

A search for a systematic method to bridge between pre-harvest, post-harvest, and consumer research aimed at increasing fruit consumption: The “Vasco da Gama” process

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SUMMARY

The goal of ISAFRUIT to increase fruit consumption has strong foundations in the new knowledge created by a multidisciplinary team of natural and social scientists addressing critical aspects of the multi-faceted fruit chain. Bridging the gap between disciplines proved to be a substantial challenge, as they have quite different languages, methods, and networks. In March 2008, ISAFRUIT launched an initiative to address this gap and named it the “Vasco da Gama process”, after the Portuguese explorer who, early in the 16th century, embarked in the first ships to sail directly from Europe to India and to bridge the gap between continents and cultures. ISAFRUIT’s process for bridging between research disciplines was to discover if the research conducted indeed contributed to increased fruit consumption in Europe. For this purpose, the Quality Function Deployment (QFD) method was applied. This includes the construction of a House of Quality (HoQ), which is a conceptual and graphical tool that presents the positive and negative relationships between technical quality traits, as studied and influenced by pre- and post-harvest experiments, and consumer-demand terms. This paper explains the methodology in greater detail. The first experience with this process showed that, even if scientists from different disciplines were keen to be involved, there was a need for a sustained effort to drive such a process. The process is still underway, and specific results will be published later.

ISAFRUIT is a project of the 6th European Research Framework Programme, aimed at increasing fruit consumption (European Commission, 2006). The Project document identified several bottlenecks which could prevent increased fruit consumption: fruit quality, fruit safety, convenience, availability, cost, and consumer awareness. ISAFRUIT addressed these six bottlenecks throughout six Research Pillars, arranged along the fruit production and supply chain, with research projects to address consumer affairs, nutrition, fruit processing, post- and pre-harvest technology, fruit breeding and variety testing, and knowledge transfer.

The primary goal of ISAFRUIT was to increase fruit consumption in Europe. It had strong foundations in new knowledge created by a multidisciplinary team of natural and social scientists addressing many aspects of the multi-faceted fruit supply chain. In order for such a project to be ‘interdisciplinary’, or even ‘transdisciplinary’, and not just multidisciplinary, natural and social scientists had to come together and develop a common language in order to discuss their findings and

to find the solutions needed to achieve the goals of the Project. Soon after the ISAFRUIT Project started, in 2006, it became evident that the interaction between science-driven technology research and consumer research to ensure the necessary interdisciplinarity in ISAFRUIT was a substantial challenge. During the 2nd General Assembly of ISAFRUIT at Bologna (June 2007), when consumer research was the central topic, it became clear that natural science- and technology-driven research and consumer research did not overlap. This proved to be a significant challenge for the Project, to be able to bridge the gap between natural and consumer scientists, and to deliver its overall objective. A key element of this challenge was that, on one hand, it seemed difficult in the view of consumer scientists to understand and validate the contributions of research aimed at addressing pre- and post-harvest technology to increase fruit consumption. On the other hand, natural scientists addressing pre- and post harvest technology had few opportunities to interact with consumer scientists and had difficulties in understanding and applying the messages from consumer science-related findings. Furthermore, it was essential for ISAFRUIT to

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demonstrate, in a systematic manner, how pre- and post-harvest-related research did address consumer demands to increase fruit consumption.

The “Vasco da Gama” process was an ISAFRUIT initiative that was launched in March 2008 by representatives of all the ISAFRUIT Pillars tasked with improving the consumer-driven supply chain, pre- and post-harvest quality management, and ISAFRUIT knowledge transfer. The aim of the process was to bridge the gap between the social and natural sciences, and the knowledge transfer specialists in ISAFRUIT, to encourage mutual learning among the disciplines involved in order to achieve the overall objective of ISAFRUIT: to increase fruit consumption in Europe.

