Organic Food Quality & Health

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Dear Readers

With pleasure we present you the first FQH Newsletter in 2007. You might wonder to receive a FQH Newsletter again as opposed to our announcement in the last 2006 edition to stop this analogue Newsletter format. But according to the outcome of our questionnaire in September that was mostly very positive and pro-argumentative for our newsletter we re-decided to continue giving you this piece of organic information at hand.

Contents

A biocrystallisation method for examining gluten samples - indicator of baking quality and health properties of wheat?

Jens-Otto Andersen[1]

Background

Experiences from organic bakeries show that organic wheat batches may show good baking properties despite low gluten content and gluten index values. Also wheat varieties with genetically determined low gluten index values may show good baking properties and taste when applying alternative fermenting and baking techniques. Thus methods are needed which may complement traditional methods for assessing baking properties (gluten content, gluten index, falling number, bread volume a.o.) in connection with alternative varieties and baking techniques.

A growing percentage of the European population shows wheat intolerance and gluten allergy responses to breads produced by means of a combination of modern high-yielding varieties and traditional fermenting and baking techniques. Experiences from nutritional therapists indicate that some persons tolerate better older varieties, specifically when these are grown organically and processed with alternative baking techniques. Thus methods are needed which may contribute in clarifying the complex dynamics behind intolerance and allergy responses.

In 2005-06 Biodynamic Research Association Denmark (BRAD) performed a study with the aim of:

(a) developing a biocrystallisation method for examining the picture-developing properties of gluten samples; (b) testing the method on a broad spectrum of wheat samples; (c) examining the statistical correlations between the resulting biocrystallisation data and other available data concerning cultivation, chemical analyses and baking properties; (d) evaluating the perspectives for applying the method in an intolerance/allergy research context.

The biocrystallisation method may complement chemical analyses of single compounds (proteins, minerals, vitamins). The output is not numerical data, but crystal structures ('pictures') with morphological criteria which may be ranked based on types and degrees of 'structural order'. The method is known to reflect especially fertilisation levels, farming systems and physiological ripeness. In the period 2001-06 the method has been validated in a cooperation between University of Kassel, Louis Bolk Institute and Biodynamic Research Association Denmark.

Materials and Methods

1. The developed experimental method

The experimental method contains the following primary elements: (a) washing out gluten from the wheat sample based on ICC-standard nr. 155; (b) watery extraction based on thin gluten slices; (c) filtration; (d) production of a crystallisation solution from CuCl2-solution, distilled water and gluten extract; (e) crystallisation of the solution over 12-15 hours on circular glass plates.

2. Wheat samples examined

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A total of 66 wheat samples were examined with differences in variety, location, sulphur treatment and farming system. The samples may be divided into: (a) controlled samples from a controlled experimental design with replicates; (b) additional samples.

The controlled samples include the following four groups: (a) Winter wheat varieties from the Danish extension service trial [02-101-05-05]; (b) Spring wheat varieties from the Danish extension service trial [02-108-05-05]; (c) Sulphur to organic spring wheat (0,20,40 kg/ha) from the Danish extension service trial [02-014-05-05]; (d) The MASCOT (Mediterranean Arable Systems Comparison Trial) long-term trial at University of Pisa).

The additional samples were supplied by: (a) the Danish certified seed producer P. Grupe (Moerdrupkorn), (b) the Swedish grain breeder H. Larsson (Swedish Agricultural University), and (c) the extension service officer Kj. Forsom (Landwirtschaftlicher Hauptverein für Nordschleswig).

3. Applied ranking criteria

Visual ranking of 12 morphological criteria in the crystal structures was performed by means of scales of 9 and 12 levels, arranged as discrete equidistant scales with units of 1, where high values are desired. Reference-pictures were selected from the overall pool of pictures, and the ranking performed with a single scale value for a group of 4 biocrystallograms from one sample. The criteria include two types: (1) general criteria which are applicable to most types of biocrystallograms; (2) sample-specific criteria which are specific to gluten samples. Means were calculated from the different groups of 4-6 criteria which performed best in statistical analyses of the different sample groups.

4. Additional parameters applied for statistical analysis

The biocrystallisation data were correlated to the following groups of parameters: (a) cultivation parameters (variety, location, sulphur treatment, farming system); (b) grain parameters (yield of grain, yield of dry matter, hl-weight of grains, water content, thousand-kernel-weight; (c) chemical analysis parameters (starch, raw protein); (d) baking property parameters (gluten index, wet gluten, amylogram-value, gelatinisation temperature, bread volume, water absorption).

