11 *Organic Milk Quality in the Netherlands: Distinguishable from conventional milk?*

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Introduction

Recent studies have indicated possible positive interactions between organic animal production and, particularly, and various vitamins. As possible distinguishing quality parameters for organic milk, the differences between organic and conventional milk in Netherlands for fatty acid composition and vitamins were investigated in milk samples form supermarkets at several points in time.

We have also investigated possible differences in taste and two alternative analytical parameters (bio-photons and bio-crystallisations) because a single quality parameter, like poly-unsaturated fatty acids (PUFA), hardly reflects organic intentions to produce quality in a more holistic way being an inherent reflection of proper agricultural practices. These two alternative parameters try to relate to the hypothesis stating that the structure (the 'order') of food is just as important to human health as the material composition (Bloksma et al, 2008).

Methodology

In every season of 2006 12 samples of milk were collected; 6 were organic and 6 were conventional. These samples were investigated on fatty acid composition (at QLIP, Leusden) particularly the unsaturated fatty acids conjugated linoleic acid (CLA) and omega-3 fatty acids, bio-photons and crystallisation degree. The radiation of light by samples of milk and cheese was measured for the determination of bio-photons. This is also called long term delayed luminescence. The crystallisation degree was determined by visual assessment of precipitation that appears after mixing milk or cheese with a copper chloride solution (Busscher et al, 2006).

In 2008 ten organic and 10 conventional samples of milk were collected in the supermarket on two moments (March and June). In March, 'winter milk' was collected, with cows still in the stable. In June "summer milk" was sampled. This milk is from cows mainly grazing day and night. Milk samples were analysed for vitamin A, carotenoids, vitamin E, Selenium, Cupper and Calcium. Further a "three alternatives, forced choice" taste experiment was performed with these samples to detect possible differences in taste. All milk samples involved processed milk collected in the supermarket (consumption package milk).

Results and discussion

Significant differences between organic and conventional milk were found for all fatty acid components (table 1), bio-crystallisations (table 3), some carotenoids and all minerals investigated (table 2), but not for bio-photons (table 3) and vitamin A and E (table 2). Differences in taste could not be detected: a panel of laymen could not distinguish the different milk sample from the three alternatives, while the blind preference was similar for conventional as for organic (47%) (de Vries et al, 2008). For all parameters except bio-crystallisations, the influence of season was high ($P<0.05$). In case of vitamin E as well as β-carotene there was a season*system interaction: the concentration in organic milk was higher than conventional milk in summer but lower in winter. The differences in bio-crystallisations could not be related to farm characteristics, feeding ration or health status.

Most differences can be explained by differences in feed ration: less maize and more green feeds, particularly fresh grass, in case of the differences in fatty acid patterns (de Vries and de Wit, 2006), and more fresh grass and less concentrate (with added trace elements) in case of vitamins and minerals. Results are similar to results in other European countries (Butler et al., 2003), particularly if one accounts for the differences in production system of both the organic and the conventional dairy system.

Table 1: Differences in fatty acid composition between organic and conventional milk (% of level of conventional milk which is between brackets; bold is P<0.05; Slaghuis and de Wit, 2007).

	Whole year average (n=48)	**Winter (n=14)**
SFA's	-2% (702 mg)	0% (726 mg)
PUFA's	15% (27,5 mg)	6% (24,8 mg)
CLA	38% (5.3 mg)	15% (3.9 mg)
Omega-3	60% (5.8 mg)	66% (5 mg)
Trans fatty acids (excl. CLA)	20% (2,2 mg)	3% (1.9 mg)

Table 2: Differences in some vitamins and minerals between organic and conventional milk (bold is P<0.05; de Vries et al., 2008).

	Conventional (n=20)	**Organic (n=20)**
Vitamin A (total retinol) (µg/100 gr milk)	39	39
Vitamin E (α-tocopherol) (mg/100 gr milk).	0,097	0,098
B-carotene (µg/100 gr milk)	16,5	16,8
Luteïn (µg/100 gr milk)	0,855	0,97
Zeaxanthin (µg/100 gr milk)	0,181	0,213
B-cryptoxanthin (µg/100 gr milk)	0,312	0,324
Ca (mg/100 gr milk)	120	123
Cu (µg/100 gr)	5	4,2
Se (µg/100 gr)	1,6	1,3

Table 3: Differences in two alternative quality parameters between organic and conventional milk (bold is P<0.05; Slaghuis and de Wit, 2007).

