Thematic area

Quality of organic food – health and safety

Title of the project

Quality analysis of critical control points within the whole food chain and their impact on food quality, safety and health (QACCP)

Project duration

15.06.2007 - 30.06.2010

Annual abstract 2009

Project summary

Consumer demand for healthy, safe and high quality food is increasing. Against this background, the demand for organically grown food has been growing rapidly. The quality of food can be defined in many different ways by physical, chemical and sensory variables. Organic farming contains the whole food chain from field to fork. Whereas the EU-regulations describe the farming in the EU 834/2007, only a few processing techniques are defined not to be applied, which shows the need for detailed improvement. Next to the food safety (hazard) in the food processing the quality aspect is getting more and more important. An analyse system to optimise the process needs to be established (QualityAnalysisCriticalControlPoint). The project puts these different aspects together following one selected product from "field to fork". The overall objective of the project is to optimise organic production and processing in order to increase health promoting aspects in consumer products. The approach is a chain analysis approach which addresses the link between farm and fork and backwards from fork to farm. The objective is to improve product related quality management in farming (towards testing food authenticity) and processing (towards food authenticity and sustainable processes). The carrot is chosen as the model vegetable since it is common for the involved SMEs and is processed for baby food; hence the results will be relevant for other vegetables and organic food in general as well. The analysis of the whole food chain regarding the aspects food safety, sensory quality and health gives important information for the product development in the future to reach more the consumers expectations on organic food: environmental friendly, healthy, tasty and safe. The project creates a European network of research institutes from different disciplines and partners from practice which will be a contact point for future project in the organic sector and international questions.

Report Work packages

Management activities

WP1: Project-coordination

The project continued successfully. The project meetings 2009 were carried out in Korsor/Denmark at May 28-29 and in Vienna/Austria at November 26-27. The project life-time was prolonged by all partners onto June 30th 2010, because one partner had problems in delivering results in time. This was not a problem, because all other Core- organic projects also finish at this date. A publication list with responsibilities and messages was set up and finally agreed on at the meeting in Vienna. Therefore we will use the prolongation to finish the planned papers within the project lifetime and being part of the final report. The project was presented successfully at the Wissenschaftstagung 2009 in Zurich/Swiss with an own session. The presentation at the BIOFACH 2010 is planned. The following messages were achieved so far according the hypothesis of the project (see Appendix 1).

Research activities

WP2: Consumer and processor research on the quality of processed vegetables, in particular baby food

At the end of May 2008 at the annual meeting in Rome, it was jointly decided to amend the original work programme, in order to allow a more efficient use of the choice experiment to gain useful information for the final steps of the project.

Therefore, the choice experiment has been conducted after summer 2009 to test how the improvements of the baby food products proposed by the other WPs will be judged by the consumer.

On the basis of the FG results a Choice Experiment (CE) has been designed by P3 based on the following 6 attributes

- Quality (organic/conventional)
- Carrot flavour (mild/intense)
- Best before (15 days/one year)
- Colour of the purée (brighter/darker orange)
- Raw material (fresh/frozen)
- Price (0,50/1/2 Euro - 2 x 80 gr.) (7/13,95/28 Kroner - 2 x 80 gr.)

Based on an efficient design, the survey consisted in:

- 6 choice tasks
- A set of questions about the choice experiment and the attribute attendance
- A set of customary socio-economic questions

A tender for market research services (recruitment) was launched. The best economic offer was submitted by C.R.A. - Customized Research & Analysis srl - Milano (http://www.cra-research.com)

Our own CAWI web-application software was used in coordination with the successful tenderer who provided online recruitment tools.

The survey questionnaire was translated in Italian, Danish, French and German.

