Organic Food Quality & Health Newsletter July 07

Edition No. 2/2007

Dear Readers

With pleasure we present to you the second FQH-Newsletter of 2007.
In this Newsletter you find two articles on the effects of organic, low-input or conventional plant production systems on the composition of rat diets and on (aspects of) the immune system of rats, and one article on the baking quality of wheat. Furthermore, you find a report on Dutch research on differences between milk from organic and conventional production systems, and a report on the inspiring Scientific Workshop for FQH-members on March 21 in Stuttgart-Hohenheim.
We wish you pleasure and inspiration reading this newsletter. More information on organic Food Quality and Health you can find on the FQH-website **www.organicfqhresearch.org**.

Contents

The effect of short term feeding with organic and conventional diets on selected immune parameters in rat

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Abstract

There is currently no evidence for beneficial health impacts being associated with the consumption of organic rather than conventional foods. This preliminary study was therefore aimed at using haematological parameters, white blood cell (WBC) number and splenocyte proliferation as sensitive assays to evaluate influence of the organic, low input and conventional components in the diet on rats' immune system function. The results of a short term feeding trial with two rat generations indicates a potential effect on immune system function, which has to be confirmed by longer-term exposure studies.

Introduction

Organic farming is an integrated system of agriculture based on ecological principles, promotion of biodiversity, biological cycles and organic matter recycling to maintain soil fertility. The regulations for organic crop cultivation prohibit the use of chemo-synthetic pesticides, mineral fertilizers, growth promoters and genetic engineering or Genetically Modified Organisms (Rosati and Aumaitre 2004). Despite the increasing interest in organic food production, the number of articles describing potential positive and negative effects of consumption of organic and conventional foodstuffs on human and animal health is still very small (Lund and Algers, 2003). The presence of chemical contaminants (e.g. pesticides) in conventional food is likely to have an influence on their concentration in the bodies of consumers, and some *in vitro* experiments indicate that they may cause immunosuppression (Finamore et al. 2004). On the other hand, it has been suggested that immune responses in farm animals fed either conventional or organic diets are similar (Millet et al. 2005). There is therefore currently no scientifically sound evidence that demonstrates health benefits associated with the consumption of organic rather than conventional foods. However, whether or not the consumption of organic foods has significant health impacts, deserves to be tested in well controlled experimental research. The aim of this study was, therefore, to assess the effect of diets, based on organically, low input and conventionally grown crops on selected immune parameters of rats in a short-term experimental feeding trial.

Materials and methods

Adult male and female Wistar rats were kept under conditions of controlled light (12-h light/12-h dark cycle) and temperature (22–23 °C) with free access to water and experimental feeds. The animals were randomly assigned to one of five experimental dietary groups, according to the pro-

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tocol shown in Table 1. After three weeks of feeding animals were paired and bred. Paternal males were sacrificed one week later, while females were fed the respective diets during the pregnancy and suckling period (total 10 weeks) and sacrificed thereafter along with a part of the off-spring of both sexes. Six young males from each dietary group were left alive to be fed subsequently for 9 weeks and this part of the experiment is still in progress. Animals were anesthetized with Tiopental, blood was collected from heart and spleens isolated aseptically and used immediately for in vitro studies. All animal procedures were in accordance with the Guiding Principles for the Care and Use of Research Animals and had been approved by the First Warsaw Ethics Committee for Experiments on Animals. Experimental diets were prepared using components produced under different agronomy regimes (Leifert et al. 2007), and characterized in a paper submitted for presentation at this congress (Rembialkowska et al. 2007). The experimental diets used for the different groups are described in Table 1. Control rats were fed a standard feed for rodents (Labofeed, Andrzej Morawski Feed Production Plant, Kcynia near Bydgoszcz, Poland).

Table 1: Experimental protocol (see Leifert et al. 2007 for details)

Exp. groups	**Type of diet**
ORG-ORG	no synthetic pesticides and no mineral fertilizers (organic farming)
ORG-CV	no synthetic pesticides and with mineral fertilizers (low input 1)
CV-ORG	with synthetic pesticides and no mineral fertilizers (low input 2)
CV-CV	with synthetic pesticides and with mineral fertilizers (conventional farming)
LF (control)	standard rodent's food – Labofeed

Hematological parameters (hematocrit value, RBC number and hemoglobin content) and WBC were assayed using standard laboratory methods. Splenocyte cultures were prepared according to a method used previously for rat lymphocytes (Bik et al. 2006). The following mitogens were then applied: Phytohemagglutinin A (PHA), Concanavalin A (ConA) or Lipopolysaccharide (LPS). Control cultures consisted of cells incubated with culture medium alone (spontaneous proliferation). Splenocyte proliferation *in vitro* was assessed by incorporation of ^{3}H-thymidine and expressed in counts per minute (cpm) as mean (± SD) and as stimulation index (SI). For statistical evaluation of differences between groups, ANOVA parametric followed by the Student-Neuman-Keuls test was used. Results were considered statistically significant when $p<0.05$.

