as follows:

- Significant increase in saturated fatty acids and oleic acid.
- A concomitant decrease in linoleic and linolenic acids in the glyceride fraction.
- The increase in free fatty acids was moderate, but there were significant increases in stearic and oleic acids.
- The monoglyceride fraction disappeared completely upon fermentation.
- The changes in cholesterol content were not significant; however, Juskiewicz and Panfil-Kuncewicz (2003) reported a reduction of cholesterol content of milks fermented with either ABT culture or a yoghurt culture, and the reduction was influenced by the level of fat in the milk base and the type of starter culture, but the level of FFA in these products was increased.
- A significant correlation ($r = 0.711$) was found between acid degree value and the level of free fatty acids.

Esters of short-chain fatty acids are aroma-compounds present in fermented dairy products (Liu *et al.*, 2004a,b). These compounds have a fruity flavour, which in some products may be regarded as a fault by the consumer. In a separate study, Liu *et al.* (2003) reported that *S. thermophilus* ST1 strain and a number of other LAB were able to synthesise esters from alcohols and glycerides via a transferase reaction (i.e. alcoholysis), in which the fatty acyl groups from the glycerides were transferred to alcohol. They concluded that: (a) strain ST1 was active on tributyrin and mono- or diglycerides of up to C10, and ethanol acted as the acyl acceptor, while its activity on C6 and C10 glycerides was initiated with 2-phenyl ethanol as the acyl acceptor, (b) 80% of the activities of transferase and esterase were detected in cell-free extracts, and five LAB had similar degrees of activities, which were enhanced slightly in the presence of ethanol and tributyrin, and (c) when ethanol and tributyrin were used as substrates, the transferase activities ranged between 0.006 and 1.37 units mg^{-1} cell dry weight, and the activities were species- and strain-dependent.

7.4.3 Changes in the level of volatile fatty acids

During the manufacture and storage of yoghurt, there is an appreciable increase in the total level of volatile fatty acids in the product. Data on the release of these fatty acids by single strains of *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus* and by mixed cultures have been reported by many investigators, and of the two organisms, the *Lactobacillus* produces more of these acids than *S. thermophilus*. The increase in the level of volatile fatty acids in yoghurt is dependent on several variables, such as the strains of starter bacteria, type of milk (i.e. cow's, buffalo's or goat's), duration and temperature of incubation, temperature of heat treatment of the milk and/or the age of yoghurt (Dutta *et al.*, 1971a,b, 1973; Singh *et al.*, 1980). However, a slight decrease in volatile fatty acids was observed in the presence of low concentrations of citric acids in milk (Dutta *et al.*, 1972).

Yu *et al.* (1974, 1985) and Yu and Nakanishi (1975a–c) have reported in detail on the levels of certain fatty acids in whole and skimmed milk cultured with yoghurt starter bacteria. Their data are shown in Table 7.11, and it can be observed that after 24 h of incubation at 37 °C, only a small degree of lipolysis has been exhibited by *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus*. It could be argued, however, that the origin of volatile fatty acids in fermented milks, and in particular in those based on skimmed milk, may not be the result of lipid metabolism by the yoghurt organisms, but may arise from the breakdown of other milk constituents (e.g. the amino acid pool), as suggested by Nakai and Elliot (1965); in the course of oxidative deamination and decarboxylation, the amino acid is split into its corresponding volatile fatty acid. The lipid constituents of skimmed and full-fat vita (i.e. Bulgarian fermented milk made with *L. delbrueckii* subsp. *bulgaricus*) have been reported by Ilinova and Naumova (1984).

However, Morichi *et al.* (1968) have pointed out that the presence of 'true detected esterases' in the lactic acid bacteria (e.g. *L. delbrueckii* subsp. *bulgaricus*) is difficult to verify, since some of the proteolytic enzymes and other factors in milk may exhibit esterase activity. Consequently, it is safe to assume that the detected esterase activity of the yoghurt bacteria (see Table 7.9) is directly related to the action of proteolytic enzymes rather than lipases. Such a conclusion is in accord with the higher production of volatile fatty acids by *L. delbrueckii* subsp. *bulgaricus*, that is, it is probably due to endopeptidases and/or exopeptidases rather than lipases.