5. Statistical analyses applied

In cooperation with the Danish Agricultural Extension Service analyses were performed including:

(a) analyses of variance in order to identify discriminative ranking criteria, and to examine the effects of different factors on the picture-developing properties of the samples; (b) multiple regression analyses with ranking criteria as response variables and the remaining groups of parameters/variables as explanatory variables; (c) multiple regression analyses with gluten index as response variable and the remaining groups of parameters/variables as explanatory variables.

Selected results

All 12 ranking criteria were able to discriminate significantly ($p < 0.05$-0.0001) different groups of samples relative to the cultivation, grain, chemical analysis and baking property parameters. The seven best-performing criteria for discriminating winter wheat varieties showed significant correlations for the following 11 parameters: location, yield, hectolitre weight, water content, starch, gluten index, wet gluten, amylogram value, gelatinisation temperature, bread volume and water absorption.

It was concluded that the criteria as a whole reflect a spectrum of relevant quality aspects, including positive/negative correlations to the six baking property parameters mentioned. Thus the ranking criteria and the traditional baking parameters generally reflect a part of the same variation among the grain samples examined. In the regression analyses the ranking criteria showed several significant correlations to the grain, chemical analysis and baking property parameters as explanatory variables, whereas very few significant correlations were found for gluten index. Thus the ranking criteria generally reflect baking properties which are not correlated to gluten index in a simple manner.

The factor variety was discriminated significantly by more criteria, specifically in the case of the winter wheat varieties. Among the additional samples the classical variety Bussard showed a high gluten index (94), but indeed the lowest ranking value. As opposed to this high ranking values were observed for the 'older' varieties including Oelandic wheat, Goldblume, H. Erbe, Holger B. and Gotlandic wheat. The latter showed a high gluten index (91), whereas the others showed very low indices (55-75).

For the samples from Sulphur to organic spring wheat was noted for the ranking criteria as response variables a combination of significant effects for sulphur treatment, raw protein and bread volume. Here better picture-developing properties were observed when adding just 20 kg S/ha.

For the samples from Farming systems it is seen that the organic samples show significantly better picture-developing properties than the conventional.

Representative pictures from three sample groups (Sulphur to organic spring wheat, Farming systems, Additional samples):

Figure 1. Representative biocrystallograms from the sample groups *Sulphur to organic spring wheat* [upper]*, Farming systems* [middle] and *Additional samples* [lower]. From the upper are shown *Untreated (0 kg S/ha)* [left] and *Treated (20 kg S/ha)* [right]*;* from the middle *Conventional* [left] and *Organic* [right]; from the lower the two winter wheat varieties *Bussard* [left] and *Goldblume* [right].

(photographic technique: Olympus SP500UZ; polarisation filters; contrast/light intensity adjusted).

Discussion and Conclusion

Concerning varieties a strong tendency was observed for the 'older' varieties showing good picture-developing properties, as opposed to the more modern varieties such as Bussard. Among the older varieties Oelandic wheat is known for good baking qualities when applying alternative fermenting and baking techniques. Concerning the correlation between the ranking criteria and the different baking property parameters several significant regression correlations were observed, yet for gluten index as response variable hardly any were observed.

Concerning Sulphur to organic spring wheat the significant effects observed (improved picture-developing properties, a higher content of protein, a higher bread volume) indicate an improved protein metabolism by adding even a small amount of sulphur (20 kg/ha), as compared to the control. This confirms the hypothesis that the method is very sensitive to factors influencing the protein metabolism. This sensitivity includes specifically the N-fertilisation, as a decisive factor for the overall plant physiological status at harvest, as observed in the case of significant differences between the conventional and organic samples from the Farming systems trial, in favour of the organic samples.

The project has generated unique new knowledge about the ability of the biocrystallisation method to discriminate wheat samples, not only on the basis of whole-grain samples which is well-known from earlier investigations, but from gluten as a single protein fraction. The results indicate that the method may contribute in assessing desired baking properties in connection with applying alternative varieties as well as fermenting and baking techniques. A follow-up study is planned which will include more modern high-yielding wheat varieties with a hard gluten structure compared to older varieties with a more soft gluten.

Concerning a possible correlation between the picture-developing properties of gluten samples, their experimental background and intolerance/allergy responses in humans, the project results encourage further studies. It is noteworthy that the older wheat varieties and organic samples show better picture-developing properties than more modern respectively conventional samples. It is generally acknowledged that organic wheat has a more balanced N-metabolism (less nitrate, more pure protein, higher EEA-index) than conventional. It is here hypothesised that older varieties

generally have a more balanced protein composition, i.e. a better balance between the nutritionally valuable fractions (albumins, globulins) and the more structural fractions (prolamines, glutelines). The method may here contribute in understanding better the complex correlations between variety characteristics, N- and protein metabolism of the wheat crop, the effects of sulphur treatment on the protein metabolism, and on the other side wheat intolerance and gluten allergy responses in humans.