Results

There were no significant differences in hematological parameters in rats of both sexes and generations and those fed different diets (data no shown). In adult female rats, the total WBC number were higher than in their 3-week-old off-spring of both sexes. In adult female rats WBC numbers were highest in the ORG-CV and lowest in the CV-ORG group (Fig. 1). In the parental generation only spontaneous proliferation of splenocytes from ORG-ORG and CV-CV diet groups have been examined. Proliferation of splenocytes in rats on the ORG-ORG diet was higher for males but lower for females in comparison with rats in the CV-CV diet group (Fig. 2A). In 3-week-old rats no significant differences could be found between sexes of dietary groups; however, a trend towards lower levels in one of the low input (ORG-CV) and conventional (CV-CV) dietary groups was detected (Fig.2B).

Mitogen-stimulated proliferation of splenocytes from young rats was examined over wide concentration range of both T-cell (PHA and ConA) and B-cell (LPS) specific mitogens. The response was dose-dependent and the effect of only one concentration of particular mitogen is shown on Fig. 3. The ability of splenocytes to be stimulated by T-cell specific mitogens was diet-dependent and seemed to be highest in splenocytes obtained from CV-CV and ORG-ORG rats. Moreover, a significantly reduced splenocyte proliferation in ORG-CV dietary groups was observed (Fig. 3A and 3B). Mitogenic response to LPS was much lower, especially in young males, which showed significantly reduced proliferation especially in the ORG-CV group. On the other hand, SI was particularly high in females on the CV-CV diet (Fig. 3C).

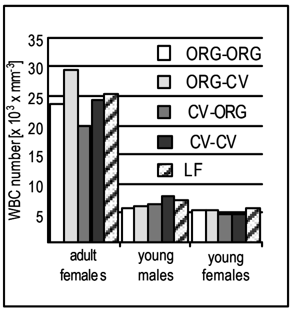

Figure 1: The effect of diet on WBC number

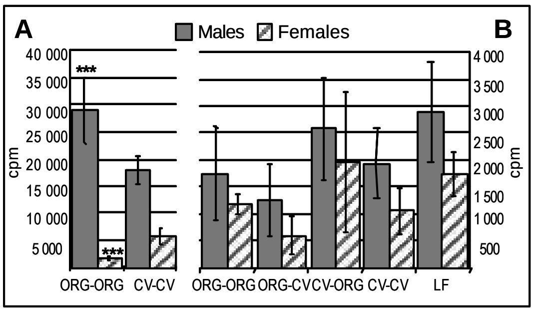

Figure 2: Spontaneous proliferation of splenocytes from different diet groups of adult (A) and young (B) rats, expressed in cpm as mean ±SD for 4 replications of each culture variant. ORG-ORG vs CV-CV ***p<0.001.

As feeding experiments of rats are still ongoing, no statistical test could yet be applied. To evaluate the effect of (and interactions between) (a) fertility management and (b) crop protection practices on the composition of crops and subsequent immune parameters in rats fed diets based on crops from different systems, 2-way ANOVA tests are planned to be carried out as soon as experiments have been completed.

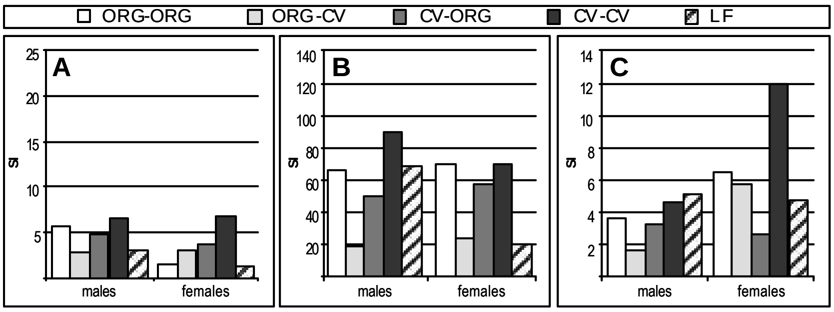

Figure 3: The influence of diet on mitogen-stimulated (PHA 2 µg/well – A; ConA 0.125 µg/well – B; LPS 4 µg/well – C) splenocyte proliferation in young rats of both sexes. Results are expressed as the mean of SI calculated for 4 replications of each culture variant.