The final sample was made up of 1,000 mothers (250 in DK, 250 in FR, 250 in DE, 250 in IT), recruited following theses criteria:

- ALL were mothers with Children older than 6 months and up to 5 years old
- ALL were also main responsible for family food purchases
- Employment (at least 1/3 and at most 2/3 full time or part-time worker and at least 1/3 and at most 2/3 housewives)
- Purchased vs home-made baby food (at least 1/3 and at most 2/3 consumers purchasing baby food and at least 1/3 and at most 2/3 self-preparing baby food)

Preliminary analysis of choice data indicate the following findings:

- Taste heterogeneity is found at country level: more precise WTP estimates can be obtained by taking into account individual heterogeineity (though preliminary analysis of RPL model shows only small differences)
- Education, more than income, appear a quite source of heterogenous preferences.
- Further analyses using RPL models still in progress

Concerning product attributes:

- Organic is an important feature, especially for educated people. In IT WTP is at maximum, the lowest being in FR.
- Taste appear less relevant, apart from IT where a stronger preference for delicate carrot taste is found. In FR there is no specific preferences for taste.
- Refrigerated short shelf-life product appear to be slightly preferred to UHT, although this was not so clear when asked directly. Again, in FR, no significant preference is found.
- (Bright) colour is the most important feature in FR. In general, as for taste, country preferences are highly diverse.
- Fresh carrots as raw material are the second most important feature in all countries except DK. In Italy the WTP for this is almost 3 times the average. Fresh (not frozen) raw material is mostly important for low income, low educated people.

An integrated paper between processor and consumer surveys was presented at the Wissenschaftstagung February 2009 in Zurich in collaboration of P2 and P3. The title of the paper is “Quality of processed organic babyfood from consumer and processor points of view “ and the most important results of the surveys were presented.

The results of the Focus Group in Germany have been published in Biowelt, a German non-scientific journal for the organic market, while the results of the Italian FG has been published in the IV GRAB-

IT workshop proceedings "*Agricoltura Biologica: sistemi produttivi e modelli di commercializzazione e di consumo*", Palermo 26-27 ottobre 2009 ("Le caratteristiche qualitative negli alimenti dei bambini: un'indagine esplorativa sui "piccoli consumatori" – Baby food qualitative characteristics: and explorative survey on baby consumers).

An integrated paper between processor and consumer surveys will be submitted to the Food and Quality Preferences Journal. The paper is in processing.

WP3: QACCP analysis: Quality-driven chain analysis

During the reporting period industrial scale tests were performed (task 3.4) with Frigemo (pre-processing) and HOCHDORF (processing) Switzerland in January, March and April 2009 according the test plan. As a CCP "the quality of raw material" was checked and optimized at industrial level. Therefore Swiss Demeter carrots, which were grown in the same field (Basedingen) and were harvested at the same time, were used. The carrots were separated in three equal parts, stored (if necessary), pre-processed to fresh and frozen carrot cubes and processed to sterilized carrot baby puree in jars. After sterilisation samples were taken according to the sampling plan.

Fresh, frozen and stored raw material was pre-processed under controlled and documented circumstances. In January half of the processed carrot cubes were packed and immediately processed to puree of fresh carrots. The second half was blanched, frozen and stored until March when the frozen raw material was processed in HOCHDORF. The stored carrots were pre-processed and processed in April.

Samples were taken according the sample plan and all samples were coded and sent as blind samples to the partners for analyses. The processed samples were shipped in April 2009 and analysed for CML, furosine, flurescence and polyphenols (P6), for sugar composition, organic acids, carotenoides, volatile compounds, dry mater, colour and sensory (P7), for biocrystallisation, dry mater and sensory (P1) and for fungi growth (P8).

During processing back up were taken at the end of cooking, after milling and after bottling.

Raw material samples were taken as pooled samples before washing at AVAG in Kerzes. Sampling of processed baby food was conducted after sterilisation. Two batches (replicates) 1 000 kg of each raw material were produced. Batch 1 and 2 describes the replicates. One batch of cooked carrot puree produced 10 500 glasses which are one and a half fillings of an autoclaves. Samples of each autoclaving process were taken and coded A and B. i.e. 2 A indicates this sample is produced in the second batch/replicate and sterilized in the first autoclave. The aim was to take glasses which have the biggest heat impact during sterilisation process. Therefore the samples taken from the middle of the trolley (3 level) and from trolleys which were in the middle of the autoclave.