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Summaries of presentations given at the BioFach FQH Workshop on Feb. 15, 2007 in Nuremberg:

Rabbit Feeding Experiment - Experimental Design and Preliminary Evaluation of Quality and Health Parameters by a Conventional and Organic Diet

Laurent Kerbage, Esther Zeltner, Gabriela Wyss, Beat Bapst, and Veronika Maurer[1]

Background

Many studies have been performed to show the nutritional quality of organically and conventionally produced food and feed. Many of them tend to show higher amounts of specific nutrients in organic food and feed – mainly secondary plant metabolites (SPM). However, there is not enough evidence for a benefit of higher intake of SPM on human health. Nevertheless, consumers expect healthy and high quality organic products. Animal feeding experiments with conventionally and organically fed groups might elucidate the health status of animals by defining specific biomarkers such as e.g. immunological fitness and reproduction rates. The results of such studies can lead to a better understanding of the effects of different production systems on product quality and subsequently on health and reproduction parameters of the involved animals. Even though only human intervention studies can directly show the impact of food on human health, animal feeding experiments can give valuable information and indications in which direction quality and health research could be done.

Hypothesis and aims of the project

FiBL has started an animal feeding experiment with rabbits in May 2006. This study will last over a period of three years. Rabbits are production animals with a relatively quick reproduction rate. Besides immunological-, behavioral- and feed preference tests this allows us to analyse meat quality of several litters.

Hypotheses of the study are (i) rabbit production in small scale husbandry and feeding with adequate feed composition leads to good meat quality and immunological health (analysed are leukocyte concentration (innate- and adaptive immunity), T- and B-cells (adaptive immunity), IgG and IgM (infection marker), (ii) rabbit production under an organic diet increases their antioxidative capacity of the blood

The aim of the study is (i) to establish a group housing system for rabbits as new model for investigating food quality (ii) to investigate the effect of lignocellulose instead of coccidiostats in the feed of rabbits as a method to reduce enteritis, (iii). to investigate the overall health status and the meat quality of the rabbits by standard chemical analytic and a holistic quality assessment method,

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(iv) to define adequate quality and health parameters to describe the health status of rabbits and (v) to include and evaluate the potential of Gas Discharge Visualisation (GDV) as a holistic method to define inner quality aspects of feed, meat and blood samples.

Experimental design and parameters

The study includes analysis on eight groups of ZiKa-hybrid rabbits each fed with either conventionally or organically produced feed. It includes behavioral observations, feed preference tests and immunological examinations. All feed and meat samples were blinded. The maintenance of a first fattening group is currently in progress. Firstly, adequate health and quality parameters for the rabbits shall be defined and experiences shall be made with the experimental set up.

It is planned to perform all analysis twice a year and to collect data of the offspring of the two feeding concepts to detect possible changes and effects of consecutive litters.

In order to ensure a well-balanced intake of all nutrients, the feed was provided as pellets to all rabbits. The composition contained dried alfalfa meal, barley, sun flower cake, soy cake, cellulose, sugar, beets, molasse, mixture of vitamins, and mineral nutrients and soy oil.

Besides chemical analyses, the meat and the feed quality were measured with GDV where high frequency voltage is impressed to a sample. As a result, a so called “corona” occurs around the sample, consisting of electrons and photons. This corona is photographed by a digital camera. The pictures (coronas) are then processed with GDV Analysis software and described by a set of numerical parameters.

The following parameters will be measured in all groups:

- Chemical feed and meat quality: Quantitative analysis of macro- and micronutrients, patterns of fatty- and amino acids, trace elements, specific vitamins, polar- and non-polar pesticides and nitrates (in feed).
- Analysis of holistic quality through GDV (qualitative comparison).
- Analysis of meat quality through measuring pH, colour of raw and cooked meat, textural properties, bone density and more.
- Analysis of immunological health status through IgG, IgM and leucocytes concentration.
- Antioxidative potential of the rabbit blood as a marker for capacity to quench free radicals.
- Body mass data of the rabbits.
- Reproduction rate and number of losses during breeding and fattening.
- Behavioral observations: mainly activity.
- Feed preference tests: fresh organic produced carrots vs. fresh conventionally produced carrots.

GDV analyses of the feed and meat of the first part of the first fattening group showed promising results. However, only GDV results throughout the whole test period can show the consistency of GDV-results and hence show the usability of this method.

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Criteria for justified nutritional and health claims

Lucy van de Vijver and Machteld Huber[1]

Background and Method

An important reason for consumers to buy organic foods is the idea that organic foods are healthier. If nutritional or health claims could be made, sales of organics would increase. But what can be said? To answer this question the Dutch government asked LBI to propose acceptable claims for organic foods based on the scientific evidence.