Discussion

In this study we used hematological parameters, WBC number and splenocyte proliferation as sensitive measures to detect potential effects of diets based on crops produced by organic, low input and conventional methods, in the immune system of rats. Changes in the parameters examined are difficult to detect after only short term exposure to different diets. We found, however, highly elevated number of WBC and spontaneous splenocyte proliferation in parental females vs young rats, which seems to be related with the immaturity of the off-spring immune system (Spencer et al. 2006). Moreover, these results seem to be related to the immunomodulatory effect of prolactin, which was found to be elevated in lactating females and identified as a lymphocyte proliferation regulator (Clevenger et. al. 1998). These observations suggest a necessity to repeat the experiment over a longer period and with the use of mature young animals. Proliferation of splenocytes from young rats appeared to be suppressed when diets based on crops grown with mineral fertiliser inputs (ORG-CV); also while spontaneous proliferation did not decreased significantly, the response to mitogenic stimulation was significantly less efficient.

Conclusions

The results of the short term feeding of two generations of rats using the diets containing organically, low input and conventionally grown components indicate some changes in their immune system function in comparison to rats fed standard diet. To support the observed tendency of immunomodulatory activity of these diets, a long term feeding and associated *in vitro* studies are necessary.

Acknowledgments

This study was supported by the EU Commission under the FP6 Integrated project Quality Low Input Food (FOOD-CT-2003-506358).

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The content of the bioactive compounds in rat experimental diets based on organic, low-input and conventional plant materials

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Abstract

Rat feed based on raw plant materials was produced according to the nutritional recommendations for rat feeding. There were four combinations of rat feed: 100% organic, 100% conventional, low input 1 (organic plant protection was used in combination with mineral fertilizers) and low input 2 (conventional pest management and only organic fertilizers were used). The results showed that rat feeds prepared from the organically produced plants contained more bioactive compounds, especially total polyphenols and lutein. The complicated procedure of the rat feeds preparation (drying, grinding, mixing, cooling, pelleting) did not have a significantly adverse effect on the content of the bioactive compounds in rat feeds. The organic rat feed can have a positive impact on the health status of rats.

Introduction

Organic foods are widely considered as being safer and healthier than conventional ones. The term “organic food” denotes products that have been produced in accordance with the principles and practices of organic agriculture. The key rules and practices of organic farming aim to enhance the long-term natural fertility of soils, to minimize all forms of water and soil pollution, to avoid the use of mineral fertilizers and chemical pesticides, and subsequently leading to a potential increase in the positive health effects compared with plant foods produced using conventional methods.

Fruits and vegetables contain significant amounts of biologically active components that have positive health benefits. Organic production systems do not use synthetic pesticides, therefore the plants have to rely upon their own inherent strategies to defend against the insects and pests. A common strategy is to produce more phytochemicals (plant secondary metabolites). Consequently, the use of organic agriculture may be a way to increase the phytochemical content of plant foods (National Organic Program 2004).

Organic spinach was found to have 120% higher antioxidant activity than conventionally grown spinach (Ren et al. 2001). Organic welsh onion and Chinese cabbage had 20 – 50% higher antioxidant activity than corresponding conventional leafy vegetables. Green pepper was the only vegetable tested which did not show any obvious difference in antioxidants due to cultivation method (Ren et al. 2001).

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Research data on the carotenoids content in organic plants crop is still insufficient. Results of some experiments showed that organic carrots contained less carotenoids (Rembialkowska 2003), but other studies showed the opposite. An experiment performed by Warman and Havard (1997) showed that conventional carrots contained significantly more beta-carotene: 102.13 mg kg-1 f. m. in comparison to one that was organically produced – 94.6 mg kg-1 f. m. 16. However there is minimal comparative data and clearly more studies evaluating the contents of health promoting compounds (vitamins, minerals, phytochemicals etc) in plant foods produced by organic, low input and conventional methods needs to be done.

Materials and Methods

The study was done in 2006 in the Division of Organic Foodstuff, Warsaw Agricultural University. Wheat, potatoes, carrots and onions from organic, conventional and low input production were dried with a moderate temperature in order to keep their nutritive value. Rat feed based on these materials was produced according to the nutritional recommendations for rat feeding Table 1). There were four combinations of rat feed: 100% organic (only organic produced with biological control and natural fertilizers – oh/of), 100% conventional (only conventional produced with pest management and mineral fertilizers – ch/cf), low input 1 (organic plant protection was used in combination with mineral fertilizers – oh/cf) and low input 2 (conventional pest management and only organic fertilizers were used ch/of). Detailed description of the field experiment design used to produce the crops can be found in a paper of Leifert et al. (2007). Selected compositional analyses of the rat feeds were done: dry matter by scale method (PN-91/R-87019), total flavonoids by Christ – Müller methods described by Strzelecka et. al (1978), total polyphenols by Folin – Ciocalteau colorimetric methods described by Singleton and Rossi (1965), beta-carotene and lutein by liquid column chromatography described by Saniawski and Czapski (1983), antioxidant activity by colorimetric method described by Re et al. (1999). The results of these qualitative characteristics of each of the different rat feeds were statistically evaluated using Statgraphics 5.1 program specifically Tukey's test at a = 0.05.

