

## **A10. Keywords**

Max. 5 keywords to describe the project activity.

Berries, herbs, safety, meat products, low-salt

## **A11. Short project description/summary on objectives, activities, and expected results, both in Danish and English language** (max 1500 characters, incl. spaces for both languages)

Målet er at udvide produktsortimentet af økologiske kødprodukter med nye spændende smagsvarianter. Nyhedsværdien er at udnytte urter og bær både til en biologisk konservering samt til at give produkterne en ny og spændende smagsprofil og udseende. Projektet er forbrugerdrevent, idet MAPP skal undersøge, hvordan økologiske forbrugere forholder sig til ny konserveringsteknologi i form af bær og urter, samt undersøge hvordan de forholder sig til de nye produkter både ved bedømmelser og i købsituationer. Blandt danske bær og urter skal AU-IHP udvælge og producere de sorter, der på DMRI skal screenes for antimikrobiel aktivitet og gode smagsegenskaber i kødprodukter. AU-IHP skal endvidere arbejde med at optimere dyrknings- og lagringsforhold, så de ønskede egenskaber bevares bedst muligt efter høst. DMRI skal kombinere de udvalgte bær og urter så det bedste resultat opnås. Herunder skal det undersøges, hvordan bær og urter skal tilsættes kødprodukterne og det skal klarlægges, hvordan forskellige råvarer og forædlingsprocesser påvirker den antimikrobielle aktivitet. Resultaterne fra DMRI skal løbende valideres ved prøveproduktioner på de to deltagende virksomheder. Som afslutning vil det blive dokumenteret om de udvalgte bær og urter kan garantere fødevarer sikkerhed og god spisekvalitet i hele holdbarhedsperioden. Der foretages økonomiske vurderinger af de samlede produktionsomkostninger.

The aim of the project is to extend the range of organic meat products by introducing new interesting flavour variants. The novelty is to utilize herbs and berries for biological preservation and to provide the products with a new and interesting flavour profile and appearance. The project is consumer-driven as MAPP will study how ecological consumers relate to a new preservation technology in the form of berries and herbs. They will also study how the consumers relate to the new products by evaluations and when buying the products. Among Danish berries and herbs, AU-IHP will select and produce the cultivars which are to be screened at DMRI for anti-microbial activity and favourable flavour characteristics in meat products. Furthermore, AU-IHP will optimize cultivation and storage conditions, preserving the desired characteristics after harvest in the best possible way. DMRI will combine the selected berries and herbs to obtain the best result. The work includes an investigation of how berries and herbs should be added to the meat products and it must be clarified how different raw materials and meat processing affect the anti-microbial activity. The results from DMRI will be validated at test productions at the two participating plants. Finally, we will document that the selected berries and herbs can guarantee food safety and favourable eating quality throughout the entire shelf-life. Economic estimates for total production costs will be made.

## **A12. Project description**

(All parts of A12 must be filled out. Use "Garamond" as font, and font size 12, single spaced)

**A12.1 The project objectives (2-3 lines).** To increase the selection and renewal of organic meat products by using herbs and berries to ensure food safety and high quality throughout shelf life. The project includes cultivating and storing of herbs and berries to obtain optimal functionality, application to minimally processed meat products, as well as consumer expectations and acceptance.

**A12.2 The background and idea (hypotheses) incl. the national and international "state of art" and incl. references relevant for the section (max. ¾ page).** Production of organic meat products is characterised by minimal processing and the use of a minimum of food additives. In Denmark the organic producers have agreed not to use nitrite for preservation of meat products. Therefore food safety mainly relies on pH, salt and storage temperature. The EU commission has requested that all memberstates reduce the amount of salt in bread, cheese, ready meals and meat products as these products are believed to be the source to high blood pressure and stroke because of high intake of salt. For this reason new preservation strategies are needed especially in the organic production but also in the conventional production. From ancient times herbs and berries have been used as antimicrobial agents (Davidson & Naidu, 2000) and during the last decades, scientific studies have shown that plant extracts, herbs and berries can be used as possible natural preservatives (Davidson & Naidu, 2000; Burt, 2004; Søltøft Jensen & Hansen, 2005, Werlein et al, 2005; Raghavan & Richards, 2007; Viskelis et al, 2009; Zhang et al, 2009). Research at DMRI and AU has shown that e.g. aronia, garlic, cranberry, mustard, horse radish, thyme, hop and hop extract could be promising agents for increased safety of food including meat products. Furthermore the number of patents on the use of natural ingredients for preservation e.g. hop and horse radish extract is increasing. This shows that the industrial potential of using plants for preservation is growing. To achieve a successful product development that includes herbs and berries as ingredients for both taste and safety, development and documentation of the antimicrobial and sensory effect in the food product intended for use are necessary. Therefore more knowledge is needed on 1) the antimicrobial effect of different herbs and berries, 2) the application of herbs and berries in meat products for both taste and safety, 3) consumer expectations and acceptance of the utilization of natural preservatives in organic meat products, 4) the possibilities of growing the herbs and berries cost-effectively in Denmark, 5) the commercial aspects of utilizing herbs and berries in the production of unique and differentiated meat products and at the same time make use of the antimicrobial effect of the herbs and berries, and 6) the reproducible antimicrobial activity of berries and herbs so the new system for preservation can be part of the HACCP programme in a modern production system.