	Conventional (n=18)	**Organic (n=18)**
Bio-crystallisation (average evaluation, scale 1-10)	6.0	6.9
Bio photons (*1000 counts, 100-200 sec.)	29,9	31,5

Conclusion

Organic milk is distinguishable from conventional milk: the organic production system generally results in a more favourable fatty acid composition and higher levels of several vitamins, particularly if it is based on fresh, green feeds. These differences do not affect the taste of processed milk.

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Distinguishable quality of organic cow milk and strategies to improve it

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Distinguishable quality: why?

- Organic milk production involves higher costs (in most Western countries)

→How to convince consumers to pay this higher price? Problems:

- –Supporting sustainable agriculture is mainly for hard-core consumers
- –most sustainability issues relate to 'collective goods' (this means also: direct payments are option as alternative for "support via product price")

- Taste and health are important for 'light consumers'

Info is scarce; human health aspects difficult to asses.

Indication of health through food chain: children who ate mainly organic dairy products in first two years developed 30% less eczema. Kummeling et al. in British Journal of Nutrition (2008, 598-606)

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Dutch organic milk quality research programme

- 2004-2007: Poly-unsaturated fatty acids like CLA and omega-3, "healthy" fatty acids.
  - +2005-2006: Biocrystallisations and biophotons.
- 2008: Taste, vitamines, minerals

Mainly results from testing consumption milk samples from supermarket

In 2004-2007 also raw bulk milk samples from farms (fatty acids, biocrystallisations and biophotons).

>400 samples of 25 farms, different in many farm characteristics + deliberate feed changes

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Difference in fatty acid composition

(4 periods, 12 samples each; values of conventional milk between brackets in mg per g fat; all average year differences are P<0.05)

	Year-average difference with conventional (n=48)	During winter (n=14)
SFA's	-2% (702 mg)	0% (726 mg)
PUFA's	+15% (27,5 mg)	+6% (24,8 mg)
CLA	+39% (5.3 mg)	+15% (3.9 mg)
Omega-3	+60% (5.8 mg)	+66% (5 mg)
Trans fatty acids	+20% (2,2 mg)	+3% (1.9 mg)

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Farm monitoring results: Levels of CLA and omega-3 and feed ration composition per season.

	Summer (n=208)	Autumn (n=78)	Winter (n=129)
CLA (mg / g milk fat)	9.51	8.86	5.60
Omega3 (mg / g milk fat)	11,06	10,83	10.32
	Percentage in ration		
Concentrate	14	17	18
Fresh grass	67	39	2
Grass silage	13	33	61
Maize silage	3	3	5
Whole grain silage	0	0	1
Red clover	2	7	10
Others	2	0	2
Added oil (g/day/cow)	38	50	78

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Multilinear regression + feeding trials + literature; main conclusions:

- Adding oil very effective (some addition might be healthy for cows), but limitedly applicable in organic (cost, milk fat depression)
- Roughage quality most important, mainly:
  - +Fresh grass (young and green)
  - +Conserved grass as 'fresh' as possible (for grass pellets, silage or hay: short field period)
  - +Minimizing maize feeding
  - +Special effects (hay, clovers, herbs) exists, but no easy tricks

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Differences in vitamines and minerals
(2 periods, 20 samples each; bold is significantly higher; P<0.05)

	Conv. (n=20)	Org. (n=20)	Seasonal effect
Vitamine A (retinol) (µg/100 g milk)	32	32	Yes (summer high)
Vitamine E (α-tocopherol) (mg/100 g milk)	0,087	0,096	Season*production system interaction is significant (organic in winter lower and summer higher)
β-caroteen (µg/100 g milk)	16,5	15,9	Idem
Luteine (µg/100 g milk)	0,855	0,97	Yes (summer higher)
Zeaxanthine (µg/100 g milk)	0,191	0,213	Yes (summer higher)
β-cryptoxanthine (µg/100 g milk)	0,312	0,224	Yes (winter higher)
Ca (mg)	120	123	Yes (winter higher)
Cu (µg/100 g)	5	4,2	Yes (winter higher)
Se (µg/100 g)	1,6	1,2	Yes (winter higher)

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There is more than composition….