Table 1. Composition of rat experimental diet

Component of diet	%	Proteins [g/kg]	Fibre [g/kg]	Lis [g/kg]	Met+Cys [g/kg]	Tre [g/kg]	Try [g/kg]	Ca [g/kg]	P [g/kg]
Lactoalbumin	6,80	3,430		0,487	0,256	0,358	0,103		
Casein	11,03	6,800		0,739	0,272	0,353	0,118		
Wheat	54,50	2,336	0,530	0,061	0,080	0,061	0,022	0,012	0,065
Potato	10,20	0,245	0,200	0,015	0,005	0,003	0,004	0,000	0,008
Carrot	3,92	0,038	0,138	0,002	0,002	0,000	0,000	0,001	0,001
Onion	0,95	0,014	0,014	0,001	0,000	0,000	0,000	0,000	0,000
Rape oil	5,79								
Min+Vit	6,81								
Total	100,00	12,863	0,882	1,305	0,615	0,775	0,248		

Results and Discussion

As shown in Fig. 1, all examined rat feeds contained similar contents of dry matter and differences were not statistically significant. Organic vegetables often contained more dry matter then conventional ones (Rembialkowska 2003, Rembialkowska 2004), but it was not reflected in the current results; probably the preparation procedure of the feeds (drying, mixing, cooling, pelleting) had some influence on the composition. The total flavonoids content was the highest in low input feed 2 (ch/of) (Fig. 2), and the lowest in purely conventional feed; however the differences were not statistically significant. The results only slightly confirm a generally found tendency to higher flavonoid content in the organically produced plant materials (Rembialkowska 2004).

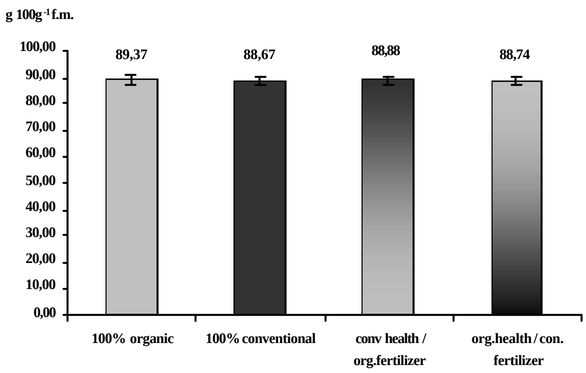

Fig. 1. Dry matter content in rats feed from organic, conventional and low input production

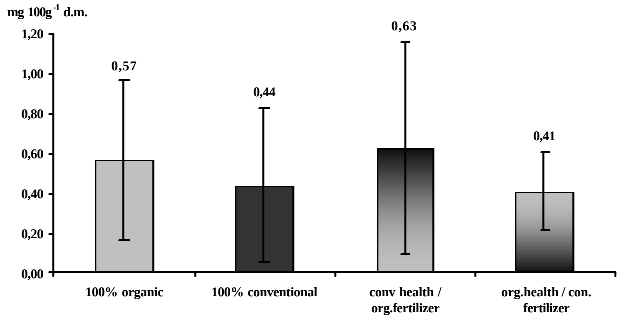

Fig. 2. The total flavonoids content in rats feed from organic, conventional and low input production

There were clear differences in total polyphenols content between organic, conventional and low input rat feeds (Fig. 3). The highest level was observed in purely organic rat feed, and distinctly lower in purely conventional rat feed. The lowest level of total polyphenols was found in low input combination nr 2 (oh/cf) (Fig.3). All differences in total polyphenols contents were statistically significant.

The polyphenols content in rat feeds depends on two main factors: the primary content in the initial plant materials and the vegetable processing methods. Next, the polyphenol content in primary materials depends on cultivar, cultivation methods, light conditions and plant protection. It seems that cultivation methods had stronger effects on polyphenols contents than plant protection. In combination with organic fertilizers (pure organic and low input combination nr 2 ch/of) the highest level of total polyphenols was measured. The current results are opposite to those of Young et al. (2005) who claimed that not fertilizers but pests attack stimulated more polyphenols production in leafy vegetables 18.