We hypothesize that the use of a combination of different herbs and berries will have a synergistic effect on inhibiting growth of pathogenic bacteria in food products, and that meat processing can be optimized to benefit from the antimicrobial plants. Since factors in the food like pH and fat as well as processing and cold storage can influence the antimicrobial effect it is essential to investigate the effect of the herbs and berries during production of meat products and to verify that production in a commercial meat production is possible. We also hypothesize that it is possible to cultivate, harvest and store herbs and berries so that a high yield of antimicrobial compounds is obtained and remain active until use and during processing and storage of the meat product. Since the way food is produced is one of the cornerstones of the organic concept in the mind of consumers, it is expected that this interest extends to processed products as well and that some of the scepticism observed concerning organic processed food has to do with reservations about or lack of knowledge on the production/preservation use. It is therefore relevant to achieve a better understanding of how consumers, interested in organic meat products, form opinions about different preservation technologies based on herbs and berries.

**A12.3 The projects contribution to solving important challenges for the organic food, agriculture and aquaculture sectors and the general political goals regarding food, agribusiness and environment as expressed in the governments Green Growth programme. Including an explanation of the projects focus on respectively the entire product/value chain or selected parts here of (e.g. primary production, processing, trade and transport) – max. ½ page.**

The research, development and demonstration activities in this project will create knowledge on the benefit of an increased use of herbs and berries in minimally processed organic meat products. The results will make it possible to produce new meat products with a high sensory quality and a huge variation in taste and appearance which complies with the widespread consumer request for new organic meat products in Denmark. The results of the project will make it possible to develop new organic products that fulfill the demands from the consumers and at the same time ensure robust products with high food safety and high quality that can be distributed in the modern retail chain. New differentiated products with high quality and safety will increase the economic potential for the production of organic products, but also conventional production of meat products added herbs and berries can benefit from the results in this project in the effort to produce "clean label" products. Organic meat products and conventional "clean label" products are characterised by a minimum of chemical additives and preservatives. This is a challenge to food safety and shelf life when this kind of products have to compete with other products in retail. The results of this project will show how herbs and berries can be used as part of both preservation and new sensory characteristics of the new organic meat products. An increased use of herbs and berries for these new products will involve the entire production chain from plant and meat to the consumer. Results from the project will show how an organic production of herbs and berries with antimicrobial activity can be established in an economical way, how the herbs and berries have to be treated and stored to have a reproducible effect and how the herbs and berries can be used in production of new meat products. It is well known how to produce organic meat but it is more complicated to produce organic herbs and berries with a uniform and high content of antimicrobial compounds and to ensure high and reproducible effect in the meat products throughout shelf life. During the project we will show which herbs and berries will be the best in different meat products and how processing will influence their capability to ensure a high food safety. This will lead to increased production of herbs and berries in Denmark and to a range of new organic meat products on the market.

**A12.4 The projects innovative value, relevance and effect including the specific barriers and development potential for the organic sector the project will solve and/or support (max. ½ page).**

This project will develop the basic tools for the organic meat producers to market a larger number of exiting and tasty products. The new products will combine meat, herbs and berries. The increased use of herbs and berries will bring both more diversity and a larger selection of new meat products to the market. In the long term the knowledge on how to utilize the antimicrobial effects of herbs and berries in the production of meat products will increase the safety of future meat products low in salt and other chemical additives - a knowledge useful to both organic and conventional production of meat products. This means that it will be possible to market new unique products that are pleasant in both taste and appearance, safe in regard to pathogenic bacteria as well as fresh and appetizing during the entire shelf life.

The project will demonstrate how different combinations of herbs and berries can be used in the production of differentiated and safe meat products with a new taste and appearance. The results will show the sensory and preservation benefits of herbs and berries, which will increase the industry's demand for herbs and berries, and thus open new possibilities for organic plant growers to increase their current production of herbs and berries or even to start producing new kinds of herbs and berries. One barrier in this project is the safety of the products, i.e. ensuring an even distribution of the active components in the meat product and in the same time ensuring a nice and tasty product. Another barrier is to ensure a consistent content of the active compounds in the herbs and berries, which may depend on the cultivar, the cultivation, harvest, treatment and storage. Finally, it is a challenge to combine the consumer expectations and acceptance for the use of natural

preservatives in organic meat products with the knowledge of the utilization of antimicrobial activity in specific herbs and berries in order to initiate a credible production of new healthy and differentiated products for the future consumer.

**A12.5 Description of activities, methods and expected results divided into work packages with clear denotation of which activity the applicant consider to be either Research, Development or Demonstration. The coherence between work packages must be clearly described and the relation between activities and the tables with milestones and deliverables must be logical and consistent. Moreover, the primary target groups should be clearly identified with a description of how these will be met by the project (max. 1 page per WP and max. 3 pages in total).** The activities

are divided into four work packages. In cooperation they will identify how a new biological preservation strategy for low-salt organic meat products should be, to ensure differentiated and interesting products with a huge diversity in taste. The combination of organic meat with organic herbs and berries will both bring new product variations and secure that the meat products are safe in regard to pathogenic bacteria and with an acceptable shelf-life. This new product concept is developed in close dialogue with organic consumers to ensure the acceptance of the strategy. The four work packages are:

WP1: Consumer expectations and requests in relation to a new development strategy for organic meat products - Research activities.