The pre-production of organic carrot cubes in fresh, stored and frozen quality was a standardised process, in which no differences were documented. The processing of, in each case 2*800kg, carrot cubes to baby puree in jars at industrial level showed variable cooking procedures. Also replicates of processing showed differences. For industrial production small differences in processing are daily routine and accepted if the end product specification is observed. Usually only frozen raw material is processed at HOCHDORF and all technical calibrations are adapted to these quality. Fresh and stored raw material has to be processed according other parameters and even with a different rate of water. If fresh and stored raw material should integrated in industrial processing new parameters have to be developed.

The end product analyse according HOCHDORF specification showed that only puree produced with frozen carrots comply the standardized requirements. Especially different sensory quality (intensive orange colour, sweeter taste) could be recognized in puree out of fresh and stored carrots. A analyses of the partners will shown, if also nutritional differences result out of these three different kinds of raw material. It may be stated that differences in the form of raw material (fresh, stored, frozen) also redraw through processing and sterilisation, and could be recognized in the quality of end product. So the QACCP is verified that we got differences with using different raw material. All samples will be analyzed in detail by the partners and final conclusions will be done based on those results. In addition to the industrial scale test procedure an overview report was done concerning different kind of sterilization methods.

WP 4: Sample organisation

Sampling and distribution of the Italian field trial

A sample amount plan for the fresh samples from the Italian field trial was made for Maestro and Excelsa samples. The samples were sampled, packed, individually coded and distributed in January and April 2009 to partners in WP 3, 5, 6 and 7 according to the Standard Operation Procedure. The sampling and distribution in Italy was performed by the AIAB (Italian Association of Organic Farming). Decoding of samples from the harvests in Denmark and Italy was performed according to a procedure of delivery of result reports from partners based on coded results followed by individual decoding by WP 4.

Sampling and distribution of the processed samples from the Hochdorf trial

The Hochdorf production was sampled and samples were packed and individually coded in corporation with The Research Institute of Organic Agriculture, CH (P2) according to the Standard Operation Procedure. The samples were distributed to partners in WP 3, 5, 6 and 7 according to the Standard Operation Procedure and the sample plan.

Interpretation of results

Results of agronomic factors (yield, harvest quality etc.) were delivered to WP 8, and WP 4 has started participation in the interpretation of results. With the prolongation of the project period, this work is continued in 2010.

WP 5: Assessment of food safety on fresh and processed carrots

In WP5 the analysis of various parameters in raw and processed carrots was performed:

In raw carrots pesticide distribution and quantification and nitrate and nitrite assessment. Pesticides correspond to the main perceived and objective chemical risk associated with vegetable ingestion. Nitrate and more acutely nitrite are considered of higher risk of elevated concentration in conventional farming as a result of possible excessive fertilizer use. Nitrite, the reduction product of nitrate is associated with a risk of formation of nitrosamine during storage in the case of microorganism development.

In processed carrot purees: fructosyllysine and carboxymethyllysine as well as furan. These processing contaminants are of variable concern according to FDA/EFSA. Whereas furan is clearly considered as a probable carcinogenic compound for humans and consequently included in survey recommendations, the two other compounds, also called "glycotoxins" are still under debate. Furthermore, they form at low levels in cooked vegetables, as compared to other dietary components (processed milk and cereals). However, they are often monitored as indicator of heat damage to the food and they could be considered as pertinent indicators of the loss of vegetable authenticity after cooking.

A deep screening of the pesticides expected to be present in the conventional carrots was done using GC-MS for the apolar and volatil ones and HPLC-UV for the polar and volatile ones. Only the second analysis was done on the organic carrots. Two extraction procedures were applied including the normalized method NF EN 12393-2. The detection limit of the method was 0.25 µg/g.

In a first approach, a wide screening of volatile and non volatile compounds was performed and no pesticides were evidenced. In a second approach, quantitative analysis of the pesticides mostly expected as a result of the treatment description was realized. Again no pesticide was evidenced neither in Italian nor Denmark crops, in 2007 or 2008.

They were analyzed only on the first crop 2007 by HPLC-UV using the procedure of Afnor NF EN 12014-4.

Nitrates were present in variable amounts and no systematic difference between organic and conventional farming was observed.