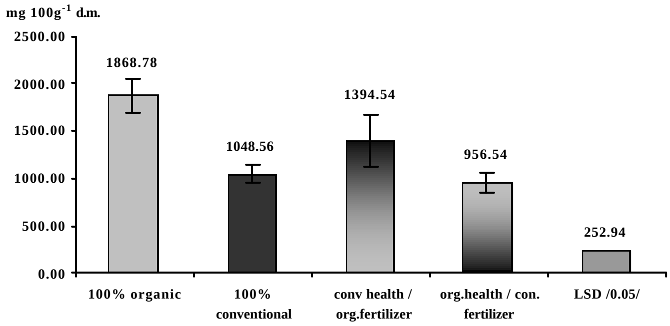

Fig. 3. The total polyphenols content in rats feed from organic, conventional and low input production

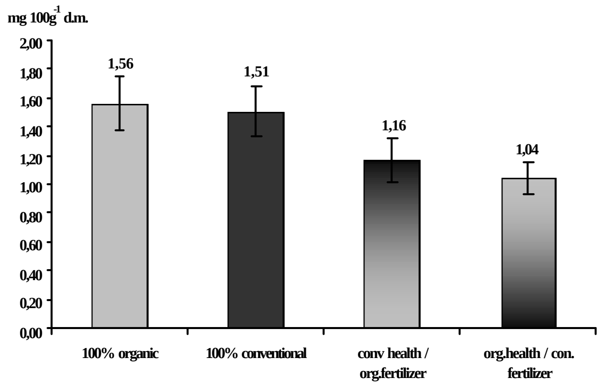

Fig. 4. Beta-carotene content in rats feed from organic, conventional and low input production

The levels of two carotenoids were measured in rat feeds during the experiment: ß-carotene and lutein. The content of ß-carotene was found to vary from 1.56 mg% to 1.04 mg% (Fig. 4).

Purely organic and purely conventional rat feeds showed the highest levels of beta-carotene in comparison to both low-input diets 1 and 2 (ch/of and oh/cf). The differences were not statistically significant. Beta-carotene was found in rat feeds due to carrots which were used as a vegetable component. Some authors found higher levels of beta-carotene in the organic carrots (Leclerc et al. 1991), and others the opposite e.g. Rembialkowska (2003) found less beta-carotene in carrots from the organic farms. According to Evers (1989) the level of nitrogen fertilization had no distinct impact on the content of beta-carotene in carrots. The weather conditions during the cultivation period had the most decisive impact: in years with the higher average summer temperature and higher number of sunny days carrots were more abundant in beta-carotene.

In rat feeds lutein was analysed and identified as an important carotenoid in the feeds. The highest level of lutein was found in purely organic rat feed, the three other rat feeds were less abundant in this compound and similar in this respect (Fig. 5). The results differed significantly in terms of the

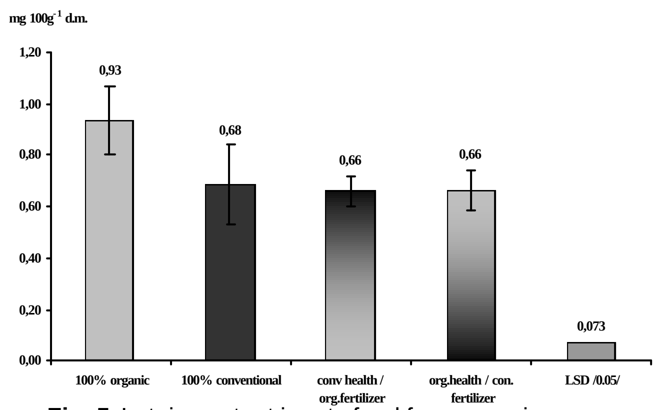

Fig. 5. Lutein content in rats feed from organic, conventional and low input production

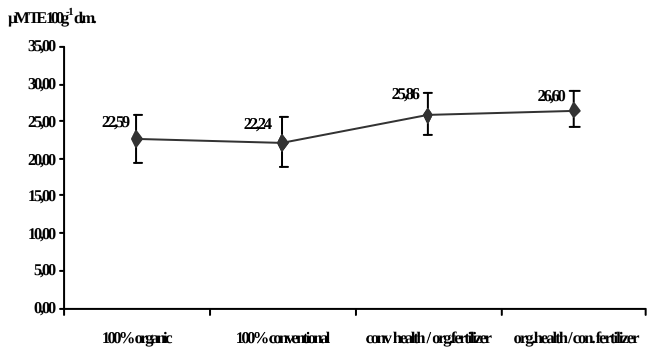

Fig. 6. Antioxidant activity of rats feed from organic, conventional and low input production

statistical evaluation. There are virtually no studies comparing the lutein content in carrots from the organic vs. conventional cultivation. Therefore the current results cannot be compared to any existing research data. However, the high level of lutein in the organic rat feed can be considered as health-promoting, because lutein is regarded as an important natural antioxidant (Alves-Rodrigues and Shao 2004).

There were no significant differences in the antioxidant activities of rat feeds from the organic, conventional, and low-input cultivations (Fig. 6), though antioxidant activity was slightly higher in both low input feeds. In the current study the organic rat feed contained a higher amount of polyphenols, but it was not correlated with the highest antioxidant status (Fig. 6). There is not always a positive correlation between polyphenols content and antioxidant activity - Cai et al. (2004) showed that some medicinal plants contained a lot of polyphenols but antioxidant activity was relatively low in comparison to those with lower amount of polyphenols.