WP2: Unique taste characteristics and antimicrobial effects of herbs and berries in meat products – Development activities

WP3: Production of organic herbs and berries in Denmark with high and stable preservative effect and unique taste characteristics for use in new preservation methods for organic meat – Research and development activities.

WP4: Commercially produced organic meat products with naturally preservatives and taste variations from herbs and berries – Development and demonstration activities.

WP 1: Consumer expectations and requests in relation to a new product development strategy for organic meat products – WP leader: MAPP (Research activities).

Aim: To understand how consumers form attitudes to preservation technologies in organic food production and to understand how these attitudes affect purchase intentions

Activities/methods: This WP will continue throughout the project and focus on organic consumer expectations and requests to ensure that the new product strategy fulfil their expectations as an important step to obtain a commercial success. When a number of herbs and berries with an antimicrobial effect are identified in WP2 and WP3 a consumer panel are going to give their opinion on the herbs and berries as a part of a new organic meat product. At the same time they will be asked about the acceptance of different pre-processing of the herbs and berries. This will be done via qualitative (explorative focus groups) and quantitative (representative survey) methods to analyze the consumers understanding of and attitudes towards the use of natural preservatives to enhance food safety of organic products. The analysis includes parameters like preference for product-types containing natural preservatives, importance of product attributes in general (Danish food, taste, quality, appearance, meat-structure, product safety), pricing of products and demographics (gender, age, geography, income, education etc). Results from these analysis will be used in WP2 and WP4 where the new preservation strategies and product development will take place. Products preserved with herbs and berries from WP2 and WP4 will be used for consumer tests where 150 consumers will receive two-five samples each for tasting, together with information on production technology. Pre- and post-trial attitude to the preservation technology and re-purchase intention will be measured. This will show how attractive the products are to the consumer eg how the products are compared to traditional products and, what price the consumer are willing to pay. The continuous sparring and guiding in relation to do the right choices of herbs and berries so the new products fulfill the expectations of the organic consumer will be based on knowledge on the Danish consumers opinion on: the use of herbs and berries as natural

preservatives to enhance the safety and taste of organic products, which herbs and berries are the most attractive, expectation on shelf life of organic products, knowledge on how organic products and conventional products preserved with natural preservatives may be marketed and communicated to the consumer.

The target group: companies producing organic/conventional meat products and producers of herbs and berries will be involved and informed during project meeting, information to stakeholders and a workshop (cf A12.8).

WP2: Unique taste characteristics and antimicrobial effects of herbs and berries in meat products, WP leader: DMRI (Development activities)

Aim: This WP will show how herbs and berries can be used to produce tasty and safe meat products. The main goal is to achieve knowledge on how the antimicrobial activity of herbs and berries can be successfully applied to the meat products during processing, and validate the effect during storage.

Activities/methods: Based on knowledge from earlier work at DMRI and AU-IHP on the use of natural preservatives in meat products and the amount of antimicrobial compounds in different cultivars of berries and herbs grown in Denmark a range of promising herbs and berries (e.g. hop, rose hib, bilberry, thyme, mustard, garlic, aronia) will be chosen for presentation and discussion with the organic consumer panel in WP1. Based on the responds from the panel, studies of the antimicrobial effect in meat products will be initiated. The challenges will be to develop tasty and good looking meat products where herbs and berries in different combinations ensure optimal shelf-life and high food safety. Using microbiological methods we will investigate the antimicrobial effect against different pathogens e.g. *L. monocytogenes* in both lab-assay and meat products. The herbs and berries from WP3 will be tested alone and in combinations as our hypothesis is that it is possible to obtain a synergistic effect of herbs and berries with different antimicrobial compounds thus reducing the necessary amount of each. In the pilot plant facilities at DMRI, meat products will be produced with different recipes, processing and packaging to learn how factors like pH, fat, water, protein, salt, etc. interact with the antimicrobial effect of the chosen herbs and berries. This knowledge will make it possible to choose successful application strategies for the utilization of herbs and berries for preservation. In the pilot plant facilities at DMRI the most beneficial procedure for applying herbs and berries as natural antimicrobials in meat products will be investigated. During these activities it will be demonstrated how herbs and berries can be applied into products (jelly, powder, juice, frozen, paste ect) or on the surface of products. Also the sensory quality will be carefully investigated to ensure that products added herbs and berries with a strong antimicrobial effect also are delicious products with good taste and appearance during the entire shelf life. The sensory quality and storage stability will be documented using microbial and chemical analysis and sensory panels. These development activities will take place at DMRI and the consumer test in WP1, however, closely coordinated with Hanegal and Tulip and based on the results from WP1 and WP3. The activities will result in three-five combinations of herbs and/or berries suitable for preservation of meat products and a documentation of how herbs and berries should be added to meat products to achieve the best antimicrobial activity and at the same time give tasty and good looking products.

The target group: companies producing organic or conventional meat products will be involved and informed during project meetings, workshop and papers as described in A12.8.

WP3: Production of organic herbs and berries in Denmark with high and stable preservative effect and unique taste characteristics for use in new preservation methods for organic meat, WP leader AU-IHP (research and development activities)

Aim: The aim of this work package is to 1) identify, procure and deliver plant material from the most promising plant species and cultivar candidates in term of preservation effect and taste for an early lab test screening at DMRI, 2) investigate how 4-5 selected species/cultivars can be grown optimally organically and

determine yield and how the concentration of major antimicrobial compounds vary with organic fertilization and harvest time and 3) investigate the effect of different methods of pre-processing of raw plant material, and storage of plant products on the level and stability of major antibacterial compounds over time.

