SCIENCE BEHIND REPORTED BENEFITS OF ORGANIC MILK

Rusty Bishop, PhD
Director, Center for Dairy Research
Professor, Dept. Food Science
Univ. Wisconsin – Madison

I. Executive Summary

Organic milk and dairy foods advocates have been very aggressive in their advertising, promotion and sales using statements and "facts" that lack scientific validity. Some of this information is true within a given context, while much is false and/or misleading. Science does not support the health, nutrition, or safety claims made by the organic industry. Actually, toxin levels have been shown to be higher in organic foods due to ineffective pesticide treatment of organic grain crops. In the one area where there exists a potential nutritional advantage of organic milk, such as increased levels of CLA, omega-3 fatty acids, and other antioxidants, access to fresh, high quality pasture is the key, not whether the production system is organic or conventional.

II. Introduction

The present consumer environment is one of growing mistrust of science and technology, rejection of advanced technology, and a favoring of "more natural" alternatives. This is most apparent in the realm of food and nutrition (2). Where it is not very apparent is in the area of health care, including GMO-produced insulin, surgical advances, etc. So why this dichotomy? The simple answer is promotion, advertising, and advocacy on the part of alternative food producers vs. conventionally-produced foods. The most aggressive alternative food production system is ORGANIC.

Consumers are motivated by perceived benefits such as better health / better treatment of animals, better nutritional value, better taste, environmentally friendly production methods, and "it's the right thing to

do" (2). Organic milk currently represents 3.4% of all fluid milk sales (19), and demand will continue to grow at a 25% annual rate (8).

After the organic food standards became effective in October of 2002, USDA Secretary Dan Glickman clarified that organic certification (by his agency) expressed a production philosophy and that organic labeling did not imply a superior, safer, or healthier product than food not labeled as organic (24). In spite of this, organic advocates continue to promote organic foods while disparaging conventionally-produced foods. The Organic Valley website (15) states, "The use antibiotics, synthetic hormones, and genetically modified organisms to intensify production in today's conventional agricultural practices gives rise to serious health questions." The website continues, "Organic foods are known (and appreciated) for their superior taste and quality. For individuals and families seeking high nutritional value and reduced risk of exposure to toxins associated with factory farming practices, organic offers peace of mind."

The Organic Valley website (15) goes on to list the 7 reasons why kids should drink organic milk:

1. produced without antibiotics
2. produced without synthetic hormones
3. produced without harmful pesticides
4. high in CLA (conjugated linoleic acid)
5. excellent source of calcium
6. organic milk is wholesome
7. it's the right thing to do.

Such statements by advocacy groups fall into 4 categories – true, true but misleading, totally misleading at best, or false and misleading. The "science" quoted by certain advocacy groups is selective at best and misinterpreted at worst. Scientific experts take exception to this. Dr. William Lockeretz from the School of Nutrition Science and Policy at Tufts University, speaking to the 5th International Federation of Organic Agriculture Movements Conference on Trade in Organic Production stated, "From my reading of the scientific literature, a claim cannot be made that there is a clear, consistent nutritional difference between organic and conventional foods." Dr. Norman Borlaug, a 1970 Nobel Peace Prize laureate, stated in Reason Magazine in April of 2000, "There's absolutely no research that shows organic foods provide better

nutrition" (2). So, what is the unbiased science behind this apparent organic vs. conventional debate, or, as Paul Harvey would say, "Now, the rest of the story."

III. Defining "Organic"

USDA introduced the Organic Foods Production Act (OFPA) as part of the 1990 Farm Bill. The program was fully implemented in October of 2002 with a 5-year sunset (October 21, 2007). The original parameters included no use of antibiotics, synthetic hormones, or "unapproved" synthetic pesticides; "access" to pasture; product labeling; etc. It is important to understand that if a food product is certified "organic", this describes the process by which the food product was supposed to be produced and processed; it does **not** describe the product itself (2). The most controversial of these parameters is the "access to pasture" due to it's vague meaning and it's apparent abuse. Organic purist believe that to promote and advertise certain nutritional benefits that are present only from significant pasture feed intake, there needs to be specifications for access to pasture. Proposed 2007 revisions to the OFPA would mandate: animals older than 6 months must pasture, animals must be on pasture for at least 120 days or growing season, a farm plan must be in place, and greater than 30% of dry matter intake must be from pasture.