The results obtained showed that the level of some bioactive compounds (total polyphenol compounds, lutein, beta-carotene) was significantly higher in rat feed prepared from the organic raw materials in comparison to the rat feed based on the conventional and low-input raw materials. At the same time the level of anti-oxidant activity was lower in organic feed than in low-input feeds and similar to conventional feed. There are two possible explanations of these results:

The anti-oxidant activity of the rat feeds has been only measured for water-soluble bioactive compounds; it wasn't measured for the fat-soluble compounds. Therefore the measured anti-oxidant activity could be underestimated and lower than in reality.

The chemical structure of polyphenols and the substitution patterns and groups have a big effect on the subsequent antioxidant and free radical scavenging activities of these plant compounds (Plumb et al. 1998). The majority of flavonoids, as aglycones, have moderate to high direct antioxidant activity. However if substitutions are made to the phenolic hydroxyl group this often reduces the activity (Cano et al. 2002, Plumb et al. 1998, Williamson et al. 1999). In addition total phenolic concentration data, as determined by Folin-Ciocalteau, does not always provide reliable comparative data concerning antioxidant activity e.g. a high polyphenol content (but with greatly substituted flavonoids) gives a high Folin value but can give a low antioxidant value. Therefore in the future it is planned to perform HPLC analyses to profile polyphenols and then determine if the concentrations of specific structures can be related to the antioxidant activity. Also in the future the anti-oxidant activity will be measured both in water- and fat-soluble compounds.

Conclusions

Rat feeds prepared from the organically produced plants contained more bioactive compounds, especially total polyphenols and lutein.

Acknowledgements

This study was supported by the EU project QualityLowInputFood FOOD-CT-2003-506358 and by the Polish Ministry of Science and Higher Education.

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Young J.E., Zhao X., Carey E.E., Welti R., Yang S-S., Wang W. Phytochemical phenolics in organically grown vegetables

Baking quality of wheat: nitrogen fertilisation, protein content, loaf volume

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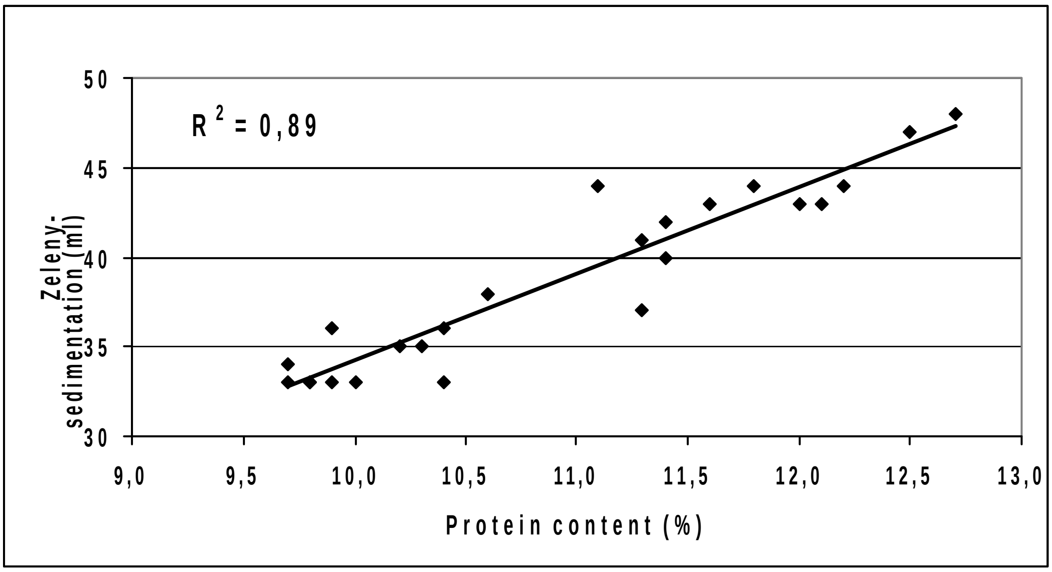
Introduction

For Dutch organic bakers, loaf volume is an important quality aspect. Millers and wheat traders transform this demand for a high loaf volume in a request to farmers for wheat with a high protein content and Zeleny-sedimentation value. For Dutch organic wheat these parameters usually partly explain loaf volume, but other aspects of protein quality might also influence the volume as is suggested by Andersen (2006, 2007). This paper is concentrating on the question how to reach a sufficiently high level of protein content in the grains and on the protein quality question.

Fertilizer treatments and protein quality.

To relate the agronomic practices to the grain protein content, wheat from a fertilizer field trial in Holland in 2006 was used for baking experiments. The fertilizer treatments were: 1. no fertilizer; 2. Goat manure; 3. Herbal compost; 4. Alfalfa pellets; 5. Chicken manure; 6. Goat manure + liquid vinasse; 7. Herbal compost + liquid vinasse; 8. Liquid vinasse.

