DELIVERABLE 3.2.2

FOOD MICRO SYSTEMS

REPORT ON FOCUS GROUP ON CONSUMERS' ACCEPTANCE

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SEVENTH FRAMEWORK PROGRAMME

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FoodMicroSystems aims at initiating the implementation of microsystems & smart miniaturised systems in the food sector by improving cooperation between suppliers and users of microsystems for food/beverage quality and safety.

The project runs from September 2011 to August 2013, it involves nine partners and is coordinated by ACTIA (Association de Coordination Technique pour l'Industrie Agro Alimentaire, France). More information on the project can be found at http://www.foodmicrosystems.eu.

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1 Introduction

As highlighted in deliverable 3.2.1 of this project, there is currently little specific knowledge how the public perceives the application of food microsystems.

This knowledge is of importance as public protest may form a barrier against the implementation of the technology (Frewer et al., 2004).

It is important to know how people construe food microsystems in terms of objections, societal embedding as well as positive images. In depth knowledge of which people construe an image in which way on these food microsystems, can help developers of the technology to:

1) Use the relevant consumer wishes and demands early in the development trajectory of new application, in order to create products and technologies with good potential for acceptability, i.e. they score low in perceived risks, and high in perceived benefits.
2) Create regulation, control mechanisms, and/or industry standards to answer to consumer concerns where needed.
3) Develop targeted communication strategies to respond to consumer information needs.

Following the findings in D3.2.1 it is to be anticipated that perceptions of risk (cf. Fife-Schaw & Rowe, 2000; Pliner & Hobden, 1992; Slovic, 1987), benefit (cf. Alhakami & Slovic, 1994; Finucane, Alhakami, Slovic, & Johnson, 2000) with particular emphasis on end-user benefits (e.g.Schenk et al., 2008; Schenk et al., 2011), ease of use (cf. Davis, 1989; Venkatesh & Bala, 2008), and trust (cf. Siegrist, 2000; Siegrist, Cousin, Kastenholz, & Wiek, 2007) are important elements of consumer perception towards food micr0-systems. However, the exact determinants of risk and benefit perceptions, and which attributes of food microsystems will raise these, as well as perceived end user benefits and ease of use and trust issues of relevance are not known and need further exploration at this stage.

Within the social sciences, a broad range of methods has been developed to extract information from consumers (e.g. interviews, focus groups, surveys, experiments Van Kleef, Van Trijp, & Luning, 2005). These can be applied to different research questions. First of all it is important to realise whether the current research aims at identification of relevant issues or that the research focusses on the quantification of previously identified determinants of acceptance.
If the research aims at identification of important perceptions, the researcher should be extremely careful not to frame the research based on a-priori assumption. Any research based on strong a-priori assumptions will be limited to findings within the scope of these assumptions, and thus the existing knowledge of the researcher. More open, qualitative techniques such as interviews and focus groups are better suited to elicit new ideas that add to the existing knowledge in the field. Focus groups have the property that they rely on interaction between participants, thus

creating a more associative discussion, where people can respond on each other. Qualitative techniques are well suited to identify important topics, but not to quantify these. If representative quantification of consumer perceptions is required, results of focus groups can inform researchers to develop a survey. In the case of food microsystems the qualitative data from focus groups can provide input into further development. Detailed quantification of these inputs is neither required, nor possible as we are dealing with non-existing future plans.

The literature review (D3.2.1) shows that at this stage we cannot confidently define the important perceptions in the mind of the participants; a qualitative method is more relevant. In this specific case focus groups are used as the interaction between participants can facilitate a more in depth associative evaluation of the relevant topic.

Thus the aim of the current study is to qualitatively elicit perceptions of food microsystems with the consumer.

2 Methodology

Semi-structured focus groups were conducted in 2012 to elicit consumer perceptions of food microsystems.

As we anticipated that participants would have little knowledge on food microsystems and their application, the discussion was facilitated by a series of scenarios, that started with broad definitions of microsystems and funnelled towards more specific and end-user directed applications. This approach is chosen to sequentially unlock more detailed information, thus creating progressively more concrete situations, while it allows consumers to discuss the general issues first (see D3.2.1 for a discussion of the relevance).

The scenarios were constructed in collaboration with the partners in the project (see text boxes 1 through 5). Scenarios were printed on paper cards and distributed during the meeting to facilitate discussion.

A semi-structured approach was adopted to allow for sufficiently broad topics to be discussed spontaneously, while a provided topic list ensured that topic of importance to the project would be discussed. The main topics that should be probed if not raised voluntary were (1) General opinion, (2) Risk perceptions (3) Benefit perceptions and (4) Trust.

Text box 1: First scenario on microsystems in general
Card 1: Microsystems:
Microsystems are very small instruments that can be used to keep track of and keep under control products and production processes. Microsystems are miniaturised to make sure they can be applied where size is a critical issue. Furthermore microsystems are created to be cheap and automatic, which means that once in place they need minimum attention. These microsystems can be created using microelectronics and sensors. They are in the millimetre scale but can contain features as small as the nano-scale, about 600 times smaller than the thickness of a human hair. This is why they are referred to as micro and nano-systems.

Text box 2: Second scenario on microsystems in food
Card 2: Microsystems in food:
The food production chain depends heavily on process and product control, as many foods are perishable, or have non-physical attributes such as a specific region of origin. Microsystems in foods can be used to detect contaminants such a chemical pollution, or bacterial spoilage during processing and in the final products. They can be used to track the history of products for example by keeping track of the exposure to warm temperatures throughout the history of the product. Microsystems can also be used to track and chase the position of the products in the production chain. Other microsystems can actively change food quality, for example by letting in less oxygen to a packaged product depending on the product age.

Text box 3: Third scenario on micro-sensors
Card 3: Micro-sensors in food production
Micro-sensors can track and trace chemical and biological contamination during the food production process. They tend to be small instruments that can give information which previously required lab testing and are sometimes called lab on a chip. By applying a small amount of food to these instruments the quality and contamination can be quickly established at any point in the production chain. If the process conditions are adequate, these systems can work continuously and automatically.

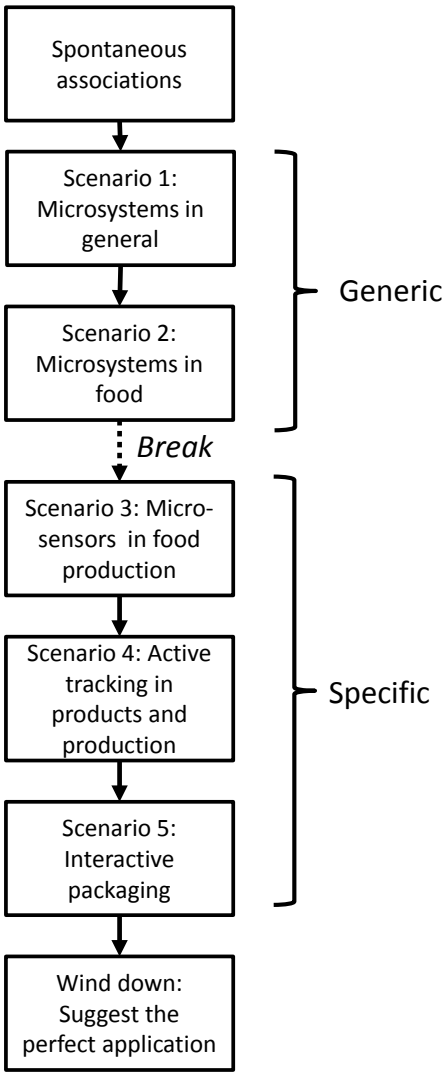

Figure 1: Funnelling of scenarios towards more specific and end-user directed applications

Text box 4: Fourth scenario on active tracking
Card 4: Active tracking systems in products and production
A small microchip can be attached to a product. These microchips are designed to emit a radio-signal that can be recorded from some distance (centimetres to meters). This way, ingredients, products and their conditions can easily be tracked throughout primary harvest, through early production all the way to the supermarket and other food outlets. In the future this may allow for a very transparent and complete surveillance system of the products.