Activities/methods: AU-IHP will from the start of the project together with DMRI identify a range of species and cultivars with anti-microbial potential and different taste profile. AU-IHP will provide plant material from these species to DMRI (WP2) for testing in a screening test for anti-microbial effects. AU-IHP will also develop different basic formulations of these plant products (i.e. fresh, dried, frozen, cut leaves or powder by milled leaves, pomace or juice of berries). Four or five of the most interesting candidate species will be chosen for more detailed analysis of the possibilities of organic cultivation and procurement of plant material with high and reproducible anti-microbial activity. Experiments will involve different species and cultivars of these to identify the plant material with the highest likelihood for providing an efficient anti-microbial component for each species. Plants will be cultivated with different organic fertilizer levels and organic composts, and harvested at different times during the crop growth. Following harvest the plant material will be kept fresh or dried either in ambient conditions or in a freeze drier, pre-processed to different product formulations (i.e. paste/powder, juice/pomace, pasteurising) and selected products stored for a period of time either under ambient condition or frozen to evaluate the effect of these methods on preservation effect (measured at DMRI in WP2) and the concentration of major anti-microbial components in the plants (measured at AU-IHP). Methods to provide products with reproducible preservation effect all year through will be described and economical aspects of using plant products for preservation of organic meat considered together with WP2 and WP4. The activities in this work package will provide plant material for the investigations in WP2 both for initial screening and the detailed analysis in most promising 4-5 candidates. Furthermore WP3 will provide knowledge on how the concentrations of the major anti-microbial compounds vary with species, cultivar, cultivation and pre-processing and storage of plant material following organic production. Potential methods of ensuring a reproducible and stable product over time will be suggested and economics of producing such organic plant material for meat preservation will be discussed in cooperation with the other partners.

The target group: herbs and berries grower, companies processing herbs and berries will be involved and informed during workshop and papers as described in A12.8.

WP4: Commercial production of meat products with natural preservatives and taste variations from herbs and berries, WP-leader: DMRI (Demonstration and development activities)

Aim: The aim is to demonstrate, that it is possible to produce safe and differentiated high quality organic or "clean label" meat products with a distinct taste of herbs and berries in a commercial company. The economic potential will be calculated.

Activities/methods:

The companies participating in the project will work with the berries and herbs selected for the project ,to investigate how they can be applied to meat products in a commercial production to develop new and exciting products added high amounts of herbs and berries. When the work in WP2 have shown how the herbs and berries must be applied to have an optimum antimicrobial effect these combinations of herbs and berries will be tested in specific products of interest at the companies. The products will be analysed for yield throughout the entire processing and for product quality parameters like taste, texture, appearance and shelf life. The product quality and shelf life will be analysed by the participating companies using sensory rapid methods and traditional shelf life tests. Further on the products will be subjected to consumer analysis in WP1. The economic perspectives in using natural preservatives will be calculated based on results from WP2 and WP3 as well as the analysis of yield, the estimated price, recipe etc. The safety of the new products with natural preservatives will be documented through challenge tests at DMRI, e.g. inoculation with *Listeria monocytogenes* in accordance with the EU guidelines on this. The results from WP2, WP3 and WP4 will be

used to elaborate guidelines on how the natural preservatives must be controlled before use in the production of commercial products and to elaborate the appropriate documentation for a company's HACCP programme. This will result in knowledge and documentation on how a range of new organic and conventional meat products can be produced using a minimum of salt and an increased amount of herbs and berries for taste, safety and shelf life.

Participants: Tulip (production, development), Hanegal (production, development), DMRI (planning, challenge test, WP-leader, economic, HACCP)

The target group: companies producing organic or conventional meat products will be involved and informed during workshop and papers as described in A12.8

**A12.6 Description of how it will be ensured that the project results can be implemented in practice and perhaps commercialized (max. ½ page).** The four work packages are carried out in close communication between the participants. The selection of herbs and berries for use as natural preservatives and evaluation on taste and quality of products produced are done in close dialogue with the participating companies and an organic consumer panel ensuring that the project only works with herbs and berries suitable for meat products and acceptable to the consumer. This is the first step to ensure commercialization of the project results. The documentation of safety, shelf life and quality in meat products added herbs and berries will prove that the specific herbs and berries can compensate for reduced salt and other chemical additives. The subsequent economic calculations on how the production of herbs and berries with antimicrobial activity can be grown, processed and stored in Denmark and how the use and marketing of natural preservatives becomes a cost-effective alternative to traditional chemical preservatives will ensure the best platform for industrial use and commercialization of the project result. Finally the analysis of consumer acceptance and opinion on the use of natural preservatives in organic and conventional food will allow the industry to communicate and market their new products efficiently.

Throughout the project period, meetings and discussions with stakeholders from the value chain, e.g. Danske bær, Økologisk Landsforening, Forskningsforeningen frugt, grønt og kartofler, 3-Stjernet A/S, Tican Food and Coop Trading will ensure that the results are communicated to e.g. herbs and berries grower for implementation in the primary production. Meetings and discussions with food companies producing meat products but not participating in WP4 will disseminate the knowledge of herbs and berries for preservation and production of new differentiated meat products. Meetings and discussion with retailers, e.g. COOP, will ensure that the meat products can be marketed in supermarkets. Finally WP1 ensures that the new products have a high credibility in relation to the consumers.