Program oversight has also been an issue raised by the organic purists, unhappy with some of the practices of the larger farms and processors. The USDA has come under fire in the past for not taking action on complaints of OFPA violations. Two audits of its organic program, performed by the American National Standards Institute in 2004 and by the USDA's Office of Inspector General in 2005, were highly critical of how USDA has handled complaints of potential violations of organic standards. The 2005 reports states that 'in fiscal year 2003, the eight complaints referred to the national organic program for a decision have not been resolved.'

There remain issues with international consistency of organic standards, especially from countries exporting organic products and ingredients to the U.S. For example, EU organic standards allow limited use of antibiotics (20). Critics claim China's fledgling organic industry is plagued by lax standards, inadequate oversight, exploitation of workers,

and practices such as using human waste to fertilize fields, which isn't the kind of "organic" the USDA and most consumers support (6).

IV. Composition

Potential attributes of organic and conventional milk are most easily compared by analyzing the gross composition. AgSource (1) provided the author with blind data for such a comparison. Table 1. illustrates the composition data from 130 midwest dairy farms, showing a major difference in rolling herds averages (RHA), slight but insignificant differences in fat and protein content of organic vs. conventional raw milk, and a somewhat significant difference in somatic cell counts (SCC).

Table 1. Gross compositional comparison of conventional vs. organic raw milk (n=130).

Milk	RHA	% fat	% protein	SCC
Conventional	24,676	3.83	3.06	236K
Organic	16,823	3.87	3.10	276K

Table 2. takes a different look at the data, comparing RHA composition data, which provides a more enlightened view of the true situation. Production system does not seem to be the issue; size of farm is the more telling with significant differences across the board between small, middle-sized, and large farms.

Table 2. Gross compositional comparison of organic and conventional raw milk across rolling herd averages (n=130).

RHA	# cows	% fat	% protein	SCC
0-15,000	64	4.20	3.34	411 K
15,001-20,000	69	4.01	3.11	247K
20,001-25,000	157	3.89	3.09	251K
> 25,000	364	3.70	3.00	203K

V. Quality and Sensory Attributes

There is very little science which examines true quality and/or sensory attributes of conventional vs. organic milk and dairy products. Zhao, et al. (27) reported organically and conventional grown vegetables did not show significant differences in consumer liking or consumer-perceived sensory quality. The only exception was in tomatoes where the conventionally produced tomato was rated as having significantly stronger flavor than the organically produced tomato. Comparisons of fluid milk quality is difficult due to processing differences. 80% of organic milk is ultra-high temperature pasteurized vs. high-temperature-short-time for conventional fluid milk. Non-scientific comparisons have been made, such as the following example. Jed Davis, Director of Marketing for Cabot Cheese, stated, "There's a real opportunity in that there's organic cheese out there but … if you did a taste test against our traditional product, (it) would win out in the case of most people's taste buds" (26).

VI. Safety

Microbiological safety comparisons have not been conducted on organic vs. conventional milk and/or dairy products. A 2004 study (14) comparing microbiological safety of organic and conventional produce [476 organic samples / 129 conventional samples] found that no samples contained *Escherichia coli* O157:H7, 2 samples (organic lettuce and organic green peppers) contained Salmonella, and *E coli* was detected in 9.7% of organic samples and 1.6% of conventional samples. Some research suggests the widespread use of animal manure, when composted improperly, result in a higher occurrence of pathogens than conventional farming (24, 25).

A Norwegian study (13) concluded there was no marked difference in milk somatic cell counts between organic and conventional herds. This agrees with the AgSource data (1) presented earlier in this paper. The bottom line is that milk is safe, whether conventional or organic. All milk must comply with very stringent safety standards. In fact, milk and dairy products are among the most highly regulated and safest foods on the store shelf.