Two processing experiments were carried out to study the impact of material pre-processing (fresh, stored or frozen and pasteurized) before processing under puree, one in a pilot plant in Finland in 2008 and one in Hochdorf (Switzerland) in 2009. These last samples were analyzed in 2009 for phenols profile, furosine and CML while furan is just being analyzed.

The data are still under processing but up to now, it is clear that some phenols are degraded while other are formed, probably due to hydrolysis reactions. However, the reaction mechanisms remain to be elucidated.
Regarding the formation of furosine and CML, cooking and autoclaving are the main steps associated to formation of processing contaminants. The impact of freezing seems interesting as it decreases the levels of furosine and CML, probably because of sugar and lysine leakage during blanching. Similarly, although pasteurization already induces formation of some furosine and CML, no significantly higher levels were obtained in the final autoclaved products, compared to the puree produced from fresh carrots.

WP 6: Product quality

The partner laboratories (P1, P6, P7) finished measuring the fresh and processed carrot samples of the project. The data are under evaluation and the main results were presented and discussed on the project meeting in Vienna in November. Until the end of 2009 all data will be evaluated. Furthermore the available (evaluated) data were send to WP8 for formal checks and presentation on our internal data homepage. Furthermore through WP8 send for multivariate statistical analysis.

Fluorescence fingerprints were regitered on the intact carrots, entire and at different sites of the root (peel, external and internal part) when fresh, and on the crushed material for purees taken at different process stages.
EEM data obtained for excitation between 250-600 nm and emission between 250-700 nm with 5 nm slits were pretreated to remove the interfering scattering signal. They were then decomposed using PARAFAC model (Matlab) allowing extraction of the excitation and emission spectra of the main fluorophores participating to the image.
In 2009, spectral images were acquired and decomposition data were obtained from the carrots produced in 2008-2009. Final analysis of the PARAFAC scores for discrimination purpose or for prediction of some interesting indicator of quality is still to be done.
The decomposed spectral images exhibit differences depending on the carrot site analyzed, the flesh being intermediate of the peel and core of the carrot. Similarly differences were identified between varieties and years. PCA of the complete set of data will allow evidencing the most influencing parameters. First analysis confirms a clear discrimination according to the carrot variety.

Spectral images of carrot purees are again very different from those of fresh carrots. The stage of processing also induces gradual quenching of the image.
When analyzing by PCA the scores of the fluorescence profiles obtained from carrot purees obtained in a preliminary assay in Hochdorf 2007, increasing scores on PC1 was associated to advancing steps in the process up to cooking. PC2 in contrast discriminated the sterilized samples.
The same analysis did not allow distinguishing the purees processed from differently stored material in Finland Pilot plant.
Differences are observed between each step of the process from stage 1 to 3, frozen, defrost and cooked samples, then no difference was observed bewteen mashed and filtered samples. Last data from samples obtained in Hochdorf, 2009 still need to be analyzed. From the various phenols identified, a combination of some of them was proposed to describe the global composition.

The biocrystallization could differentiate the treatments in the Danish field trial in that the conventional could be separated from the organic treatment with one criteria (variable) and the O1 could be differentiated from the other treatments C, O2, O3 with another criteria. The Italian carrots could be differentiated only in one year of the two harvest seasons, visa versa for each variety. The processed samples of both, the pilot plant as well as the Hochdorf samples could be crystallized and the treatments could be differentiated according the texture analysis results. Furthermore it was possible with this method to indentify a change in the processing parameters during the production.

For the second harvest year, fresh carrots from the Danish field trial (VegQure samples) and Italian farm comparison (Maestro and Excleso varieties) were analyzed for their chemical (dry matter, soluble solids content, titratable acidity, sugar and organic acid composition, carotenoid and volatile compounds composition), physical (texture and color characteristics) and sensory characteristics.
Moreover, concerning the study of the critical steps along the food chain, the following parameters were determined on fresh carrots and processed samples (carrot puree) from an industrial plant (Hochdorf): dry matter, organic acid composition, color, volatile compounds composition and sensory characteristics.