Text box 5: Fifth scenario on active packaging
Card 5: Interactive packaging of food products
In the future, novel materials can be applied to food packages that actively measure and regulate the quality of the food product. For example, labels that are capable of indicating how ripe a packaged fruit is. In combination with smartphone apps that can interpret a picture of the label, this can give the consumer a lot of background information on the history and specific origin of a product.

Procedure:
A detailed focus group protocol was developed, and translated into the local languages (see appendix for the full protocol in English).

Focus groups were conducted in France (Strasbourg) by Euroquality and AERIAL, Spain (Barcelona) by Triptleomos Foundation and CSIC-CNM and in the Netherlands (Ede) by Wageningen University. Focus groups were conducted in May 2012, and consisted of 8 participants for the French and Spanish focus group and 7 for the Dutch focus group.

Participants were invited for the focus groups. They were welcomed into the room. After that, the participants were given the ground-rules (there is no right and wrong, respect each other) and asked for permission to audio-record the focus group. After

that the audio recording was started and the participants introduced themselves. This was followed by a warm-up round where microsystems were discussed without any information. Subsequently card 1 on microsystems was provided. Participants were asked to study this and the topic was discussed. After this, card 2 was discussed, followed by a brief break. After the break the more concrete scenarios (3, 4, and 5) funnelling towards end-user relevant applications were discussed. Finally the participants were asked to speculate about the most optimal food microsystems they could imagine as a wind down question. After that, participants were debriefed, thanked and left (see figure 1). The focus groups took between 1.5 and 2 hours.

Analysis plan:
The audio-recordings were transcribed and translated into English. The contents of the transcripts was content coded using Atlas.ti (http://www.atlasti.com/), software dedicated to the analysis of qualitative data. Emerging themes were aggregated from the codes and reported in the results. Within each theme, subsequently subthemes were identified. Based on the codes, the underlying quotes and their context, the sub- themes were then content analysed. Findings are illustrated by exact quotes of respondents where illuminating printed in italics. Editorial comments needed for comprehensibility of the quotes outside the context are included between square brackets.

3 Results

A thematic analysis was conducted. At the highest level of aggregation, 7 themes emerged. These related to

1. risk perception: concerns raised by participants when discussing food microsystems
2. benefit perception
3. trust and regulation issues: such a who is in control, and how should these systems be regulated
4. un-decidedness and ambivalence, where participants perceived conditional support depending on situations
5. consumer knowledge and communication needs
6. Understanding of the technology and its applications.
7. Future developments: how participants perceived the technology to develop and

At a lower level, these major themes consisted of subthemes. In the following sections the focus groups were subjected to an in depth analysis. The report structured along the lines of the 7 major themes that were identified, and subdivided into subthemes. To show the actual words of the participants, the focus group report is illustrated with quotes from the transcripts.

3.1 Risk Perception

Within the theme risk perception, distinct subthemes could be distinguished.

<u>General determinants of risk perception</u>
A series of general determinants of risk perception reflecting the psychometric determinants of Slovic (1987).
Uncertainty and lack of knowledge *"It is also scary, I don't know why, because we just don't know".* Another voiced feeling reflect to the existence of yet unknown side effects "*it may have side effects that we are not yet aware of ."*
unnaturalness for food applications *"Trying to associate food with microchips or tiny sensors, so technical, that is what makes me get a bad feeling."*; although this may partially be due to the terminology used *"but I don't know, maybe if it were called something else...[second participants kicks in] rather than technology linked to health. Yes, that is true. [first participant continues] the vocabulary is what has made it more negative."*
Another topic that raises concern is that the particles are that small they would be invisible "*So I mean it could inevitably go unobserved".*

<u>Microsystems in the consumed foods</u>
A second broader group of concerns, revolves on the presence of (parts of) the microsystems in the actual food stuffs.

By intentional inclusion of particles in the product

"Then here is my problem it is: Where are the Microsystems in the products I buy in the supermarket? Are they in the product";

"I'm a bit sceptical about wholesale; it would have to be on the inside [of a food product]!"

"I am thinking that if it is inside the food, then it is edible... [next participant continues] maybe what they want is to put the chip inside. Not controlling the food but controlling you. Like [in the movie the] Matrix.",

The contact of an active packaging to the product may cause some unintentional contamination "*But each time that [packaging] will touch to the product because the aim is to give some information about the portion for example"*, or that damaged micro-sensors could lead to particles remaining in the food *"In my opinion, the micro-sensors are finally into the product … maybe, I don't know, it's maybe broken by…It's uh…I don't know…".* While not all contact is considered to be a direct health risk, participants also consider the possibility that active sensors may negatively influence product quality "*It will interact with the product actually. It's a possibility…. It's finally…That can also deteriorate them"*

Uncertainty about possible toxicity of micro-sensors in the food were voiced

"And is that toxic for health, that concerns me…With all the things we already eat and nobody tell us that or that. It's still and all uh…I personally think it's alarming".

"So from this point, there is the problem regarding plastic I don't know some people say there is more and more a loss of micro particles which will go into the food, with the hot and the cold, the…the baby's bottle with the problem of biphenyl A."

<u>Environmental concerns</u>

Some environmental concerns were raised, although these were not very salient, and often in response to probing of the moderator to mention risks. Environmental concerns related to the fate of the micro-sensors: Where some participants were worried that involved nanoparticles might become airborne, might become waste materials themselves, or that production of micro-sensors may create additional waste streams "*We can also talk about the production of these Microsystems regarding the wastes that the production of these microsystems generates…".* After use participants wondered whether the micro-sensors would biodegrade or that recycling/reuse might be an option *"Yes right. Are these micro-sys… these micro-sensors they are uh disintegrated, they are they are retrievable, or they are uh……"* although recycling was not considered a feasible option *"Or I don't know uh…If they are so small, I don't think they are recycled"*

Unintentional waste creation was also considered a potential environmental risk. First of all, since the application of micro-sensors may results in more packaging materials being applied to food products, the volume of packaging waste would

increase. Secondly, the application of sensors that can be read by end users or chain actors, may lead to the removal of products that are not yet spoiled, but are getting close to spoilage from the food chain prematurely, or not being selected by consumers *"if all the products are good fine but if there are some that are not as good [according to the active package]… it will stay there. The first people who use this will take what is good."* thus resulting in more food waste.

Potential for fraud

While participants in general appreciate better control and monitoring especially in cold food chains, several participants worried that the application and usage of the systems needs to be monitored to prevent these in providing a false sense of security. Application of time temperature stickers was seen as one opportunity for chain actors to actively commit fraud, by only placing a sticker on the product long after harvest *"Who is in the boat controlling the day they froze it? They might have the fish for three days in the sun!!"*, or by replacing a sticker that had registered a breach in the cold chain with a new one *"that is very easy to manipulate! You take off the sticker and change it!".* Another worry that was voiced regarded the potential of active microsystems to visually enhance products that were past their best "*Could the Microsystems be used on the one hand to check that the food has been well preserved? Could it be also used to embellish a staple that has been badly stored?*". These concerns link closely to the issues of trust and the issue of who should be handling microsystems in the food chain, and what regulations should be set up around their use.