**A12.7 Description of possibilities for a general utilisation of the results (max. ½ page).** The project will document to what extent herbs and berries can be used in different meat products, how processing and recipes normally used in meat products affect the antimicrobial activity and how these new natural preservatives most beneficially can be applied to the products during meat processing. This knowledge is general and can be used by both organic and conventional companies producing processed meat. Most likely the solutions that work in processed meat products will also work in fish products and ready meals. The use of herbs and berries for preservation could also reduce the amount of e.g. salt and nitrite necessary in the production of several processed meat products and ready meals. This would provide the Danish meat producers with new knowledge enabling them to meet the guideline from EU on reducing sodium (salt) in meat products and ready meals. Furthermore, several berries and herbs are known to be beneficial to health in general and many will add to the taste and thereby compensate for the less salty taste. The successful use of herbs and berries for preservation will increase the possibilities of an increased production of herbs and berries in Denmark and of bringing new meat products with a low salt content and an exciting taste to the

market. Such new products will increase product differentiation and the competitiveness of Danish food production.

The results obtained in the project will be communicated to the participating companies at regular meetings and to the food industry in general through articles in journals such as "Plus Process". Furthermore, an open workshop will be held at the end of the project period. The public will be informed through "papers" in journals like "Food Culture". The "papers" will stress the food safety issue by describing the presence and role of bacteria in food (beneficial, harmless, spoilage, and pathogenic), the importance of preservation strategies to produce safe food and how this can be achieved by the use of herbs and berries. The scientific results of the project will be published in peer reviewed international journals and presented at international and national scientific conferences and workshops.

#### **A12.8 Description of the coherence between the research, development and demonstration activities in the project, including involvement of relevant users of the results (max. ½ page).**

One of the end user segments are the Danish consumers who are buying organic meat products. Their opinion on an increased use of herbs and berries for both preservation and a new taste and appearance in a new range of meat products will be addressed during the research activities in WP1. The results of these discussions and analyses will be used in WP2 where new concepts of meat products will be developed based on antimicrobial activity, taste and appearance. The herbs and berries chosen for the research and development in WP2 will be based on feedback from the organic consumers (WP1) but also on the potential of cultivating these plants in Denmark (WP3). The research and development in WP3 will show how berries and herbs with antimicrobial activity can be cultivated, processed and stored in order to optimize and stabilize the content of antimicrobial compounds. Finally the most promising combinations of herbs and berries will be used by the meat producing companies in new product concepts thus demonstrating the commercially possibilities in the production, economic perspectives, the shelf life, implementation in a HACCP-programe (WP4) and consumer acceptance (WP1). Another group of end users of the results are: plant-growers producing herbs and berries, companies processing herbs and berries and companies producing organic or conventional processed meat. During project meetings and discussions with stakeholders like Danske bær, Økologisk Landsforening and Forskningsforeningen frugt, grønt og kartofler will ensure that the results are communicated to e.g. growers of herbs and berries for implementation in the primary production. Meetings and discussions with differnt companies producing meat products e.g. Stryhns, 3-Stjernet and Tican beyond the companies participating in WP4 will disseminate the knowledge of using herbs and berries for preservation and production of new differentiated meat products and meetings and discussion with retailers e.g. COOP will prepare the retailers for the new products and the new biological preservation technic thus increasing their interest in the new concept. Finally the research in WP 1 are used in WP2 so the herbs, berries and processing chosen to develop the new meat products ensures that the new products have a high credibility to the consumers. At the end of the project an open work shop will be held and the results presented ensuring communication to the Danish food industry as a whole.

#### **A12.9 Project organisation, management and administration (max. ½ page).**

The project will be organised with a steering committee, a project leader and work package leaders. The steering committee will meet twice a year to discuss the overall direction of the project and to approve economic and scientific issues. In the steering commitee each partner in the project is represented and the head of the steering commitee will be a manager from the applicant company. The project leader is the daily manager of the project and is responsible for the technical and scientific progress of the project and the coordination of economic, meetings, communication between the partners in the four work packages including the industry partners (Hanegal, Tulip Food Company). This job will be carried out by Flemming Hansen, DMRI. Since 1997, he has worked as project leader in different food safety projects at the Danish Meat Research Institute (DMRI). Several projects have been performed in cooperation between universities, DMRI and the meat industry and financed by DFFE. The Work package leaders are responsible for the scientific research in the work package



which must be carried out in accordance with the described milestones and budget. The project leader, work package leaders, scientific staff and the participating meat companies (Hanegal, Tulip Food Company) will meet twice a year to discuss scientific results. At these meetings, results will be presented and the research for the next 6 months will be discussed and coordinated and after that confirmed in the steering committee.

Further on a group of stakeholders will be established. In this group stakeholders from meat processing, herbs and berries growers, herbs and berries processing and retail will be invited. The group will meet two or three times during the project to learn about the results, to discuss the possibilities on using herbs and berries for preservation, how to market the products and how to communicate the perspectives to a broader range of stakeholders. During the project the group of stakeholders will also be used for discussions and opinions when necessary and to solve different technical challenges that might arise during the project. Expression of interest from COOP trading, 3-Stjernet, Tican, Økologisk landsforening, Forskningsforeningen frugt, grønt og kartofler are attached in A15 List of Appendices.