- Taste

Two alternative parameters related to hypothesis "Structure (the 'order') of food is just as important to human health as the material composition":
- Biophotons (light counts in dark; quality to store light energy)
- Bio-crystallisation

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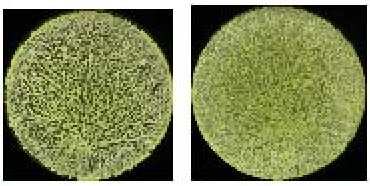
Biocrystallisations



Subjective qualification 1-10 of image (5 aspects plus overall) that appears after mixing milk with copper chloride

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	Conventional	Organic	Seasonal effect
Bio-crystallisation (average evaluation) n=36	6.0	6.9	No
Biophotons (*1000 counts, 100-200 sec.) n=36	29,9	31,5	Yes (28 winter, 35 summer)
Taste "three alternatives, forced choice"	No difference tasted by laymen (37 and 35% correct guess, not different from 33%); preference 47% for bio (not different from 50%)		

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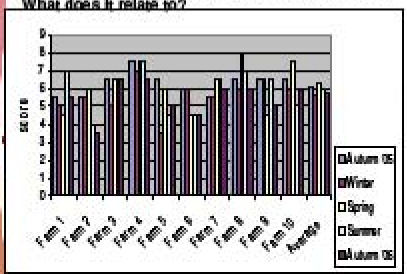
What does difference in bio-crystallisation means? What does it relate to?



No relation with farm characteristics, season, feed, health
Also: the score of mixed sample is not equal to average of original samples!!!

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Conclusion 1

Dutch organic milk better than conventional?
+ Fatty acid composition
+ Some vitamins

± Better in bio-crystallisation, but meaning and scope for improvement?
± No difference in taste, some vitamins
± Lower in some minerals (but this is hardly important for human health)

- none

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Conclusion 2

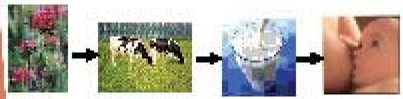
Most and main favourable differences are related to:

- Fresh grass (and hay/silage as green as possible)
- Summer

Why not base organic dairy production more on this?

- ➢ Adjusting feeding ration
- ➢ Seasonal (=natural) milk production.

The organic chain: tastefull products supporting human health from a healthy production system



Thank you for your attention

Multiple linear regression

(only including significant factors, p<0.05)

Feed components

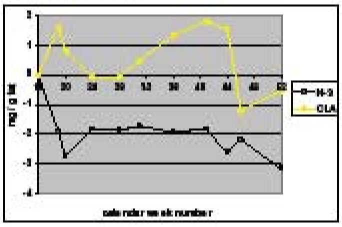
Estimated effect per kg DM (mg per g fat)

	CLA	Omega-3
Fresh grass	0.33	Not incl.
Maize silage	-0.23	-0.25
Whole grain silage	Not incl.	-0.70
Added oil	9.61	5.71
Grass pellets	0.29	0.74
Red clover	0.24	0.21

Multiple linear regression
Explained variance and other factors

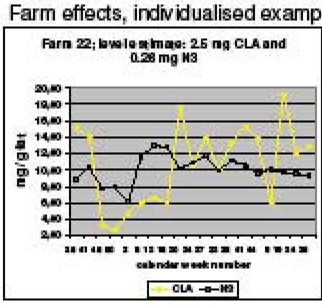
	CLA (%)	Omega-3 (%)
Feed ration components	12.0	15.1
Sampling date (calendar week number)	48.3	11.7
Farm effect	38.2	68.9
Total explained variance	74.5	62.1

Seasonal effects



Most seem related to grass quality

Farm effects, individualised examples



No clear breed effects

Farm number	CLA level estimate	N3 level estimate
12	-3.10	2.94
4	0.99	-0.19

Literature: within breed variation high; daughter groups differences are considerable (van Arendonk et al)

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