Table 7.11 Changes in volatile fatty acids (VFA) in whole and skimmed milk fermented at 37 °C for different durations with yoghurt organisms

Fatty acids		Milk[a]	*S. thermophilus*		*L. delbrueckii* subsp. *bulgaricus*		Mixed	
			24 h	72 h	24 h	72 h	24 h	72 h
Total VFA ($mg\ 100\ g^{-1}$)	W	3.20	6.05	6.26	4.90	4.19	6.88	7.55
	S	2.97	5.89	6.32	4.88	3.79	6.80	7.20
C2	W	0.21	0.55	1.26	0.51	0.45	0.57	0.48
	S	0.20	1.95	1.36	0.45	0.37	0.12	0.20
C3	W	Tr	Tr	Tr	0.05	0.03	0.22	0.11
	S	–	0.05	0.05	0.03	0.03	Tr	Tr
i-C4	W	0.03	0.03	0.05	0.05	0.04	0.13	0.14
	S	0.03	0.04	0.61	0.05	0.05	0.03	0.06
n-C4	W	0.39	0.74	0.94	1.21	0.97	1.05	1.44
	S	0.38	0.50	0.96	1.20	0.90	0.66	1.08
i-C5	W	0.05	0.21	0.21	0.14	0.10	0.15	0.06
	S	0.03	0.13	0.18	0.11	0.09	0.07	0.17
n-C5	W	–	–	–	–	–		
	S	–	Tr	Tr	–	–		
n-C6	W	1.09	1.73	1.24	1.24	1.05	1.56	2.57
	S	1.13	1.72	1.35	1.25	1.07	2.40	2.04
C8	W	0.97	1.44	0.99	0.74	0.53	1.78	1.64
	S	0.96	1.30	1.18	0.87	0.56	2.26	2.36
C10	W	1.21	1.59	1.30	0.91	1.10	2.65	2.22
	S	1.10	1.81	1.74	1.06	0.68	3.11	2.92

[a] W: whole milk; S: skimmed milk.

TR: Trace. (–): not detected. Empty space signifies test was not determined.

Data compiled from Yu *et al.* (1974) and Yu and Nakanishi (1975a–c).

After Tamime and Deeth (1980). Reprinted with permission of *Journal of Food Protection*.

Examples of Non-nutritive Sweetener Use in Products without a Nutrient Content Claim

1. Dannon Activia Fruit on the Bottom.

2. Kroger Delight Lowfat Yogurt

3. Krogers Lowfat Yogurt Blended

4. Lowes Nonfat Yogurt

5. Lala Lowfat Yogurt

APPENDIX 8

List of Subject Matter Experts to Testify on Behalf of IDFA at a Future Hearing on Objections to the FDA Yogurt Standard of Identity Final Rule

OBJECTION 1:

Kathleen Glass, PhD, Distinguished Scientist, Associate Director, Food Research Institute, University of Wisconsin-Madison
Dr. Glass will present evidence and testimony on the safety of cup-set yogurts and how risks are controlled through current industry practices, including impact of pH and TA development during and after fermentation. She will illustrate through pathogen survival modeling examples and sharing research and challenge studies performed to evaluate pathogen survival and growth in yogurt under various conditions.

Mirjana Curic-Bawden, PhD, Senior Principal Scientist and Application Manager for Fermented Milk and Probiotics, Chr. Hansen.
Dr. Curic-Bawden will speak to the evolution of cultures over the decades and how they impact product characteristics. She will also help provide information on the impact of flavoring ingredients on the fermentation process.

Experts from IDFA member companies will provide information on the following:

- Basic yogurt making processes as it relates to acidity/pH
- Explanation (as deemed necessary) of vat set, warm fill, hot fill products
- Industry practices of using pH for breaking the fermentation as well as finished product testing
- Explanation of the continued drop in pH over time
- Explanation of the types of products that may fall into the 0.6 – 0.7 TA range
- Provide data outlining the minimal effects of acidic fruit preparations on fermentation process and essential finished product attributes
- Microbiology of yogurt and the safety of cup-set product
- Explanation of the requirements of the Pasteurized Milk Ordinance for pH, time and temperature for yogurt products and what was modified in 2007 and 2019
    - Discuss the research that was presented in 2005 and 2007 to NCIMS and FDA supporting these changes.