Loss of control and Privacy concerns

Several participants raised concerns that on-going automation of the food chain, as supported by these microsystems may result in loss of control both for the consumer both in making their own voluntary choices and in privacy issues.

Consumer loss of control is considered an issue, with the potential of active packaging in combination with smartphones in guiding the choice of products to a large extent *"Yes for me the risk is as I said before when it's robotized uh…Almost they impose you a choice try…try… trying to guide you whereas you maybe don't want to be guided…not specifically".* This could be by services offering best offers unasked for "*you go past the Corte Inglés and it tells you the special offers... that is frightening*" or when the active label becomes dominant in determining quality "*That's why they are limiting how am I going to say that our …our personal judgment. Uh I don't know… is relegated to a machine*"

The potential to track food products beyond the shop using radio-waves creates some feeling of unease among consumers, as they feel this may allow chain actors to create profiles of their eating behaviour *"I did not feel good! As if they were spying on what you ate!"* or the perception that manufacturers might be able to track food handling in the home *"The manufacturer could find out how long the product is in the fridge and when it disappears. I don't know".* The feeling of increased control on the private atmosphere is seen as somewhat oppressive *"what enormous control!*

They control everything about us.“, even towards an oppressive system “*It’s Big brother…”*

Unequal access and distribution of risks and benefits

A final class of risks that is perceived is derived from potential unequal access to risk and benefits and unfair distribution of the risks and benefits.

Participants consider these systems to benefit large companies and industrialised food chains much more than smaller companies “*but only large chains could do this, it could not be a small company.*”, “*It’s made to be cheap and automatic and so advantageous for the industrial food chain*” thus further increasing the dominance of large food chains in the market “*I see it in modern distribution. I cannot see it in a fruit market where the granny goes and I go and they serve you the fruit without you choosing it.*”. The automation of food control may also lead to job loss “*Is the machine replacing man?”.*

A second concern is related to the money that is required to install these systems. With the introduction of a novel partner in the food chain (the microsystems company) participants consider a good chance in price increase for the end user “*the microchips manufacturers will hit gold and we will end up paying for it. I think it would make the product more expensive.*”. In general participants consider that most, if not all benefits for the increased quality control will go to the producers, and there is little willingness to pay a price premium for this although there is scepticism whether this will indeed play out like that “*The advantage is more for the distributor than for the consumer. At this point I don’t know much. The consumer… [another participant takes over] Anyway he always undergoes the consumer always undergoes anyway*.”

A third concern of this type, relates to unequal benefits to consumer who may have smartphone to read out the labels, versus those who have not “ *They would have to think of blind people and grandparents who would not make purchases with this!”, “It’s necessary to have a smartphone… The application of price comparisons on the smartphones.”.* Although a participant imagined this problem would be mitigated by the fact that smartphone use would be close to 100% in the near future “*it is the future. It would be weird for someone not to have a telephone and with a certain technology*.”.

3.2 Benefit Perception

Countering the risks, participants consider the launch strategy an important moment to mitigate risk perceptions “*we would go along with it and that is all. It depends on how it is launched, I don’t know...*”. Reassurance is received from the positioning as extensions of existing electronic systems “*it’s completely electronic! [2nd participant] I don’t need to worry so much then*”, or by many of the sensors being outside the

food products themselves "*I'm a bit sceptical about the application; it would have to be on the inside! [2nd participant] I don't think it would be inside.* "

Besides mitigation of existing concerns, consumers consider the probability that the benefits may actually outweigh the risk and costs of microsystems, for example by reducing the price of monitoring systems *"Yes that could have a cost…But well after the controls have also always been realized I mean…There was a man who…well I mean if it's replacing the cost uh…If it's cheaper I mean…",* where increased profit for chain actors is considered the more likely price benefit "*Yes, exactly, it's maybe to create some profits for the enterprise at the end".* Participant consider the benefits for chain actors in particular related to the reduction of losses in the production chain "*those who begin to have fewer returned products and less wastage will improve the production process."* or extended shelf life *"Should it maybe increase the shelf life of a product yes or the preservation lifespan of a product?".* Participants think some of the price benefit could be transferred to them *"will it be sold at a lower price?",* but they also consider the possibility that read outs from these systems will be used for continuous price differentiation in the food chain *"And the stuff that is not as good will get a different price."*

Participants also see end user benefits from improved control of the food chain in terms of better safety control. Where the fact that this system allows more or less continuous control is very much appreciated "*Here it's planned every week*, *I don't know*, *a lab will maybe come… once every six month or…several times in the year but not so often than…*" leading to the feeling that after implementation of microsystem monitoring systems food safety is better guaranteed: *"…that there is no danger to your health, with this food. Based on this information that we spoke of. …. love it*". Participants see food microsystems also as a powerful aid for tracing causes of food outbreaks after illnesses have occurred "*the medical company has a control which is deposited in the microchip and so then we check the data of results……".* End user benefits are considered in the possibility to pick up, and report traces of ingredients such as nuts, that are very relevant to allergic consumers (cf. Cornelisse-Vermaat, Voordouw, Yiakoumaki, Theodoridis, & Frewer, 2008; Pfaff, Frewer, & Cornelisse-Vermaat, 2007; Voordouw et al., 2010).

> *"Another thing I considered was allergies. Preparing the birthday of my children with colleagues when you go mad looking at labels and to see there is not a trace of nut or whatever. It could help there too. Families with someone who is allergic go insane looking for information and making sure each product is free from any type of allergy. It is another market where this could be applied. Guarantee to the maximum that there is nothing at all that could affect. There are increasingly more allergies!"*

Tracking product history in the cold chain is considered of particular interest in relation to food safety "*when buying a frozen food it may be that it has been defrosted and been frozen again. [Without such systems] you would not realise.*".

Indeed participants consider the very detailed tracking of the cold chain would be a way forward

> "*Everything about the cold. And handling the foods, maybe at one time, someone handles it and without knowledge and this affects the product. Being able to detect at what moment in the chain there was an effort. Not just thinking of how fresh it is but how much it has been handled. How they transport a calf, if they cover it with something ...".*

Tracking of temperature exposure of products in the home is considered a desirable application of food microsystems, extending the use beyond the point of sales

> *"We could use it at home too. Sometimes you go away a couple of days and you don't know if the electricity has gone off or the fridge has gone off. I could control my home better with this. When did I take the milk out? A long time ago? Inside the home there is chaos too and among all of us! How long has this yoghurt been outside the fridge? Sometimes it stays in the children's bag and the only think you can look at is whether it has expired or not but not much else. For control inside the home.".*

Participants also see opportunity for these systems to bring product with improved quality to the shop "*Really, up to now it is like a seal of quality which you also have to believe in. A further distinction of quality. I still think that it will be more expensive.*", and think this will benefit consumers as well as chain actors "*Not just the quality that we receive as customers, but also them, as supplier customers, what they receive. Paying for something that really has that value. Improve the quality and we all benefit.".* Participants can easily see the relevance in the application of fruit ripening "*Yes, so for example for fruits and vegetables, to follow the maturation, the process"*
Participants, however, consider the use for quality improvement as less interesting compared to food safety applications "*It's less attractive than what we learn about the control and detection of bacteria."*

Another benefit consumers see, is that if sufficiently controlled, these microsystems would make fraud in the food chain more difficult "*I do not know who said it but it does appear to be because of imported product. The cucumber. [2nd participant] having guarantees. That when you buy you have a guarantee that everything has been respected."*…. "*What seems interesting is the fact that it will be more or less impossible to forge for the producer."*

In specific situations, the low cost and high quality read out of food microsystems is considered to provide a potential benefit for small scale producers who cannot afford formal laboratory testing "*promoting individual artisan work. If I have this material I can manufacture my wine and whatever because I am saving on the laboratory investigation because this gives me the confidence that I can make my wine".*

3.3 Trust and Regulation

A number of issues related to the reliability of the system and the trust of people implementing and handling the system were raised in relation to who should be in control of the systems and set conditions for their implementation.