**A12.10. The technical competences of the partners and their contribution to the project including how they complement each other (max. 5 lines per partner).**

The Danish technological Institute-DMRI: DMRI works closely together with the Danish meat industry. During 50 years DMRI has worked with meat technology, meat quality, food safety and sensory methods to show how new technologies and ingredients can be used in the meat industry. During 15 years an excellent experience in carrying out challenges in pilot plant has been established. DMRI also has managerial expertise from leading research projects with different partners from universities and food industry.

Århus University- Department of Horticulture (AU-IHP) has long experience in research in cultivation of berries and herbs also organically and how different cultivation factors affect quality of the produced crops measured in terms of taste or content of secondary metabolites of which some are anti-microbial. AU-IHP has for 15 years worked with bioactive ingredients in such products targeted towards improving human health and has developed competences for detection of such compounds by e.g. HPLC and NIR spectroscopy.

MAPP–Aarhus University is a leading research centre dealing with consumer behaviour and relations between actors in the food chain. MAPP has solid experience with qualitative and quantitative methods for studying consumer behaviour, and has participated in numerous projects with companies and trade organisations. Areas of research have been consumer quality perception, consumer attitudes to new technologies, novel food, lifestyle and segmentation, and consumer demand for organic food and other process characteristics.

Hanegal is a pure organic company, which since 1996 has developed and produced organic meat products totally without additives and synthetic flavorings. During the development of new products the work is targeted against optimized health and taste by using herbs and vegetables and by reducing fat and salt in the recipes. This experience on increased use of vegetables and herbs in meat products will be used in the project. Hanegal looks forward to obtain new knowledge in this area, which is of great importance to the company.

Tulip Food Company: Bent Olesen has years experience in product development and implementation of new products in the meat industry. He will use this experience in product development, commercial production of meat products and consumer preferences to guide the project in a commercial direction so the berries and herbs chosen for investigation are suitable for future meat products. During the project commercial products will be produced at Tulip.

**A12.11. Expected collaboration with other research institutions/companies nationally and internationally (max. ½ page).**

At the beginning of the project a group of stakeholders will be established. In this group stakeholders from meat processing, herbs and berries growers, herbs and berries processing and retail will be invited. The group will meet two or three times during the project to discuss the possibilities on using herbs and berries for preservation, how to market the products and to get to know the results to be able

to communicate the perspectives to a broader range of stakeholders. During the project the group of stakeholders will also be used for discussions and opinions when necessary and to solve different technical challenges that might arise during the project. Expression of interest from COOP trading, 3-Stjernet, Tican, Økologisk landsforening, Forskningsforeningen frugt, grønt og kartofler are attached in A15 List of Appendices.

**A12.12. The relation to previous projects within the projects focus areas (if any) including references to these (max. ½ page).** DMRI has undertaken a number of projects with the objectives to ensure food safety by the use of chemical preservatives. This has provided DMRI a good experience in developing recipes for tasty products with new additives and carrying out challenge tests in the pilot plant. (Føtek 93S-2469-Å96-00143) In previous projects DMRI have screened both new lactic acid bacteria and different ingredients for anti-microbial activities and the effect in meat products regarding taste, shelf-life and food safety (Føtek 93S-2469-Å96-00143 and 93s-2469-Å96-00144). To ensure a sustainable organic product the packaging must be considered. DMRI has been a partner in NANOPACK (Strategiske vækstteknologier, Forsknings og innovationsstyrelsen jr.nr 2106-06-0061) where a sustainable packaging material was developed.

MAPP has been involved in a number of national and international projects relating to organic products and/or the evaluation of meat quality. Of Danish funded projects can be mentioned: "Alternative sale of Danish beef from young bulls", "Certified meat quality", "Food quality and safety: Consumer behaviour, grocery retail chains and economic perspectives", "Beef product development and branding of Danish Beef. EU funded projects in this area are: "Consumer decision-making on organic products", "Sustainability in the production of pork with improved nutritional and eating quality using strategic feeding in out-door production", "Novel processing methods for the production and distribution of high-quality and safe foods", "Improving the quality of pork and pork products for the consumer: Development of innovative, integrated and sustainable food production".

AU-IHP has worked intensely with production and storage of fruit and berries including an increased focus on organic production the last years with new specially designed organic research fields. More recently focus has been on taste and flavour of berries including biochemical compounds and the potential positive health effect to humans. Ongoing projects on Aronia and blueberry are focussing on obtaining both good taste and still preserving the bioactive components in the berries providing healthy and tasty berries. AU-IHP have participated in a number of projects that involves herbs in the aim of identifying variation in content of essential oils, phenolics and other compounds that may provide health promoting compounds. Furthermore AU-IHP has done a number of projects where collections of plants i.e. humle has been screened for taste and flavour and performance under organic cultivation conditions.

**A13. Tables with milestones and deliverables with information as requested in the table in A16.**

1.1.: Instrument for measuring attitudes and future purchase intentions of the products from WP2 developed. Based on earlier research on Danish consumers expression of attitudes and intentions and the link between what is expressed and what is reality, an instrument will be developed.