Literature was studied on differences in nutritional content of organic and conventional food, and on relations between organic food consumption and health. Next to this legal frameworks and conventions were studied, discussion meetings were held with pr-experts, lawyers and traders. Finally consensus was reached within the Dutch organic movement on a code for communication.

Results

Result is that studies are divided into 3 categories (“pyramid of validation of scientific research”), depending on their quality and contribution to the scientific evidence. In the highest category (1) studies are placed that used traceable products with respect to origin, and by methodology met the scientific criteria postulated by the Soil Association. Category 2 is for studies with a lower contribution to the scientific evidence; scientific research not being solid in every step of the chain, and category 3 is for studies that can be categorized as anecdotic.

As basis for the literature search several important reviews were used (e.g. 1, 2) completed with more recent studies. Heaton (1) already selected studies based upon a set of scientific criteria (29 out of 99 fulfilled to his criteria). With respect to studies on organic food consumption and health,

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only few studies belong to the first category. For instance the Darcof study on rats (3) and the study of Ren et al. on antimutagenic properties of organic extracts (4). More studies belong to the second category, as the nun-study (5). Many studies belong to the third category (for instance the study on sperm quality in organic farmers).

Three types of claims can be distinguished: Nutritional claims, Health claims and Medical claims. These last are not yet allowed on foods!!

The literature search showed that some nutritional claims are possible, but for health claims to little evidence exists. Nutritional claims that can be based on the literature are:

- Organic dairy products contain a higher amount of good fatty acids (omega 3 and CLA)
- There are clear indications that organic leaf vegetables have higher vitamin C content.
- There are clear indications that organic fruit and vegetables contain more antioxidants.
- There are indications that the protein content of organic grain products is of a higher quality
- There are clear indications that organic products have higher dry matter content, resulting in relative more nutrients per portion.

Prospect

When health claims are desired in the future, scientific evidence is a necessity. With the new EU regulation all health claims needs to be checked before they are used.

In short more scientific prove is needed to enable a claim on a food product.

This scientific prove needs to be of a high scientific standard.

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Human health related fatty acids (Omega-3-fatty acid and conjugated linoleic acid isomer c9t11CLA) in German dairy milk samples with regard to the amount of maize in the animal diet.

Maria Ehrlich[1]

Background and Method

The objective of this study was to measure the fatty acid composition, and carbon isotope ratios of milk fat from 18 milk samples from 15 different dairies (6 samples of organic milk, 9 samples of conventional milk) bought in German supermarkets and food stores in February 2006. The concentration of fatty acids was determined using a gas chromatography analysis estered with TMSH (GC 6890, USA). The carbon isotope ratios (13C) were measured using a "continous-flow" isotope ratio mass spectrometer (IsoPrime, GB). Milk with special image qualities (pertaining to advertising strategies) was preferably selected (e.g. "Alpenmilch" [Milk from the Alps], "Bergbauernmilch" [Mountain Farmer Milk]).

Results and Discussion

The concentration of omega-3-fatty acid proved higher in organic than in conventional milk (10,47 versus 7,72 mg/g fat). This corresponds to the lesser amount of maize found in the animal diet used to produce the organic milk samples analysed in this study. The concentration of c9t11CLA was very different in both organic and conventional milk, but milk from dairies in Southern Germany generally had a higher concentration of c9t11CLA (> 6 mg/g fat) than milk from other parts of Germany (< 6 mg/g fat).

With the help of Isotope analysis and the identification of fatty acid patterns in the milk, it could however be shown, that that the conventional wintertime "Alpenmilch" – contrary to advertising motives and the associations evoked in consumers ("happy cows grazing on high mountain grassland"), was not produced solely by feeding silages prepared from grassland as the milk's image suggests, but rather with high amounts of maize in the animal diet as well. The conventional "Alpenmilch" from the "Weihenstephan" dairy, and the conventional "Alpenfrische Vollmilch" from the "Allgäuer Alpenmilch" dairy were produced in large part with high amounts of maize in the animal diet (35 and 42,3 %), and the concentration of Omega-3-fatty acid and c9t11CLA were subsequently the lowest (Omega-3: 5,86 und 7,43 mg/g fat/ c9t11CLA: 6,15 and 4,82 mg/g fat). In contrast to this, the organic "Alpenmilch" of the dairy "Berchtesgadener Land" contained the highest concentration of Omega-3 (12,06 mg/g fat) and c9t11CLA (8,31mg/g fat). The amount of maize in the animal diet was accordingly very low (6,9%).

It remains to be hoped for that a stronger conformity between the marketing/imagery of a dairy, and the actual origin and production methods of the milk it uses be experienced in the future.

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