OBJECTION 2:

John Allan, MS, Vice President of Regulatory Affairs & International Standards, International Dairy Foods Association
Mr. Allan will present evidence demonstrating that milkfat is not critical to the basic nature and characteristics of yogurt, in large part because the yogurt cultures do not act on the milkfat during the culturing process.

Mirjana Curic-Bawden, PhD, Senior Principal Scientist and Application Manager for Fermented Milk and Probiotics, Chr. Hansen.
Dr. Curic-Bawden will also present evidence demonstrating that milkfat is not critical to the basic nature and characteristics of yogurt, in large part because the yogurt cultures do not act on the milkfat during the culturing process.

Experts from IDFA member companies will provide the following:

- Presentation of scientific research by subject matter experts demonstrating the results of sensory and analytical chemistry research conducted that has identified the specific compounds that contribute most to the *unique* flavors and aromas of yogurt and how they are derived predominantly through lactose fermentation.

OBJECTION 3:

Michelle Matto, RD, Principle at AM Food & Nutrition
Mrs. Matto will present evidence on the amount of vitamin D found in yogurt, both historically and today; and the amount of vitamin D found in other dairy products such as milk. She will also describe how the final rule conflicts with current regulations for addition of vitamin D in foods and how the rule will deter addition of vitamin D in yogurt.

OBJECTION 4:

Mirjana Curic-Bawden, PhD, Senior Principal Scientist and Application Manager for Fermented Milk and Probiotics, Chr. Hansen.
Dr. Curic-Bawden will present evidence demonstrating that milkfat is not critical to the basic nature and characteristics of yogurt, in large part because the yogurt cultures do not act on the milkfat during the culturing process.

Experts from IDFA member companies will provide the following:

- Presentation of scientific publications by subject matter experts demonstrating the results of sensory and analytical chemistry research conducted that has identified the specific compounds that contribute most to the *unique* flavors and aromas of yogurt and how they are derived predominantly through lactose fermentation.
- Data showing consumer acceptance and preference for lower fat yogurt products and why a yogurt standard aligned with NLEA and a minimum of >3 g of total fat per RACC promotes honesty and fair dealing in the interest of consumers.
    - Explain the disconnect for consumers between the yogurt fat labeling requirements vs NLEA when flavor ingredients that contain fat are added to the product
    - Provide sales data showing acceptance of lower fat yogurts
- Evidence demonstrating that total fat is of greater significance to consumers when choosing yogurt products.
- Examples demonstrating that removal of the 3.25% minimum milkfat requirement and replacement with a total fat content will enable the development of greater options for

consumers, including products with varying and lower fat content, as well as products with flavors from ingredients that inherently contain fat, such as nuts, coconut, and cacao.
    - Explain the challenges of formulating products around the “no-man’s land”
- Evidence demonstrating how the ingredient statement and a potential statement on the label regarding percent milkfat will ensure transparency regarding milkfat content.
- Examples and sales volumes, demonstrating that fat from nondairy ingredients is consistent with the basic nature and essential characteristics of many flavored yogurts on the market today and accepted by consumers.

OBJECTION 5:

Donna Berry, Food Scientist, Editor and Consultant, Daily Dose of Dairy
Mrs. Berry will share insights in consumer and product trends across the dairy industry and how flexibility in the use of sweeteners is key to continued innovation by the industry to stay relevant.

Experts from IDFA member companies will provide the following:

- Consumer insights regarding consumer demand and consumption of yogurt, specifically yogurt with non-nutritive sweeteners
- Consumer insights regarding consumer acceptance of non-nutritive sweeteners in yogurt
- Insights into the value that yogurt provides to consumers and highlighting the roles various sweeteners play in delivering that value.
    - The market for yogurt provides many choices for yogurt; sweetener type is one that consumers are used to making.
- The benefits of using non-nutritive sweeteners at lower levels that will reduce the sugar levels while still delivering on the flavor desired.
- Explain how higher levels of non-nutritive sweeteners without the support of sucrose can deliver a suboptimal product.