1.2.: Qualitative data on attitude formation and purchase intentions used for further selection of products in the other 3 work packages.

By means of the instrument developed, data will be collected and used for developing a framework to provide input for choices of products with different levels of appeal to consumers.

1.3.: Design of final consumer testing based on results from WP2 and WP4.

Based on products developed in WP2 and WP4, a product testing and tasting experiment will be conducted including parameters of important attitudes and willingness to pay for the different versions.

1.4.: Data from consumer testing analysed.

Data from the consumer tests will be analysed in order to qualify and quantify the importance of the different developed product versions, and will provide input for future potential and commercialization.

2.1. Berries and herbs for presentation to consumer panel in WP 1 chosen.

Based on current knowledge on antimicrobial content, taste and meat products suitable herbs and berries will be chosen for the consumer evaluation.

2.2. Documentation of antimicrobial effect in Lab-systems.

Species of the chosen herbs and berries will be screened in lab-assay for antimicrobial activity to choose the ones with best activity.

2.3. Effect of meat processing and ingredients on the antimicrobial effect shown.

In pilot plant and lab-test it will be shown how traditional meat processing and ingredients in typical recipe interact with the antimicrobial activity

2.4. Synergistic effect of berries and herbs documented in meat products.

In pilot plant and lab-test it will be shown how herbs and berries with different types of antimicrobial compounds can act synergistic.

2.5. Method of application of the antimicrobial herbs and berries elucidated.

In pilot plant it will be shown how the herbs and berries most beneficial can be added to the meat products to ensure good taste and antimicrobial effect throughout shelf life.

2.6. Recommendation on production of new tasty products with high safety.

Conclusion from the project will be communicated so they can be used in product development in the organic as well as the conventional meat industry.

3.1. Candidate species and cultivars are identified and first material delivered to DMRI for initial screening. Knowledge distributed to project partners.

3.2. Knowledge on how yield and antimicrobial compounds vary in 4-5 selected species and cultivars depending on cultivation methods, harvest time and year is described in a report shared with all project partners. A magazine article will be produced based on this knowledge.

3.3. Knowledge on how antimicrobial compounds vary depending on pre-processing and storage of plant material is described in a report and shared with all project partners. A magazine article will be produced based on this knowledge.

4.1. Berries and Herbs for test in each company chosen.

Based on consumer evaluation and initial screening at DMRI the companies choose which herbs and berries they will use in the initial work on developing meat products with increased amount of herbs and berries.

4.2. Commercially products produced and analysed for quality and shelf life.

Based on the result from 4.1. and documentation from pilot plant test at DMRI the companies choose specific combinations of herbs and berries for production of products for shelf life studies and consumer test.

4.3. Economical calculations on cost of using natural preservative

Results from commercial production of meat products and growth/processing of herbs and berries will be used to calculate the cost of using natural preservatives.

4.4. Documentation of stabilization against growth of *L. monocytogenes*

The commercial product is proved to be stabilized against growth of *L. monocytogenes* as described in the EU legislation.

4.5. Documentation for use in HACCP programme completed

Results from pilot plant documentation of the antimicrobial effect of herbs and berries as well as challenge test on commercial products will be used to write input to a generic HACCP programme.

**A14. List of deliverables from the project (also fill out the table in A17)**

**1. Consumer opinion on herbs and berries as natural preservatives in organic products explored (S1, P2).**

A report will be made based on the results from the analysis of consumer attitudes and purchase intentions. This report will provide input for the further development of products in other work packages and will also provide input of general interest regarding consumer attitudes towards preservation.

**2. Knowledge on how organic products and conventional products preserved with natural preservatives may be marketed, priced and communicated to the consumer (S1, P2).**

A report describing results from the product tests will be written and will provide input interested stakeholders about future potential of the tested products.

**3. Documentation on 3-5 combinations of herbs and berries suitable for preservation of meat products (P1, P2, S1, C4).**

The documentation from pilot plant test is collected in technical reports for the end users.

**4. Documentation on process and recipe optimization to achieve high antimicrobial effect, good shelf life and tasty product (P1, P2, S4, C4).**

The documentation from pilot plant test is collected in technical reports for the end users.

**5. List of candidate species as identified by content of natural compounds (P1).**

Species with potential antibacterial activity and of sensory value will be identified from previous research and from existing literature. A small report with this background evidence will be developed for sharing with project partners.

**6. Results of first and second year cultivation and harvesting of 4-5 major species on yield and quality presented (P1, P2, S1).**

A report will be produced that summarizes the results of the two years organic cultivation of different cultivars and species depending on harvest time and organic cultivation techniques. The project report will later be developed into a magazine article for public dissemination of results.

**7. Results of pre-processing and storage of plant material on quality including content of major antibacterial compounds presented (P1, P2, S1).**

A report will be made of results from the investigations on preprocessing and storage of plant material at the end of the project. The project report will later be developed into a magazine article for public dissemination of results.

**8. Methods of obtaining a stable and reproducible antibacterial effect and content of antibacterial compounds in the raw or slightly preprocessed plant material are described (P1, P2, S4).**

This project report will contain evaluations and discussions on how a stable and reproducible plant product may be obtained based on the knowledge on variation in the antibacterial effect and the variation in the content of major compounds.

**9. New meat products with increased berry/herbs (C4).**

Based on the activities in WP4 new products based on an increased use of herbs and berries will be produced.