Inconsistent trends between the harvest years were detected for the most of the parameters measured on the fresh carrots, both from the field trial and the farm comparison, thus indicating a strong effect of the harvest year (climate conditions) on the quality characteristics. The organic carrots from the field trial showed only a higher level of sesquiterpenes (volatile compounds) than the conventional ones. This difference could be correlated with those observed for the parameters “carrot flavor” and “bitter aftertaste” from sensory analysis. The organic carrots from the farm comparison resulted characterized, instead, by a lower carotenoid content (in particular, lutein) in both the harvest years.

The heat processing caused significant changes in the measured parameters in comparison to the fresh carrots. The storage of the jars did not affect the characteristics of the puree, but the use of stored carrots and in particular of those frozen and stored before the heat processing resulted in a higher decrease of carotenoid content, aroma volatile compounds concentration, flavor and texture characteristics.

For sensory analysis the two panels in Germany and Italy were compared. The results will be published. No consistent discrimination of the samples could be achieved. Although sensory analysis seems to be a powerful tool for the purpose, specially on the processed samples, because it bridges the product related quality aspects to the consumer expectations.

Decomposition tests with all replicates of the Danish and Italian carrots have been performed. In the Danish tests the lowest dry matter loss during incubation was found in the variant O2 followed by O3. There was no difference between the conventional variant C and the organic variant O1. The Ergosterol contents were highest in O3 followed by C and lowest in O1 followed by O2 (O3>C>O2>O1).
The decomposition tests comparing the organic and conventional variants of the Italian cultivars Maestro and Excelso showed a statistically significantly higher loss in the organic Maestro compared with its conventional counterpart, but the organic variant Excelso had a statistically significantly lower dry matter loss compared with the conventional variant. The Ergosterol contents were lower in the variants exhibiting lower dry matter loss.

Carrot purée samples from different processing methods were inoculated with the test fungi *Penicillium sp*. and *Fusarium sp*.
In 2008 three variants from the Pilotplant representing different handling methods of the raw material were used for the inoculation. The carrots were either fresh, or pasteurized or frozen. Slight differences in fungus colony diameters were found, but the main differences concerned the sporulation development of *Penicillium sp*..and the exudates color of *Fusarium sp*.. The sporulation was more advanced in the purées derived from frozen carrots as compared to the other variants. The exudates were red in the purée samples derived from fresh carrots and yellow in the ones from pasteurized carrots. The colonies growing on the samples from frozen carrots displayed a different growing pattern.
In 2009 two variants from Hochdorf were used for the inoculation tests with the same test fungi. The purées were either made from fresh or frozen carrots. In both cases the colony diameters and areas of both test fungi were statistically significantly smaller in the samples derived from frozen carrots. Thus a clear differentiation was possible.

WP 7: Impact on health

Denmark:

Carrots from VegQure, 2008 were freeze-dried and included at 40% in an Altromin diet, which was given to weaned female GKMol rats, in groups of five rats per diet. At arrival the rats were put in a balance trail, where they were given their assigned diet (C1, O1, O2, O3 and CO (control/Altromin)) for a week. Faeces and urine was collected individually and digestibility of dry matter and protein was determined. Afterwards they were re-grouped again and given their assigned diet, for approx. 2.5 months (Except for O3). Throughout the experimental period the rats were monitored and weighed each week. At the end all blood was drawn by heart puncture for measuring some biomarkers, including glucose, cholesterol, triglycerides, NEFA in plasma, and activity of alkaline phosphatase. The plasma was also analysed for vitamin E and A, and immunoglobulins. All the organs (heart, lungs, kidney, spleen, ovary, pancreas, stomach and adipose tissue) were removed and weighed. The liver and fat tissues was frozen and further analyzed for vitamin contents. The spleen and Peyers Patches from the small intestine were send to Bernhard Watzl's lab for measuring cytokine production and flow cytometry analysis of CD4/CD8 lymphocytes and NK cell activity. Finally, a preference test was performed on 15 rats, during two separate weeks with one washout week in between.

Analysing statistically the data from 2007 and 2008, the preliminary conclusion is that harvest year rather than diet has an effect, and if any effect of diet, this is ascribed to the Altromin differing from the experimental diets. Meaning there appears to be no difference between experimental diets, i.e. no impact of the cultivation systems on the health biomarkers of rats after eating the carrot diet. The preference test showed that rats are able to differentiate between the diets and that there appears to be a field influence on the preference for certain diets.