The general consensus is that some kind of human controllers will be needed to interpret the analysis of the system "*It's nice to set up methods, it's also necessary to control them yes, and that still and all requires teams… [other participant] Reliable… [first participant] Technicians, any…",* as only human operators will be able to reflect on what they find "*Afterwards in term of control maybe a scientist would have some reflections uh more elaborated than a machine that is going to answer to a defined algorithm*". Although one participant considered this may lead to fully automatic food monitoring "*What makes me think is the automatism on-going aspect, so there are everything to gain for the industrial. That does not need a monitor".*

Trust in food companies to actually run, interpret and act upon the microsystems seems to be limited *"I would prefer it were a computing company than a food company. Something that had nothing to do with food and was neutral. It should not be a multinational food company like [blanked].".* Some participants consider microsystems as a public health issue, and would prefer the health sector to control the systems "*it would have to have something to do with health… a medical company".* Alternatively government control is considered an option "*it would be state run wouldn't it?",* or in the absence of sufficiently funded state agencies certification bodies "*there are certification companies that certify the processes which are properly done and this is why there are ISO standards and everything. They are neutral. The state? It has no money and I would not be reassured by it. I would feel more confident if it was a certification company."*

Participants consider that microsystems may become part of formal food safety practices but that at this moment it is choice of producers to implement them "*It's not mandatory, it's a technology, it's a choice.* It is considered that complete traceability may be only possible with the application of microsystems, which may make it mandatory to some extent "*it is mandatory too. In theory all fishmongers should be able to say where the fish comes from, what day it was caught... that would be a way of having the minimum information".* The introduction of microsystems may then follow a trajectory from optional control systems to essential systems to act in certain chains and may end up being mandatory in the longer run "*it begins as something that is optional that you use as a plus until it becomes essential and becomes mandatory on a national or European health level."*

3.4 Undecided and Ambivalent

There were several participants that voiced an undecided and ambivalent opinion. These were based on either seeing good and bad attributes to micro sensors and

their applications "*traceability could have some positive and also negative aspects",* for example the weighing of increased product quality against higher price *"It would have to be a good product. If an apple costs you more …".* There is some hesitation because it is considered high tech, with the potential not yet fully gained "*Me I'm confident enough, but it is still high-technology*".

Also the exact implementation of technology may decide whether people see sufficient benefits, for example an active packaging identifying bacteria growth should give a guideline when it is really spoiled, not merely listing bacteria growth *"knowing if it is OK; if this happens and is has been infected and whether it is still edible? Should it be thrown away?".* There is also a difference in the place of application where the package is seen as more favourable than the food itself *"initially I thought that it was inside the food. But then you think, of course, you will not eat it! So then you maybe associate it with the package".*

There is also some ambivalence regarded the use of the technology, while several participants notice that the microsystems technology in itself is not particularly worrying, it may be abused by people who apply it for their own benefit at the cost of others

> "*It will depend on the intention of the person using it and if there is a body regulating everything is correct. We all have doubts. What does someone gain by arranging all this?"*
>
> *"The only thing is that you could use this information for better or worse. If the company uses it for a good reason that would be great.",*
>
> *"Could the Microsystems be used on the one hand to check that the food has been well preserved? Could it be also used to fake the quality of a staple that has been badly stored?"*

3.5 Knowledge and Communication

Participants think it is likely that consumers will have limited knowledge of these packages at first, nevertheless they see potential end-user benefits if consumers can easily read-out information from the smart systems.

The information need for applications that are limited to the food chain and do not aim to communicate with end-users is likely to be limited as that information is considered to add little of relevance to the end user

> "*The aim would be for someone who really wants to apply it properly, for the clientele (because I think it would be difficult for us to get to see the microchip information or for the big hypermarkets. We would get good quality products but I doubt if we would have the details regarding the whole process of an egg of an apple. I think it is difficult."*

This may be to the extent that the end-user may not even realise that microsystems have been applied to the food chain "*Because otherwise you will never know it I mean, because finally if you buy… if actually there is something to tell you that it has been controlled uh…ok".* Nevertheless participants agree that the public should be informed if micro-sensors are entered into the food chain in one way or another *"Ok if the process is done but… [2nd participant] First I think that the consumer has to be informed about the product. … [that] There are some microsystems somewhere".*

Regarding the implementation of packaging aimed at communicating to the end-user, participants think it likely that at least some consumers will ignore that information but that there are likely consumers interested in these packages

> "*those who read labels now. There are still people who buy without looking and those who look at the food composition and the calories.. those people would have the opportunity of knowing much more about the product…"*

> *"of course, the person who wants to know will read it and the one who does not will not... [2nd participant] information is power isn't it? [3rd participant] But they are not forcing you to read it"*

This type of information will supplement existing on package information

> "*Like the [nutrient declaration] table with all the products and if you are interested you read it and if not you do not. There are some who are interested".*

Consumers think that there is potential in combining active packaging with smart phone apps

> "*it sounds like a system for offering information about the product to me, maybe it is for reading with a mobile... an application or one of those daft things*" and "*like the codes that you have with the mobile that you read and they offer you information (QR) and a lot of things. Maybe something like that.*".

Several participants are confident that such smartphone apps will be designed to be easy to use to overcome consumer problems for a broad target group

> "*I do not think that they are doing this for those of us with a university degree education. They are going to make it simple for anyone to understand. [2nd participant] these phone applications are very simple. Take a photo and that is all."*

3.6 Understanding technology and applications

Based on the scenario's participants construe an understanding of the technology as a further iteration in the development of microelectronics and computers, "*Yes*

computers… [2nd participant] computer systems [3rd participant] me too, computers. That is what I think of …" or chip-card technology "*Me, it makes me think to the starting chip, the chip card, it is quite the same start…At the level of…controls*". The application to food, especially of the smallest applications does raise some question though "*But how is it used? Is it injected into the product? Well that's strange*". Also active microsystems are considered somewhat futuristic, and some people envisage for example laser technology as a way to act towards a *product "I think that it should finally go very, very fast because I think that if it goes through a chain or what it should…If it's electronic, it's going very, very fast and maybe it's not even something which brushes, it's maybe only detecting because they talk about chips, so a bit of laser you see…"* Finally the application in packaging or food themselves raises issues how food technologies and their control may be affected by the use of microsystems *"Could Microsystems be used in organic products? Wouldn't we lose the organic product label after?"*. However by thinking of these products as microchips people are able to make sense of the technology itself. They think there should be an important distinction between sensors that are in the package or in the food itself "*the microchip going into the product? Is it in the packaging?"*

Participants consider tracking and control of cold chains as the most relevant application, but they see the impact of that monitoring to be mainly relevant to chain actors, and hardly to consumers. The application is for example compared to the yellow ear labels of livestock: *"It's a little bit like the ear's ring of the cow which says from which farm she comes, instead of we…miniaturized…".* Participants see interesting potential for active microsystems that go beyond merely monitoring food quality but also interact with the food itself in future applications "*thing that there the detection can be followed up in a favourable way, by the modification aspect*", for example by changing gases in the package "*other microsystems which can actively change the quality of foods…For example by adapting the oxygen quantity that filters through the packaging, you know huh…".*

3.7 Future developments

While participants gave several critical appraisals of microsystems in food, they realised and accepted that on-going development would likely result in their implementation in one way or another in the near future "*it is the immediate future",* and that public response has little influence on the eventual implementation of such a system in one way or another "*We won't stop the progress*".