The first steps in the process involved presentations of research in the natural and social science disciplines, to provide a better understanding of the different languages used. The intention, from the start of the process, was to link the results of technological research, mainly described quantitatively, to terms that may be aligned with consumer trends (i.e., terms associated with consumer behaviour) such as healthiness, sustainability, convenience, etc. This meeting took place in the Conference Center at Amsterdam airport, which was named “Vasco da Gama”. Dom. Vasco da Gama was a Portuguese explorer who lived from 1460 (or 1469) to 1524 and was one of the most successful explorers in the European Age of Discovery. He commanded the first ships to sail directly from Europe to India. So it could be said that he formed a ‘bridge’ between continents and cultures. During the Amsterdam ISAFRUIT meeting, the participants were also challenged with a cultural bridging problem, (i.e., bridging the gap between the social sciences and the natural or technical sciences). Consequently, the process was labelled the “Vasco da Gama process”!

This paper is a report on the “Vasco da Gama” process, which was designed to address, systematically, the challenges of such a large-scale, multidisciplinary project as ISAFRUIT. We describe the methodology developed and the first experiences of applying this methodology. A thorough validation of the “Vasco da Gama” method will be made, and its realisation achieved by the end of the ISAFRUIT Project in 2010.

RESEARCH METHOD

Point of departure

To test if the research conducted under the ISAFRUIT Project indeed contributed to increased fruit consumption in Europe, a methodology was required to crosslink the pre- and post-harvest research (organised *via* the “fruit quality traits” that it addressed, such as fruit sugar content, firmness, sensory aspects, and other traits) to “consumer terms” that are scientifically proven to be associated with increasing fruit consumption. In particular, the intention was to establish a Table to map the relationship between consumer demands and those technical quality traits studied during the pre- and post-harvest experiments. The Table should allow any significant quality effects, obtained from the pre- and post-harvest experiments, to be related to social science-based consumer demands in either a positive or negative way. The ultimate goal was to validate the contributions

that the pre- and post-harvest ISAFRUIT experiments will make to addressing consumer demands and to increasing fruit consumption. In this way, ISAFRUIT could put its consumer-related pre- and post-harvest research in a much stronger, science-based, context.

As an example, ISAFRUIT studied the possibility of achieving crop load regulation (i.e., thinning) by shading trees, in order to develop a method that did not require the use of agrochemicals for flower and/or fruit thinning, and for smarter use of the resources that are available in an orchard (Widmer *et al.*, 2008; Zibordi *et al.*, 2008). The experiments showed that tree shading may result in adequate thinning, and that a reduced crop load may lead to a higher soluble solids content (i.e., sweetness) that corresponds to improved market standards. However, without any science-based argument to prove that the quality standards associated with fruit produced using fewer or no agrochemicals did indeed relate to increased fruit demand and consumption, the contribution and scientific value of this innovative pre-harvest technology to increasing fruit consumption would remain unproven.

Exemplary technical issues addressed

To provide a more accurate overview of the range of technical issues to be addressed by the “Vasco da Gama” process, some exemplary ISAFRUIT studies and technological developments in the pre- and post-harvest area are listed below. All need to be validated by the same process as indicated for the tree-shading experiment.

Pre- and post-harvest research in the ISAFRUIT Project aimed to develop sustainable technologies for apple and peach/nectarine production and their supply chains (e.g., by reducing or avoiding the use of pesticides). Most of these studies are still on-going. However, in the third year of the Project, substantial results were already available, making it possible to appreciate the impact of an innovative technology and its relation to consumer demand-related terms. Such technologies were, for example, an innovative spray technology developed to reduce pesticide use substantially, could be evaluated. Other alternatives to pesticides to prevent fruit losses due to rots, especially during storage, are also being developed. These include hot water treatments, antagonistic GRAS (generally recognised as safe) micro-organisms, or combinations thereof. Other studies address the need for a more efficient production and supply chain, to increase the potential for reduced prices (e.g., developing management tools for sustainable fruit farms), or improving fruit quality traits through: (i) innovative crop load regulation, aimed at preventing alternate fruit bearing, and an optimised, site-specific crop load; (ii) a prototype of a Decision Support System (DSS) for apple and peach quality chain management; (iii) a model for a rapid, portable, non-destructive multi-sensor device for fruit quality measurement in peach; and (iv) a new portable DA (Difference in Absorbance) meter, based on Near Infrared (NIR) technology in apple and in peach, which should be useful in identifying the desired stage of fruit ripening and predicting the optimum harvest time.