Italy:

Freeze-dried carrots from the bulk of organic and conventional Danish (VegQure) and Italian (Maestro and Excelso) carrots of the second year harvest were analyzed. They were included at 7% (corresponding to about 70% fresh carrots) in a standard diet and given to weaned Balb/c mice for 1 month. At the end of the experimental period, the spleen and small intestine were removed for the isolation of splenocytes and lamina propria and intraepithelial lymphocytes (LPLs and IELs, respectively). Blood was also collected for the isolation of peripheral blood mononuclear cells or stored for cytokine analysis. The immune phenotypes of lymphocytes were analyzed by flow cytometry (FACS), by CD4+, CD8+, CD4CD8+, CD19+ and Treg cells CD25+Foxp3+ staining. The overall results showed some differences on the lymphocyte populations of all districts between organic and conventional Danish and Italian carrots the cultivation systems of the Danish field trial. In addition, the results of the second year do not always confirm those observed in the first year harvest, especially in the case of the VegQure carrots.

Austria:

This year the carrots originated from the Danish VeQure cropping system. The two test carrots were the conventional variant C and the variant of the most advanced organic system O3. Two mice groups were formed and supplied with the conventional (group C) and the organic (group O3) carrots respectively. Otherwise the test was performed as described in the Midterm report 2008. The results showed no significant differences in feed consumption between the groups. All 20 females of each group had 1st litters. 19 group C and again 20 group O3 females had 2nd litters. The days between the 1st and 2nd deliveries were on average 32 and 35 days for group C and O3 respectively. This period is comparable with the feeding test conducted in spring and summer 2008 with Italian carrots (var. Maestro). But the time span between the 2nd and 3rd litters differed greatly in this RACB as compared to last year's. Group C females took an average of 28, group O3 females 31 days to deliver the 3rd litters. Last year the difference was 40 days. Similarly more 3rd litters were delivered in 2009 than in 2008, although the test period was 18 weeks each year. There were 12 group C and 9 group O3 litters in 2009, whereas only 5 resp. 7 litters were delivered in 2008. These differences could possibly be attributed to seasonal influences.

The weight development of the parents did not show any statistically significant differences between the groups nor between the years. The 1st litters were comparable as to average litter size and weight as well as to the total litter weight gain during lactation. Only a very slight tendency to a more successful breeding performance of group O3 could be observed. But the 2nd litters of group O3 showed a statistically significantly higher litter weight at weaning ($P = 0,035$) and total weight gain during lactation ($P=0,029$) as well as a tendency of more pups per litter. Only 12 group-C and 10 group-O3 females had 3rd litters. Neither weight gain nor litter size was significantly different in the last litter, only a slight tendency comparable to the 1st litters.

Two growing studies with weaned pups were conducted with Danish carrots (3 weeks) and processed carrot purée (1 week).Three-weeks growth study with Danish carrots (Variants C and O3): The test carrots used originated from the Danish field trial VeQure. The variants C and O3 were chosen to compare the most differently cultivated variants. The weight development of 23 (group C) and 21 (group O3) pups randomly chosen from 2nd litters of the same size was monitored during 3 weeks after weaning. The weight increase was not significantly different between the groups. When the pups were 5 weeks old their sex was determined and they were then weighed separately. In group C there were 13 males and 10 females, whereas group O3 had 10 males and 11 females. At the end of the experiment after 3 weeks the males were slightly heavier in group O3, whereas the females were slightly heavier in group C.

One- week growth study with differently processed carrots: This test was conducted with 29 (group 1) resp. 27 (group 2) pups randomly chosen from litters of the same size. The variants differed in the production intensity concerning the treatment of the raw material. Feed 1 was purée made from fresh carrots, feed 2 from frozen carrot cubes. Group 1 pups had a slightly higher but not significant weight increase (P = 0,232) as compared to pups from group 2.