Participants think it likely such products will become part of normal practice *"This [active packages] is something that people would look at in the short run", "What does not make sense now will in the near future. Sending a photo by telephone 10 years ago was unthinkable".*

Participants also consider automation and miniaturisation incremental next steps rather than a revolutionary innovation "*There used to be systems before…Now there are microsystems*", "*You still collect samples.", "it was fine before and it is more of*

that same [quality]. Increasingly better.". There are however some uncertainties about the level of application, should it be at batch level or at the level of the individual product in the batch (which participants feel is unlikely to work), "*how much time it takes to get an apple off the tree and up until wherever it goes, but they can see this without having to insert a chip in each unit, it could be random in some and you could see where it was. So the client controls what happens to the raw material. Or if it is jam then knowing the origin of the ingredient. I do not think it is for all materials.*", and the feasibility to control bulk commodity with the limited range of the current radio-wave sensors "*the power of radio waves, evoking the few centimetres, the few meters. That will be not very powerful…"*

4 Discussion and conclusions

Based on the results, the predictions for consumer response to food microsystems can be specified beyond the existing knowledge from the literature.

The main determinants as identified in previous research (see D3.2.1): Risk, Benefit, and Trust were indeed shown to be important. The current report provides the specific attributes of relevance for food microsystems to deal with these.

In general participants appear to be moderately positive about the application of food microsystems under the condition the application is responsibly applied and monitored.
There are some initial concerns about food microsystems where it is perceived as a novel technology, causing limited control, and harbouring many unknowns (cf. Slovic, 1987). However, when the scenarios became progressively more concrete, many of these initial concerns were mitigated by participant reappraising the technology as incremental extensions of existing microelectronics rather than a revolutionary novel food technology.
Remaining worries mainly focussed on end-user health. In particular negative effects caused by the transfer of (toxic) particles and/or parts of (broken) microelectronics into the food. This worry was especially present for systems that where implemented inside food products, or those micro-systems that were physically in contact with food. This is consistent with contamination research by Paul Rozin and colleagues who show that mere contact with unwanted materials can result in disgust or fear reactions (e.g. Rozin, 2007; Rozin, Fallon, & Augustoni-Ziskind, 1985).
To mitigate these concerns two suggestions were provided. (1) Create safe-fail microsystems should be applied, for example by using non-toxic, biodegradable or edible materials. (2) Application of microsystems should avoid immediate physical contact with the food.
Some worries were voiced about unfair distribution of risks and benefits, where participants thought that industrialised food chains would benefit at the expense of local and traditional food producers. On the consumer end, participants thought younger, more highly educated consumers among the public would benefit more than others, as these are most likely to pick up the novel communicating packages.

In addition some worries about privacy violation and limitations of freedom cause by over-controlling food chains were voiced. Finally, the possibility of environmental damages were noted either caused by spread of the microsystems in the environment, but more likely because of the mere creation of more packaging material, and the possibility that products close to, but not yet, being spoiled would be removed from the food chain more readily (especially in retail) thus resulting in more food wastage.

Against the risks, consumer noticed substantial benefits in the application of food microsystems. The most important benefit was related to food safety control, where cheaper and more ubiquitous and continuous control was considered a great benefit. Consumers were particularly interested in the use of microsystems to control the safety of the cold-chain, and imagined this could be extended to use after purchase. At home this would allow consumers to check warming up of products as a consequence of shop-to-home transport, as well as to the exposure of cold products to high temperatures by daily use (e.g. taking yoghurt out of the fridge an placing it on the table for a while). Use of micro sensors to pick up traces of allergenic substances like nut, was also considered of great interest to end-users. This is especially of relevance in the context, where allergic consumers are limited in their lifestyle by warnings on packages that these products “may contain traces of nut”. The ubiquitous presence of these warnings, has led to consumers construing their meaning as a liability guarantee for the consumers, rather than any meaningful communication about allergenicity risks to the allergic consumer (Cornelisse-Vermaat, et al., 2008; Pfaff, et al., 2007; Voordouw, et al., 2010). In this context, systems that could pick up traces of allergens in the actual (single) product would be a major improvement. Improved quality of the end product, e.g. better ripened fruit, were also seen as potential end-user benefits, although of lower relevance.
End-user benefits by active labelling were considered of interest, to those consumers who take the effort to read out the details of the current label. Combining smart packaging with smart-phone apps allowing consumers to read out the active labels was considered a way to present the data in a consumer friendly and easy-to-use manner for many people.

While the participants were in general fairly positive about the applications of micro-systems, they emphasised that the functioning of these systems would depend to a large extent to the regulatory guarantees behind their application. Uncontrolled application, could lead to fraud (e.g. by replacing sensors that did pick up breaks in the cold chain) and a false sense of safety with the consumer. Food industry was not considered the most trustworthy actor to drive the application of these sensors. Participants showed more trust in medical or ICT companies, certification agencies or the government. Participants voiced the desire to be able to know which food chains were to be controlled through microsystems. This indicates that clear and transparent regulations for the application of food microsystems should be developed in parallel with their technological development.

The limited sample size, and the selection of only a few countries limits the potential for generalisation of these results to the general public in Europe. However, this is never the aim of qualitative methods, where the main aim is to identify the issues that may arise. The reported focus groups were conducted from an a-priori defined protocol, and fully transcribed to follow best practice. This has resulted in comparably conducted focus groups, allowing the data to be pooled. The convergence of opinions across focus groups gives confidence that the research has picked up the main topics and limits the chance that main issues are overlooked within the scope of the provided scenarios.

The main conclusions of this report therefore are that if concerns about food contamination are dealt with, and if adequate communication, regulation and controls about the application and analysis of food microsystem data are provided, there seems to be little cause for major public concern. The focus groups voice the opinion that for food microsystems, as with many other technologies, it is not the technology itself that is good or bad, but the application thereof. Therefore it is to be expected that it is the organisation of the introduction of the application, especially the responsible introduction, the checks and balances put in place, and the communication about the application of food microsystems that will determine success or failure to a large extent.

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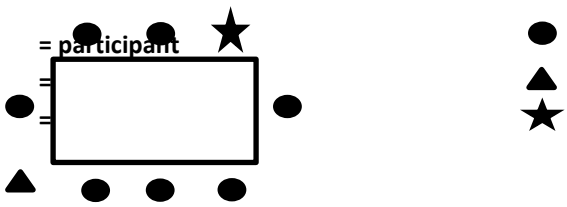
6 Appendix I: Full focus group protocol

CONTEXT and PREPARATION	
Focus Group outline	The main topic of the focus group discussion will be the application of microsystems in food production and consumption. During the focus group we will take the participants through a general description of microsystems, followed by a discussion on microsystems in food. This will be followed by 3 cases of food microsystems, one based within the production chain with no immediate exposure to consumers, one in the production chain extending to consumers, and one that is also aimed at consumers.
Main & sub questions	What are consumer perceptions of the use of Microsystems by the food industry • How do consumers perceive and understand the use of micro and nano- systems in general? • How do consumers perceive and understand the use of micro and nano- systems in food consumer products and production? • How do consumers perceive and understand the use of micro and nano- systems in specific consumer products that differ on implementation in production versus product?
Ins & outs	• Number of participants per focus group: 6-8 • Participant's recruitment: Suggested to use marketing company • Focus groups should consist of the following participants: o 'Normal' people (that is, we do not look specifically for people with special needs.) o 18-65 years old. o (Approximate) Equal gender split. o Maximum of 1 student per focus group o Some spread on background, assessed by: ▪ Age ▪ Location: urban vs. rural ▪ Education ▪ Marital status ▪ Education ▪ Marital status