Protein content and Zeleny-sedimentation value showed a positive correlation with loaf volume, and protein content was related to agronomic properties, in this case fertilizer treatments.



Graph 1. Relation between Protein content and Zeleny-sedimentation value.

Zeleny-sedimentation value is supposed to be an indicator for gluten quality, and gluten quality is supposed to be an indicator for potential loaf volume. In this experiment, a strong linear relation (R^2 = 0,89) was found between protein content and Zeleny-sedimentation (graph 1). If we expect an effect of the *type of fertilizer* on the protein quality (expressed by Zeleny-sedimantation), we expect that the three replicates of a fertilizer treatment are systematically above or below the regression line. This was not the case here.

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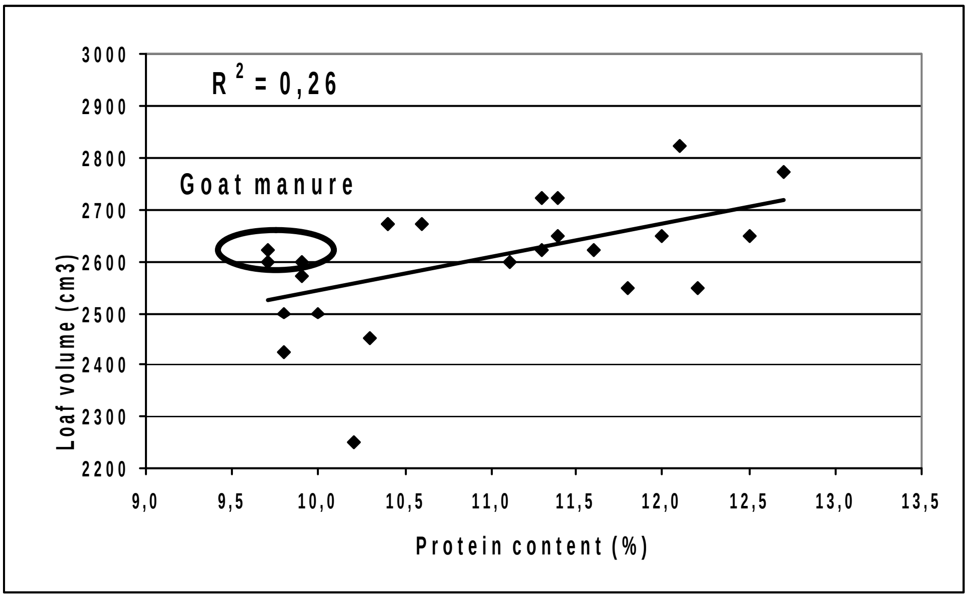


Graph 2. Relation between protein content and loaf volume.

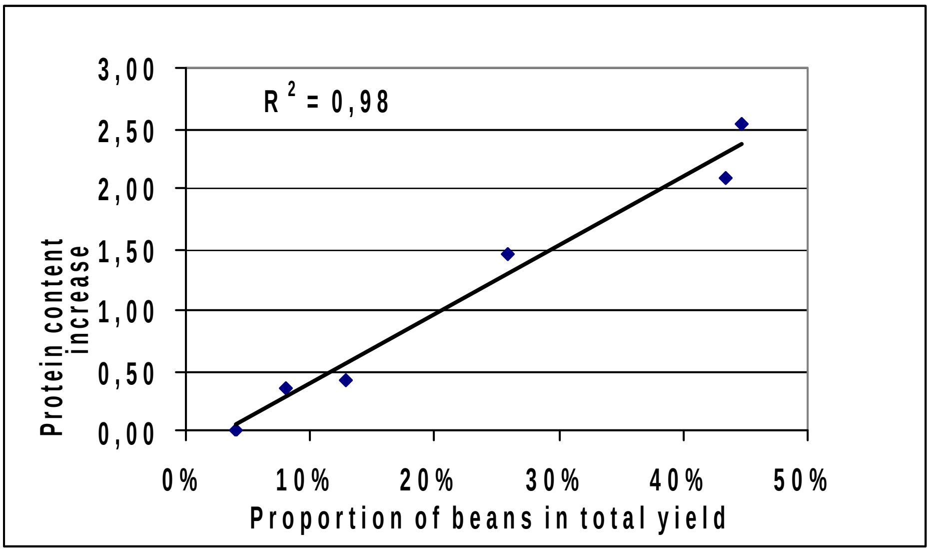
For baking quality, the loaf volume itself is the ultimate parameter, not the Zeleny-sedimentation. If we correlate the protein content to the loaf volume (graph 2), a weak correlation is found (R^2 = 0,26).