Food preference tests were conducted with the four variants of the factorial field trial in Denmark (VegQure), the two field comparisons from Italy and rocessed carrots. The tests were performed as described in the Midterm report 2008. 12 food preference tests, 6 with laboratory mice and 6 with laboratory rats have been performed testing the 4 variants of the Danish carrots as mixed samples. The laboratory mice did not distinguish between the Danish variants, except for a trend to prefer the conventional variant C over O2, an organic variant (P = 0,082). The tests with the laboratory rats only showed a significant preference of the conventional variant C as compared to O1 and O3. These two variants were also used in the feeding experiment with mice. A second food preference test was performed with C and O3 after 3 months of storage. This time there was as slight preference of O3 with a significant result on the 2nd day. The Italian carrot samples represented the two cultivars Maestro and Excelso, each from organic and conventional growing systems. Neither rats nor mice distinguished between the Maestro samples, whereas both statistically significantly preferred the conventional Excelso. The food preference test with processed carrots was conducted with 20 laboratory rats. The samples were offered as pellet lumps held together by the carrot purée mixed with water. The purée samples were differently processed. Both samples were autoclaved, but sample A was made from fresh raw material and sample B from frozen carrot cubes. The tests revealed no significant preference for one of the two production processes (P = 0,464).

WP 8: Quality definition

The initial literature study has ended up with a review paper entitled 'Fresh and processed organic carrots *(Daucus carota L.)* – a critical review on quality aspects and their influencing factors' that has been sent to publication in Journal of the Science of Food and Agriculture (Submitted).

Relation to the overall project:.The samples are coded and send to the labs. The labs are measuring the coded-samples with their methods. WP is organizing the gathering, checking and merging of the measurement data of these coded samples. The samples are decoded to one common code. The merged data are sent to a statistician for further multivariate evaluation and the correlations between the methods are calculated and made accessible through a web page. Goals of the WP are: Organizing of the measurement data; checking the data; merge the data for multivariate evaluation; adaptation of the existing SW and the gathering process to the core-organic 1885 project needs. We add the feature to

be able to merge the data for the case where not all codes from a sample were measured, e.g. the measurement of 1 of 12 samples was missing.

We achieved to merge the data from the field repetitions with the data from the bulk samples, by simply adding the data from field repetitions to the bulk data. The sample code was set to the same as the bulk sample and the field repetition information was set to 1. According to the Field repetitions the Sample Preparation repetition is counted up. To handle the data from health studies with rats and mice the method type *pairwise Test* for feeding preference tests and *control group Test* for test with control groups. The data from the method type *pairwise Test* could not be merged with the data from the normal methods. The data from *controlgroup Test* were added n a first step simply by leaving out the control group data.

The work package was presented on the Wissenschafttagung in Zurich in February 2009 with the title: ”Organisation und Zusammenfassung quantitativer und qualitativer Messdaten im Rahmen des CORE-Organic QACCP Projektes”

Additional files with formats due to the needs of the statistician were added. The names of the variables used in the merge files as column names were limited to 20 characters and were converted to ASCII letter and number only, so most of the statistical programs can handle the data files. Next tasks: Receiving the last data for 2008 measurements; merge data set for the statistician and correlation; writing the documentation and the work package project report.

Data were organized to get them into a form that is possible to use in the multivariate statistical analyses. The datasets were used to study mainly the hypothesis number 1: “Carrots from organic and conventional farming systems can be differentiated in a field trial or by comparing carrots from neighboring organic and conventional farms”. The statistical method we use is a principal component analysis. This work was done separately for the available AIAB-data and VegQure-data from both 2007 and 2008. Results were presented and discussed by all project participants on the project meeting 26-27 Nov. this year. The results indicate that it may be possible to differentiate carrots from organic and conventional farms by using combinations (that is principal components) of the measured variables. Besides it seems possible to say something about which of the measured variables that contribute most to this separation. When all data will be available next year we plan to do some more detailed multivariate analyses based on the same methods, but perhaps on some sort of a reduced set of variables.

The results of the analysis on the factors that are correlated to high or low product quality in experimental trials will be then combined with the results of WP2 (factors influencing consumer perceptions of quality) in order to provide guidance for WP9 (e.g. House of Quality).