Checklist Materials	Make sure (either yourself or your agency): • You have invited and confirmed all the participants. • The confirmation letter contains: o Thanks for participation. o The day and time on which the group discussion will take place. o Venue's address and directions o Arrival time (10 minutes before the start of the discussion). o Phone number / email to confirm attendance or wants to cancel. An example of a confirmation letter can be found in appendix 1. • You have 2 audio recorders. • You know how to use the audio recorders. • You have checked that the audio recorders work (battery). • You have sufficient gift vouchers. • You have printed the group discussion stimulus materials. • You have sufficient informed consent forms. • You have a flip chart and markers.
Checklist Staff/Venue	**Make sure:** • **A moderator has prepared him/herself and is committed to be present.** • **A note taker is committed to be present.** • **You have access to a private and quiet room.** • **The participants can be seated around a table or in a circle. Participants should be able to look at each other.** • **The moderator should not be the central person in the seating.** • **The note taker is seated at the least dominant position the circle.** **Example of seating arrangements:**  • **You have ordered refreshments like:** o **Tea, Coffee & Water** o **Fruit and or Cookies**

ON THE DAY OF THE FOCUS GROUP	
Before starting the group discussion	Make sure: • You have set up the room (at least) 30 minutes before the start of the discussion. • There are enough chairs. • There are 2 audio recorders in the room. • There is a flip chart in the room. • There are (working flip chart) markers in the room. • The refreshments are in the room. • You have the informed consent forms. • You have all group discussion stimulus material. • You have a watch/clock. • You have the gift vouchers.

Moderator guide:
The main thing is to get the people talking and keep them talking. The task of the moderator is to nudge them on track.

Avoid at all cost that the focus group becomes a "serial interview" where you ask the questions at the participants directly.
Also avoid that the provided prompts become the structure of the interview. Let the participants talk and use the prompts as nudges if they wander of track.

Text between [square brackets] indicate an action by the moderator

Your most important prompts are probably non-verbal for example:

- Do not cross your arms, but adopt a more open body language
- Lean inwards to show involvement
- Nod to show you are listening
- Humm (mmm) sounds to show you are listening

These are followed by general elicitation prompts either to investigate a topic in more DEPTH, or to create a DYNAMIC by switching to other participants.

- DEPTH PROBE: Why (not)?
- DEPTH PROBE: Why does it appeal to you?
- DEPTH PROBE: Can you be more specific?
- DEPTH PROBE: Can you tell me more about that?
- DEPTH PROBE: Why do you think that?
- DEPTH PROBE: Do you have an example of that?
- DEPTH PROBE: Anything else?
- DEPTH PROBE: Tell me more…
- DEPTH PROBE: Anything you can add?

- DYNAMIC PROBE: Has anyone else experienced that?
- DYNAMIC PROBE: Does anyone else have a different experience/perspective?
- DYNAMIC PROBE: Do you feel that way too?
- DYNAMIC PROBE: Does anyone feel different about this?
- DYNAMIC PROBE: Is that the same for all of you?
- DYNAMIC PROBE: Does anyone else have something to say about this?

In addition, topic prompts can be used that are specific to the topic. These should only be used if the discussion is not going to discuss these spontaneously.

Text outside the brackets can be used as statements and topic prompts

Welcome (5 min)	***[WELCOME PEOPLE WHEN THEY ARE COMING IN AND OFFER THEM A REFRESHMENT]*** For starters I would like to welcome you all en thank you for your presence. My name is…… and I will be the facilitator for today's group discussion. I am a researcher at the ……, which is a …… My colleague's name is…. and (s)he will take notes of the discussion. We have invited you to take part in today's discussion, because we would like to know your opinion on the application of Microsystems for food production

	[Make sure to mention these five ground rules] The discussion will have some ground rules: • I will offer you several discussion topics; I would like everyone to take part in the discussion. I would appreciate that only one person speaks at a time. I would also ask you to turn off your mobile phone. • Feel free to treat this as a discussion and respond to what others are saying, whether you agree or disagree. I am interested in your opinions and whatever you have to say is fine with me. There are no right or wrong answers. I am just asking for your opinions based on your own personal experience. I am here to learn from you. • Don't worry about having a different opinion than someone else. But please do respect each other's answers or opinions. • If there is a particular question you don't want to answer, you don't have to. • We ask that each of you respects the privacy of everyone in the room and does not share or repeat what is said here in any way that could identify anyone in this room. 1. Does everyone agree on this ground rules? ***[EVERYONE WHO DOESN'T AGREE IS ALLOWED TO LEAVE.]*** Today's discussion will be audio recorded, because we don't want to miss any of your comments. All of your answers will be anonymous. We will not include your names or any other information, that could identify you in anyway outside the research team, in any reports coming from this research. 2. Is everyone OK with this session being recorded? ***[EVERYONE WHO DOESN'T WANT TO BE RECORDED IS ALLOWED TO LEAVE.]*** In that case I would like you to sign this written consent form. ***[GET WRITTEN CONSENT TO AUDIO RECORD THE DISCUSSION. USE THE CONSENT FORMS TO DO THIS.]*** The discussion is going to take about 1.5 hours. About halfway through we will have a short break of 10 minutes. We ask you to stay for the entire meeting. Because we have a limited amount of time, I might have to interrupt from time-to-time to keep things moving. At the end of the discussion you will receive a gift voucher **of 25 euro to** thank you for your participation. We will discuss this at the end of the session. 3. Does anyone have any questions before we start?

Introduction (5 min)	***[START 2 AUDIO RECORDERS AND PLACE THEM ON DIFFERENT SPOTS]*** For starters I would like to go around the table/circle, starting on my right, and have each person introduce him or herself. 1. Please tell us your first name (only) and your favourite food. [Moderator draw seating plan with first names to use during subsequent discussion – question is intended to get them to speak and break the ice – not part of the actual focus group content]
Warm-up (5 min)	Ok , now I would like to talk to you about microsystems. Please take about 5 minutes to think of some thoughts you may have when thinking about microsystems. **[WRITE KEYWORDS OF THE ANSWERS ON A FLIPCHART]** Ok, ….
Group discussion Micro systems in general (5-10 min)	***[HAND OUT CARD 1: DESCRIPTION OF MICRO and NANOSYSTEMS GENERAL]*** Study the description carefully, so we can discuss it. [wait until everyone shows non-verbal cues they are done. If needed confirm by asking whether everyone is done] Can we now discuss what these systems mean to you as a whole. [Allow open discussion to evolve, however as the topic is rather abstract you may have to prompt by asking the following] • TOPIC PROMPT: In general are you positive or negative about these systems? • TOPIC PROMPT: Do you see any risks to society associated with these systems? • TOPIC PROMPT: Do you see any benefits to society associated with these systems? • TOPIC PROMPT: Who would you trust to produce and manage the implementations of such systems in society? [If all these topics have been discussed, either spontaneously or after prompting, close the topic with] • Does anyone have some final remarks?

Group discussion Micro systems in food products (10-15 min)	***[HAND OUT CARD 2: DESCRIPTION OF MICRO and NANOSYSTEMS IN FOOD APPLICATIONS]***
	
	Study the description carefully, so we can discuss it.
	
	[wait until everyone shows non-verbal cues they are done. If needed confirm by asking whether everyone is done]
	
	Can we now discuss what these systems mean to you as a consumer.
	