**10. Economic evaluation of the use of natural preservatives (P1).**

A report with documentation of the estimated cost of using herbs and berries for preservation will be written the end users

**11. HACCP documentation on the use of natural preservatives (P1).**

A report with documentation for a generic HACCP-programme will be written for the end users.

**12. Open workshop on project results (P2).**

At the end of the project the results will be presented in an open workshop.

## **A15. List of appendices**

Budget

Participation forms for MAPP, DMRI, AU-IHP, Tulip and Hanegal.

CV for key persons in the project.

Litterature cited in A12.2

Letter of interesst from COOP Trading, Tican, 3-Stjernet, Økologisk Landsforening, Forskningsforeningen frugt, grønt og kartofler.

**A16. Milestones and time schedule for the entire project**

wp no.	Milestone no.	Title/activity	Responsible project participant	Date/year	Other participants
1	1	Instrument for measuring attitudes and future purchase intentions of the products developed	MAPP	01.02.2011	AU-IHP, DMRI
1	2	Qualitative data on attitude formation and purchase intentions used for further selection of products in other work packages	MAPP	01.05.2011	
1	3	Design of final consumer testing based on results from WP2, WP3 and WP4	MAPP	01.06.2013	AU-IHP, DMRI
1	4	Data from consumer testing analysed	MAPP	31.12.2013	AU-IHP, DMRI, Tulip, Hanegal
2	1	Berries and herbs for presentation to consumer panel in WP 1 chosen	DMRI	01.02.2011	AU-IHP, MAPP, Tulip, Hanegal
2	2	Documentation of antimicrobial effect in Lab-systems	DMRI	01.10.2011	AU-IHP
2	3	Effect of meat processing and ingredients on the antimicrobial effect shown	DMRI	01.06.2012	AU-IHP, Tulip, Hanegal
2	4	Synergistic effect of berries and herbs documented in meat products	DMRI	01.12.2012	AU-IHP, Tulip, Hanegal
2	5	Method of application of the antimicrobial herbs and berries elucidated	DMRI	01.06.2013	AU-IHP, Tulip, Hanegal
2	6	Recommendation on production of new tasty products with high safety	DMRI	01.12.2013	AU-IHP, Tulip, Hanegal
3	1	Candidate species and cultivars are identified and first material delivered to DMRI for initial screening.	AU-IHP	01.08.2011	AU-IHP, DMRI, MAPP
3	2	Knowledge on how yield and antimicrobial compounds vary in 4-5 selected species and cultivars depending on cultivation methods, harvest time and year is described	AU-IHP	31.10.2013	
3	3	Knowledge on how antimicrobial compounds vary depending on pre-processing and storage of plant material is described.	AU-IHP	31.12.2013	
4	1	Berries and Herbs for test in each company chosen	Tulip, Hanegal	01.10.2011	DMRI
4	2	Commercially products produced and analysed for quality and shelf life	Tulip, Hanegal	01.07.2013	DMRI
4	3	Economical calculations on cost of using	DMRI	01.10.2013	AU-IHP, Tulip, Hanegal



**A17. List over deliverables (D=deliverables) for the entire project, stating whether the deliverable belongs to the research part of the project (R); the development part (D); and/or demonstration (Dm).**

D. no.	Deliverable	Responsible project participant	Date/year	R, D, or Dm Effective working time, months <sup>1</sup>	Type of deliverable*
1	Consumer opinion on herbs and berries as natural preservatives in organic products explored	MAPP	31.12.2011	R, 7 months	S1, P2
2	Knowledge on how organic products and conventional products preserved with natural preservatives may be marketed, priced and communicated to the consumer	MAPP	31.12.2013	R, 7 months	S1, P2
3	Documentation on 3-5 combinations of herbs and berries suitable for preservation of meat products	DMRI	01.06.2012	D, 19 months	P1, P2, S1, C4
4	Documentation on proces and recipe optimization to achieve high antimicrobial effect, good shelf life and tasty product	DMRI	01.06.2013	D, 18 months	C4, P1, P2, S4
5	List of candidate species as identified by content of natural compounds	AU-IHP	01.03.2011	R, 1 months	P1
6	Results of first and second year cultivation and harvesting of 4-5 major species on yield and quality presented.	AU-IHP	01.12.2012	R, 15 months	S1, P1, P2
7	Results of pre-processing and storage of plant material on quality including content of major antibacterial compounds presented	AU-IHP	31.12.2013	R, 8,2 months	S1, P1, P2
8	Methods of obtaining a stable and reproducible antibacterial effect and content of antibacterial compounds are described	AU-IHP	31.12.2013	R, 1 month	S4, P1, P2
9	New meat products with increased berry/herbs	Hanegal, Tulip	01.12.2013	D, 8,6 months	C4
10	Economic evaluation of the use of natural preservatives	DMRI	01.12.2013	Dm, 1 month	P1
11	HACCP documentation on the use of natural preservatives	DMRI	01.12.2013	Dm, 3 months	P1
12	Open workshop on project results	DMRI	01.11.2013	Dm, 1,1 month	P2

<sup>1</sup> The total amount of months must be consistent with the total number of months in the budgets, and will therefore show the relative working effort per work package.



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\* Fill in the type of deliverable. Use the List of type of deliverables on the last page in Annex 3 "Instructions for filling in the application form".

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