VII. Antimicrobial Resistance

Much has been stated concerning the increased antimicrobial resistance of conventionally-produced food products. The science paints a different picture. Ray, et al. (16) administered a survey of antimicrobial use (antibiotics, etc.) by dairy farms. Over 90% of organic farms (n=26) reported no antimicrobial treatment of dairy cows. The majority of conventional dairy owners (n=69) reported antibiotic use for treatment of various gastrointestinal, respiratory, and mammary infections in the herd. In addition, 49% of conventional farms reported use of medicated milk replacer whereas only 1 organic farm (3%) reported use of medicated milk replacer. The most commonly reported antimicrobial agents used within the previous 60 days on conventional dairy farms were penicillin, cephalosporins, and tetracyclines. Although resistance by Salmonella isolates (n=1,243) to these antimicrobial agents was observed among a high percentage of dairy herds, it is interesting to note that no significant difference in resistance to these individual antimicrobial agents was observed between organic and conventional dairy farms in the study.

This lack of difference in antimicrobial resistance of microbial isolates between conventional and organic dairy farms is further supported by others studies conducted domestically and internationally. Sato, et al. (18) saw no evidence that restriction of antibiotic use on dairy farms in Wisconsin was associated with prevalence of resistance to the antimicrobials tested – ciprofloxacin, gentamicin, erythromycin, and tetracycline. A Danish study (4) reported no difference in prevalence of penicillin resistant *Staphylococcus aureus* or in the proportion of *Staph aureus* resistant to penicillin between conventional and old organic herds, or before and after converting to organic farming. Roesch, et al. in Switzerland (17) found clear differences in the percentage of antibiotic resistance were mainly bacterial species related, but did not differ significantly between isolates from cows kept on organic (n=60) and conventional (n=60) farms, except for *Streptococcus uberis*, which exhibited significantly more single resistance when isolated from cows kept on organic farms (6/10 isolates) than on conventional farms (0/5 isolates).

VIII. Mycotoxins

Claims of lower levels of toxins in organic milk vs. conventional milk appear to also be unfounded. Two European studies indicate higher levels of aflatoxin M1 in organic milk and cheese compared with conventional products. Ghidini, et al. (11) observed that aflatoxin M1 contamination in some, but not all, samples (n=156) of organic milk (35 ug/l) was significantly higher than those of conventional milk (21 ug/l). Vallone, et al. (22) research results showed the presence of aflatoxin M1 in organic cheese samples frequently, but at low levels (<0.25 mg/kg cheese). This occurrence has been hypothesized to be due to ineffective pesticide treatment of organic grain crops.

IX. Pesticides

The exposure of organic crops to synthetic pesticides is, indeed, less than that of conventional crops, but product results are somewhat variable and often mis-interpreted. USDA results from the Pesticide Data Program show no significant differences in pesticide levels between conventional and organic milk. Of the 739 milk samples tested, 100% contained low level pesticide residue, all below actionable levels. A similar survey in Italy concluded that organic and conventional samples of milk do not show relevant differences for organochlorine pesticides, PCBs, and heavy metals. It must be pointed out that regulatory surveys worldwide do not test for organic pesticides – including non-synthetic and approved synthetic.

In a review conducted by Cal-Davis and IFT (24), it was reported that research has shown that organic foods contain less pesticide residue than conventional food, but "the marginal benefits of reducing human exposure to pesticides in the diet through increased consumption of organic produce appear to be insignificant." It is important to consider the risks, if any, currently posed by pesticide residues in foods before determining the incremental health benefits from consuming organic products. Results on pesticide residues in organic vs. conventional milk and dairy products is mixed at best, and shows no clear advantage for consuming organic milk.

X. Nutrients

Nutrition, health, and wellness is currently the major food marketing push. This, of course, includes highly nutritious milk and dairy foods, whether organic or conventional. In an extensive study of published results from 1926 to 1994, which included cereals, potatoes, vegetables, fruits, wine, beer, milk, and other dairy products, Woese, et al. (25) concluded that no major differences in nutrient levels were observed between the different production methods. Other studies (24) indicate organic production methods result in higher nutrient levels, but the same mechanisms that can produce potential benefits, like polyphenolic compounds, may also generate higher levels of toxins such as glycoalkaloids in potatoes and tomatoes.