	[**Allow open discussion to evolve!]**
	
	[Make sure by careful use of general and topic prompts that the following topics are discussed:
	• **General opinion**
	• **Risk perception**
	• **Benefit perception**
	• **Trust**
	
	• The difference between microsystems in the product, and microsystems used during the production process (but not physically part of the product)
	
	• Prompt participants to name specific risks (think about those associated with ICT in relation to food products such as privacy, consumer health etc. – but do not steer overly actively)]
	
	[Possible TOPIC PROMPTS (note these are not questions that need to be asked, but topics that need to be raised at some stage)]
	
	• **In general are you positive or negative** about microsystems for food applications?
	  • Can you tell me something about microsystems that are part of the final product?
	  • Can you tell me something about microsystems that are essential during the production of the product?
	
	• **Do you see any risks** specific to food products that contain microsystems?
	  • Can you tell me something about microsystems that are part of the final product?
	  • Can you tell me something about microsystems that are essential during the production of the product?
	  • Can you name any specific risks that may be caused by microsystems in food products?
	  • Can you name any specific risks that may be caused by microsystems in food production?
	
	• **Do you see any benefits specific** to food products that contain microsystems?
	  • Can you tell me something about microsystems that are part of

	the final product? • Can you tell me something about microsystems that are essential during the production of the product? • Can you name any specific benefits that may be caused by microsystems in food products? • Can you name any specific benefits that may be caused by microsystems in food production? • Who **would you trust** to produce and manage the implementations of such systems for food products? • Can you tell me something about microsystems that are part of the final product? • Can you tell me something about microsystems that are essential during the production of the product? [If all these topics have been discussed, either spontaneously or after prompting, close the topic with] • Does anyone have some final remarks? ***Ok, at this stage I suggest to take a break of about 10 minutes.***
Break (10 min)	Participants take refreshments, use bathroom etc. Allow people to return to their own seats. However, if you find yourself in the situation were people annoyingly whisper to/interact with their immediate neighbour you can intervene and state that the protocol asks you to alternate seating plan after the break
Group discussion Biosensors Food Microsystems (10 min)	Welcome back everyone. Before the break we discussed general applications of food microsystems. At this moment I would like to discuss three specific applications of microsystems in food. **[Hand out card 3: Micro-sensors in food production]** Please read the text, and think about this application. [wait until everyone shows non-verbal cues they are done. If needed confirm by asking whether everyone is done] Can we now discuss what these systems mean to you as a consumer? [**Allow open discussion to evolve!]** [Make sure by careful prompting – see below - that the following topics are discussed: • General opinion • Risk perception • Benefit perception

	• Trust
	
	• The difference between microsystems in the product, and microsystems used during the production process (but not physically part of the product)
	
	• Prompt participants to name specific risks (think about those associated with ICT in relation to food products such as privacy, consumer health etc. – but do not steer overly actively)
	
	[Possible TOPIC PROMPTS (note these are not questions that need to be asked, but topics that need to be raised at some stage)]
	
	• **In general are you positive or negative** about this type of microsystems in food production
	• **Do you see any risks** specific to food production with these microsystems?
	  • Can you imagine any risks for the consumer
	  • Can you imagine any risks for society as a whole
	  • Can you imagine any risks for the environment
	• **Do you see any benefits** specific to food production with these microsystems?
	• Who **would you trust** to produce and manage the implementations of such microsystems?
	
	[If all these topics have been discussed, either spontaneously or after prompting, close the topic with]
	
	• Does anyone have some final remarks?

Group discussion Active tracking systems in products and production (10 min)	**[Hand out card 4: Active tracking in food products and production]** Please read the text, and think about this application. [wait until everyone shows non-verbal cues they are done. If needed confirm by asking whether everyone is done] Can we now discuss what these systems mean to you as a consumer? [**Allow open discussion to evolve!]** [Make sure by careful prompting – see below - that the following topics are discussed: • General opinion • Risk perception • Benefit perception • Trust • The difference between microsystems in the product, and microsystems used during the production process (but not physically part of the product) • Prompt participants to name specific risks (think about those

	associated with ICT in relation to food products such as privacy, consumer health etc. – but do not steer overly actively)
	
	• **In general are you positive or negative** about this type of microsystems in this food production application
	• **Do you see any risks** specific to food production with these microsystems?
	  • Can you imagine any risks for the consumer
	  • Can you imagine any risks for society as a whole
	  • Can you imagine any risks for the environment
	• **Do you see any benefits** specific to food production with these microsystems?
	• Who **would you trust** to produce and manage the implementations of such microsystems?
	
	[If all these topics have been discussed, either spontaneously or after prompting, close the topic with]
	
	• Does anyone have some final remarks?

Group discussion Interactive packaging of food products (10 min)	**[Hand out card 5: Interactive packaging in food products and production]**
	
	Please read the text, and think about this application.
	[wait until everyone shows non-verbal cues they are done. If needed confirm by asking whether everyone is done]
	
	Can we now discuss what these systems mean to you as a consumer?
	
	[**Allow open discussion to evolve!]**
	
	[Make sure by careful prompting – see below - that the following topics are discussed:
	  • General opinion
	  • Risk perception
	  • Benefit perception
	  • Trust
	
	  • The difference between microsystems in the product, and microsystems used during the production process (but not physically part of the product)
	
	  • Prompt participants to name specific risks (think about those associated with ICT in relation to food products such as privacy, consumer health etc. – but do not steer overly actively)
	
	• **In general are you positive or negative** to this type of microsystem in this food application??
	• **Do you see any risks** specific to food production with these microsystems?
	  • Can you imagine any risks for the consumer
	  • Can you imagine any risks for society as a whole
	  • Can you imagine any risks for the environment

	• **Do you see any benefits** specific to food production with these microsystems? • Who **would you trust** to produce and manage the implementations of such microsystems? [If all these topics have been discussed, either spontaneously or after prompting, close the topic with] • Does anyone have some final remarks?
Wind-down (5 min)	During the discussion all of you have thought about microsystems in food. If you would have a free hand as a designer of food products, what microsystems would you develop for food.
Final thoughts / Debriefing	We are at the end of today's discussion. This discussion is part of an EU funded, project which is called Food Microsystems. The purpose of the project is designing a best practice for exploring the potential of microsystems in food products. Your opinions will bring is us closer to achieving this goal. Does anyone have any final thoughts about the discussion or the microsystems that I've showed you?
Wrap-up	Thank you for joining us today and for sharing your opinions with me. I hope you enjoyed today's discussion. Have a safe trip home. ***[HAND OUT GIFT VOUCHERS AND TRAVEL EXPENCES FORMS]*** *=>* ***People have to sign receipt.***
AFTER THE FOCUS GROUP	
Data transcription	**Labelling Focus Group Transcripts** The focus group transcript shall include the following information at the top of the document: • Focus Group Location: • Name of moderator: • Name of note taker: • Name of transcriber: • Date: • Time: • Number of Attendees: • Name of audio recording: Participants are assigned a number in the audio recording from P1…. Pn (where n is the number of participants)

	Documenting comments and responses Comments or questions by the moderator should start by typing **M:** at the left margin and after that the question or comment. If the note taker makes a comment, use an **N** Any comments or responses from participants should start with the number **Px:** at the left margin and after that the response or comment. A response or comment from a different participant should be written on a new line. Every question/comment/response should be separated by a blank line. If the specific participant is not recognisable from the audio-file a single **P** can be used (sparingly) *Example:* **M:** Is everyone done reading? **P1:** Yes, I have read it and understand it. **P4:** I am also done. **M:** Do you have any questions before we proceed? **N:** Can I please check we have everyone? **Editorial remarks** Editorial remarks like break, end of discussion, sound of a chair falling over should be placed between square brackets. For example [Chair falls] **End of focus group discussion** When the group discussion is done, please type [END OF DISCUSSON]. *Example*: **M:** Do you have any final questions or thoughts? **P7:** Nope, I think I have said all. **M:** Well, thank you for your presence here today. [END OF DISCUSSION] **What and how to write** Recordings have to be transcribed verbatim (i.e., recorded word for word, exactly as said) and include filler words like: *hmm*, *huh*, *mmm*, *mhm*, *uh huh*, *um*, *yeah*, *yuhuh*, *nah*, *ugh*, *ah*… etc.