WP 9: Implementation in the quality management system, recommendations and dissemination

WP 9 implements the results in the quality management system and will handle the dissemination and implementation of the results from the project in the most efficient way. The following actions have been made according this task during the reporting period (01/09-12/09).

A general description of the project as well the main objectives of the work packages (WP) are uploaded on the project web site http://www.qaccp.coreportal.org/.

In 2009 the following dissemination activities were done:

1. Participation at the Wissenschaftstagung ökologischer Landbau 11-13. February 09 at the ETH in Switzerland with the following workshop: Qualitätsbeeinflussende Prozessschritte in der Verarbeitung
2. Review paper Organic quality of carrots from field to fork is finalized and in the review process in the journal of the science of food and agriculture
3. A workshop at Biofach Februray 18th 2010 is organized: Quality of organic baby food; Consumer demand and quality optimisation based on the principle of QACCP
4. A detailed paper outline connected to the hypothesises is worked out and approved by all partners. The papers should be finalized until end of May 2010.

   Paper outline:

   Hypothesis 1

   1. Sensory results on fresh carrots
   2. VegQure (single plus multivariant) Journal: JAFC
   3. AIAB (single plus multivariant) Journal: IB JAFC

   Hypothesis 2

   1. VegQure and AIAB
   2. VegQure
   3. Preferences

   Hypothesis 3

   1. Hochdorf Journal: EFRT
   2. Pilot Plant Journal: RAFS

   Hypothesis 4

   1. QACCP (model)
   2. QACCP (applied)

Hypothesis 5

Focus group and processing survey Journal:FQP

Consumer study Journal: FQP or RAFS

Measurement results

Next steps:

1. Actualisation of the Core Organic hompage continuous
2. Workshop Biofach February 18th 2010
3. Publish the papers until Mai 2010
4. Defining and preparing processors event to publish the results and to present the leaflet in 2010 e.g VBP Netherlands, Verarbeitertagung FiBL Schweiz, AOEL Deutschland
5. Preparing a PWT presentation of the most interesting results of the project, which could be presented by each partner in his own country.

Appendix 1 of the annual report of the project CORE Organic QACCP

Messages of the project:

Hypothesis 1 to be tested within the project CORE Organic QACCP

Carrots from organic and conventional farming systems can be differentiated in a field trial or by comparing carrots from neighbouring organic and conventional farms.

Answers to hypothesis 1

1. Year (climate) and variety/harvest time have influence on quality which seems as stronge as the farming practice.
2. Answers are limited on selected samples.
3. The selected single compounds or criteria measurements seem not to be sufficient for the differentiation organic-conventional.
4. Multivariate analysis seems to increase the possibility for the differentiation.

Hypothesis 2 to be tested within the project CORE Organic QACCP

Organic cropping increases positive quality and health attributes and decrease negative effects on the safety of the carrots.

Answers to hypothesis 2

1. Year (climate) and variety have influence on the selected health markers which seems as strong as the farming practice.
2. Differences in the research design (food composition, replication, stress) occur which may make the answers difficult.
3. Answers are limited on selected samples.

Hypothesis 3 to be tested within the project CORE Organic QACCP

Along the organic production chain of carrot baby food critical steps according to quality, safety and health can be identified.

Answers to hypothesis 3

1. Influences of selected critical steps in the food chain could be determined.
2. Although sterilisation of the product at the final production step, the selection of the raw material has an significant influence on the quality and safety of the baby food.

Hypothesis 4 to be tested within the project CORE Organic QACCP

A Quality Analysis Of Critical Control Points (QACCP) can successfully be performed on carrot baby food and the effects of changes in selected critical control points can be determined.

Answers to hypothesis 4

1. QACCP could be successfully applied in carrot baby food production.

Hypothesis 5 to be tested within the project CORE Organic QACCP

The consumer response to the changes can be tested, in order to see if these changes are seen as improvements by consumer and if this affects their willingness-to-pay for the product.

Answers to hypothesis 5

1. Carrot baby food taste heterogeneity can be explained by socio demographic variables.
2. The choice of raw material plays an important role for the willingness of the consumer to pay for the products.