Again we consider the question whether the fertility treatment does or does not influence protein quality – now reflected in loaf volume. Here, the three replicates of the fertility treatment "Solid goat manure" are all above the regression line. This might indicate hat the use of goat manure results in a higher loaf volume than what could be expected on protein content only. In other words: use of goat manure might result in a higher protein quality, the exact feature of this quality being unknown.

The differences in loaf volume were small (minimum 2500 cm3 for treatment without fertilizer, maximum 2675 ml for Herbal compost + vinasse and for pure vinasse) , and further statistical analysis of these results is not possible because of the trial set-up which was not designed for this purpose. Further research might go into detail into the relation between type of fertilizer and loaf volume. New developed parameters such as the biocrystallisation for gluten analyses (Anderson, 2006) might be part of this research.

Other strategies to reach a high protein content

To reach a high protein content, different strategies can be followed. Usually a sufficiently high level of soil available nitrogen during flowering and grain filling is recommended. To reach this, additional fertilizers with a fast nitrogen effect can be applied at flowering time. This practice, although allowed in organic standards, can be questioned within the scope of the further development of the organic agriculture. In another field experiment in 2006, wheat (cultivar Lavett) was cultivated in a mixture with three cultivars of field beans (Vicia faba). The protein content of the wheat was increased in the mixed cropping system from 11,0% (pure wheat) to a maximum of 13,4% (wheat in mixed cropping with cultivar Diane). There was a very strong relation R2 = 0,98) between wheat protein content and relative proportion of beans in total yield (graph 3). Wheat yield decreased, but total yield per hectare was the same as pure wheat. These results are very promising: it turns out to be possible to increase protein content in wheat without adding fertilizers and maintaining overall yield level.



Graph 3. Relation between wheat protein content and proportion of beans in total yield.

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(The report of this research is available in Dutch only. If you are interested, please contact the authors.)

Quality of milk and cheese: differences between organic and conventional products

The PWG Zuivel en Rundvlees, financed by the Ministry of Agriculture, initiated research at the difference between organic and regular dairy products. The Animal Sciences Group of Wageningen UR concentrated on the investigation of the differences at national level, while the Louis Bolk Institute (LBI) is investigating the differences at farm level to estimate the scope for improvement.

In every season of 2006 12 samples of milk and cheese were collected; 6 were organic and 6 were regular.

These samples were investigated on fatty acid composition, especially the unsatisfied fatty acids, biophotones and crystallisation degree. The radiation of light by samples of milk and cheese was measured for the determination of biophotones. 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.

Differences between organic and regular milk were found for:

- Saturated fatty acids: 69,2 and 70,2% from all fatty acids for organic and regular milk
- Polyunsaturated fatty acids: 3,17 en 2,75%
- Omega 3 fatty acids: 0,93 en 0,58%
- Omega 6 fatty acids: 1,41 en 1,58%
- Trans fatty acids (CLA's excluded): 2,66 en 2,22%
- Conjugated linoleic acids (CLA's): 0,73% en 0,53%.

Also in cheese significant differences were found for:

- Polyunsaturated fatty acids: 3.21 en 2,98% from all fatty acids for organic and regular milk
- Omega 3 fatty acids: 1.02 en 0,74%
- Trans fatty acids (CLA's excluded): 2.76 en 2,50%
- Conjugated linoleic acids (CLA's): 0.83 en 0,72%
- Contrary to milk no significant differences were found for saturated fatty acids and omega 6 fatty acids.

Differences between seasons were found for all mentioned fatty acids in milk and cheese, except for omega 6 fatty acids in milk. Saturated fatty acids were higher in winter (72,5% in milk and 72,7% in cheese) and all other mentioned fatty acids were lower in winter compared to the other seasons.

Analysis of biophotones showed differences between seasons both for milk and cheese. In contradiction with the results in milk, significant differences between organic and regular cheese were found for two measurings with blue light.

Analysis of crystallisation degree showed significant differences between organic and regular milk, but not in cheese. Also no influence of season was found.

FQH Scientific Workshop Stuttgart-Hohenheim

On March 19, 2007, an inspiring Scientific Workshop with FQH-members took place in which the design of excellent experiments on food quality and excellent animal feeding experiments - the two corner stones of FQH research - were discussed. A summary of the workshop as well as the presentations given by Johannes Kahl and Eva Rembialkowska are published on the members area of the FQH-website. In the end of 2007 as a result of the workshop two papers will be produced for publication in a peer reviewed journal.

Imprint

The Organic Food Quality & Health Newsletter is published by the International Research Association for Organic Food Quality and Health FQH, c/o Louis Bolk Instituut, Hoofdstraat 24. 3972 LA Driebergen, The Netherlands, Tel. +41 343 523860, Fax +41 343 515611, E-mail fqh@louisbolk.nl, Internet www.organicfqhresearch.org

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