In a UK study, Ellis (9, 10) found that milk with a higher level of omega-3 fatty acid content could be presented as a valuable contribution to a balanced diet to consumers, but it is important to emphasize that both organic and conventional milk are excellent sources of conjugated lenoleic acid (CLA), regardless of the production system, as well as other vitamins and minerals. Reported data is shown in Table 3.

Table 3. Mean % of each group type of fatty acid averaged over 12 months sampling each milk type (organic vs. conventional) (10).

Fatty acid	Conventional	Organic
Saturated	67.25	68.13
Monounsaturated	27.63	26.19
Polyunsaturated	3.33	3.89
Total n-3	0.66	1.11
Total n-6	1.68	1.68
C18:1 trans-11 (vaccenic acid)	1.75	2.06
C18:2 cis-9, trans-11 (CLA)	0.58	0.65
	n=17	n=19

Organic milk has a higher proportion of polyunsaturated to monunsaturated fatty acids and of n-3 fatty acids than conventional milk. There was no difference between organic and conventional milk with respect to the proportion of CLA or vaccenic acid. A number of factors other than farming systems were identified which affected milk fatty acid content including month of the year, herd average milk yield, breed type,

use of total mixed rations, and **access to fresh grazing**. Season, herd yield, and access to fresh pasture were also important factors in determining the milk content of vitamins A, E, and beta-carotene. Increased milk yield was associated with decreased vitamin E and beta-carotene content. Farming system was less important, except in the case of vitamin A, for which there was a slightly lower concentration in organic farm-gate milk (9). Access to fresh, high quality pasture seems to be the most significant variable in the nutrition equation, regardless of organic or conventional production systems.

The story is exactly the same for levels of antioxidants in milk such as flavenoids, etc. and other valuable compounds. Research by Bani and Sandrucci (3) concluded that pasture plays **the** pivotal role under organic systems. Grazing can increase the CLA content of milk, however, this largely depends on pasture botanical composition, altitude, and stage of maturity, regardless of whether the production practice is organic or conventional. Even Organic Valley agrees with this assessment in their scientifically-slanted study conclusion that milk from **pasture-raised** organic cows has been shown to have significantly higher levels of vitamin E, omega-3 fatty acids, beta-carotene, and other antioxidants than milk from conventional cows raised **in confinement**.

Grazing is the key. The problem is that the majority of organic fluid milk on the market is from cows on pasture an average of 60 partial days and pasture grasses make up <5% of their dry weight feed intake.

XI. Environment

Scientific studies on the environmental impact of organic vs. conventional farming systems is all over the board. Inherently, one would think organic farming would be better for the environment. Some researchers have taken a different view. A Dutch study by Boer (5) on life cycle assessment evaluated the environmental impact of organic vs. conventional milk production. He concluded global warming potential of milk production was 48-65% due to emission of methane. Organic milk production inherently increased methane emission.

XII. Conclusions

Collins (7) concludes that, when evaluating the health claims, research does not support a health advantage of organic over conventional milk for any segment of the population. With regard to chemical, nutritional, technological, or organoleptic quality traits of organic and conventional milk, Bani and Sandrucci (3) reported no significant difference between the two dairy systems has been observed when compared under similar technical and environmental conditions.

Winter (24) observed that, while many studies demonstrate qualitative differences between organic and conventional foods, it is premature to conclude that one food systems is superior to the other with respect to safety or nutritional composition. Pesticide residues, naturally-occurring toxins, nitrates, and polyphenolic compounds exert their health benefits or risks on a dose-response basis, and data do not exist to ascertain whether the differences in the levels of such chemicals between organic foods and conventional foods are of biological significance.

Science must focus on the facts at hand which have been generated by well designed and conducted research studies. It becomes the only truth in a marketing environment of consumer confusion and misconceptions, as well as false and misleading promotion and advertising. The key to success for dairy is to be truthful to the consumers. We should be saying, “Buy our products; they’re great; you’ll love them; and they’re good for you”, instead of “Buy our products because they won’t kill you and your children, and our farming methods won’t trash the planet like those other guys” (2)!

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