	Background sounds like: coughs, claps, laughter, finger snaps, pen clicking, police siren …. etc. may be excluded. If moderator or participants mispronounce words, these words have to be transcribed as the individual said them. The transcript shall not be "cleaned up" by removing foul language, slang, grammatical errors, or misuse of words or concepts at this stage. If an incorrect or unexpected pronunciation results in difficulties with comprehension of the text, the correct word may be typed between square brackets, to show it is an editorial remark *Example*: **P3:** I thought I was pretty pacific [specific]. *Inaudible information* Parts that are inaudible or difficult to decipher have to be identified. If a relatively small part of the recording (a word or short sentence) is partially inaudible or indecipherable, the transcriber has to type [inaudible segment]. *Example*: **P2:** I don't think [inaudible segment] is red. If a long segment of the recording is inaudible or difficult to decipher, the transcriber has to record this information as [inaudible] and provide a time estimate for information that could not be transcribed. *Example*: [Inaudible: 2 minutes missing] Long parts were no one is speaking has to be recorded as [dead air]. The transcriber should indicate how long the silence took place. *Example*: [Dead air: 3 minutes missing] *Overlapping Speech* If participants are speaking at the same time and it is not possible to distinguish what each person is saying, the transcriber has to place the phrase [cross talk] immediately after the last identifiable speaker's text and pick up with the next audible speaker. *Example*:

	P1: The frequency of the messages [cross talk] <u>*Pauses*</u> If a participant pauses briefly between statements , the transcriber has to use three dots. A brief pause is defined as a 1to 2 seconds break in speech. *Example*: **P7:** I think this is a good product … because … the tracking system is anonymous. If a substantial speech delay occurs at either beginning or the continuing of a statement (more than two seconds), the transcriber has to use the phrase [long pause]. *Example*: **P4:** I don't know what to say (long pause) maybe this application is better because it is much more detailed. <u>*Questionable Text*</u> If the transcriber is unsure of the accuracy of a statement made by a speaker, this statement shall be placed inside parentheses and a question mark is placed in front of the open parenthesis and behind the close parenthesis. *Example*: **P6:** Last night I saw a commercial of ?[FoodControlXYZ]?, which said that it is the best system in the world.
Checking accuracy	The transcriber has to check all transcripts against the recordings and revise them if necessary. After this all transcripts have to be translated into English. The original transcript and the transcript translated from English into the original language of the focus group have to be compared. In case there are essential differences in meaning the English transcript has to be revised. The audio recording, the original transcript and the English version are sent to Wageningen for storage and further analysis.

Protocol – Background materials (I)

Confirmation letter

([Name)
(Address)
(City, State, Zip)

(Date)

Dear **(Name),**

By means of this letter we would like to thank you for your participation in our group discussion on how the utilisation of microsystems by the food industry.
The discussion will take place on **(date)** and start at **(time pm/am)**. Please arrive around **(10 minutes earlier than the official start time)** as we will begin the group discussion at **(official start time)** sharp. The discussion will take place at the **(Venue's address)**. Enclosed are directions by car and public transportation.

We would appreciate if you could confirm if you are able to attend before **(date of confirmation)**. We can be reached at **(phone number)** or e-mailed at **(e-mail address)**. Feel free to contact us if you have any questions.

We look forward to seeing you.

Kind regards,

Protocol – Background materials (II)

General probes

- DEPTH PROBE: Why (not)?
- DEPTH PROBE: Why does it appeal to you?
- DEPTH PROBE: Can you be more specific?
- DEPTH PROBE: Can you tell me more about that?
- DEPTH PROBE: Why do you think that?
- DEPTH PROBE: Do you have an example of that?
- DEPTH PROBE: Anything else?
- DEPTH PROBE: Tell me more…
- DEPTH PROBE: Anything you can add?

- DYNAMIC PROBE: Has anyone else experienced that?
- DYNAMIC PROBE: Does anyone else have a different experience/perspective?
- DYNAMIC PROBE: Do you feel that way too?
- DYNAMIC PROBE: Does anyone feel different about this?
- DYNAMIC PROBE: Is that the same for all of you?
- DYNAMIC PROBE: Does anyone else have something to say about this?

- LISTENING PROBE: Mmm…
- LISTENING PROBE: Ok….

- NONVERBAL PROBE: Nodding

Protocol – Background materials (III) : Descriptions of technology

These texts to be translated into the local language. Printed 12 times each, in fairly large font on heavy paper (A5 format) and handed out when asked for.

Card 1: Microsystems:
Microsystems are very small instruments that can be used to keep track of and keep under control products and production processes. Microsystems are miniaturised to make sure they can be applied where size is a critical issue. Furthermore microsystems are created to be cheap and automatic, which means that once in place they need minimum attention. These microsystems can be created using microelectronics and sensors. They are in the millimetre scale but can contain features as small as the nano-scale, about 600 times smaller than the thickness of a human hair. This is why they are referred as micro and nano-systems.

Card 2: Microsystems in food:
The food production chain depends heavily on process and product control, as many foods are perishable, or have non-physical attributes such as a specific region of origin. Microsystems in foods can be used to detect contaminants such a chemical pollution, or bacterial spoilage during processing and in the final products. They can be used to track the history of products for example by keeping track of the exposure to warm temperatures throughout the history of the product. Microsystems can also be used to track and chase the position of the products in the production chain. Other microsystems can actively change food quality, for example by letting in less oxygen to a packaged product depending on the product age.

Card 3: Micro-sensors in food production
Micro-sensors can track and trace chemical and biological contamination during the food production process. They tend to be small instruments that can give information which previously required lab testing and are sometimes called lab on a chip. By applying a small amount of food to these instruments the quality and contamination can be quickly established at any point in the production chain. If the process conditions are adequate, these systems can work continuously and automatically.

Card 4: Active tracking systems in products and production
A small microchip can be attached to a product. These microchips are designed to emit a radio-signal that can be recorded from some distance (centimetres to meters). This way, ingredients, products and their conditions can easily be tracked throughout primary harvest, through early production all the way to the supermarket and other food outlets. In the future this may allow for a very transparent and complete surveillance system of the products.

Card 5: Interactive packaging of food products
In the future, novel materials can be applied to food packages that actively measure and regulate the quality of the food product. For example, labels that are capable of indicating how ripe a packaged fruit is. In combination with smartphone apps that can interpret a picture of the label, this can give the consumer a lot of background information on the history and specific origin of a product.

Example of a card to hand out

Card 1: Microsystems:

Microsystems are very small systems that can be used to keep track of and regulate products and production processes.

Microsystems are miniaturised to make sure they can easily be fit in.

Furthermore microsystems are created to be cheap and fully automatic, which means that once in place they need no further attention.

These microsystems can be created using microelectronics and sensors that are as small as the nano-scale, about 600 times smaller than the thickness of a human hair.