Further examples of ISAFRUIT pre- and post-harvest innovation could be given. All seek to avoid one or more

of the bottlenecks identified in ISAFRUIT that prevent increased fruit consumption. The “Vasco da Gama” process should allow us to validate these technological developments in a systematic way in terms of their contribution to fulfilling the overall objective of ISAFRUIT.

Step 1: An inventory of pre- and post-harvest ISAFRUIT research

An inventory of pre- and post-harvest experiments, including a list of the quality traits addressed by each experiment, was established. This was carried out to provide a primary overview of the technologies to be validated by the “Vasco da Gama” process.

Step 2: An inventory of consumer demands

An initial inventory of consumer demands was made on the basis of: (i) interviews with experts from outside, as well as from within the fruit industry; (ii) 16 focus group discussions took place on the motives for, and barriers to the consumption of existing fresh, prepared, and processed fruit products; and (iii) 16 focus group discussions also took place on consumer innovativeness¹ and their adoption of novel fruit products. Interviews and focus groups were carried out in Greece, Poland, Spain, and The Netherlands. These countries were selected on the basis of being representative of the variety of fruit consumption behaviours (and production methods) across all EU countries. The initial inventory of consumer demands will be updated on the basis of the results from two quantitative surveys in the four countries mentioned. One survey will be on consumer preferences and perceptions in relation to existing fruit products. The second will focus on consumer innovativeness and the adoption of novel fruit products. In addition, the inventory will be complemented by the findings from a selection of experiment on factors that influence consumer adoption of novel fruit products.

Step 3: Constructing a House of Quality

To find out whether the research conducted within ISAFRUIT did indeed contribute to increasing fruit consumption in Europe, the method of Quality Function Deployment (QFD) (Benner *et al.*, 2003; Hauser and Clausing, 1988) was used. This links pre- and post-harvest research, *via* “fruit quality traits”, with “consumer terms” related to increasing fruit consumption. One important step in QFD involves the construction of a House of Quality (HoQ). This is a two-dimensional Table that presents the positive and negative relationships between those technical quality traits studied and influenced by the pre- and post-harvest experiments, and by consumer demands.

The HoQ (Figure 1) is a graphic tool used to define the relationships between customer demands and the characteristics of a product; fruit in the case of ISAFRUIT. The graphic resembles a house in which the main room connects the inputs from the natural and social sciences, where the ceiling is formed by the characteristics of the product (defining the columns in the

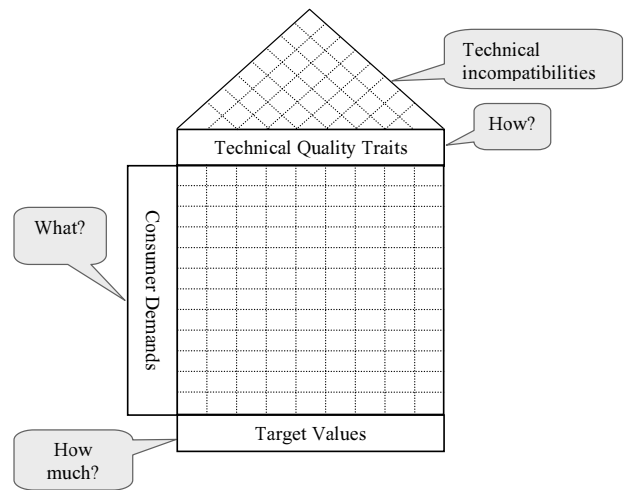


FIG. 1
The principal “House of Quality” used by ISAFRUIT for the “Vasco da Gama” process

matrix), while the walls are defined by consumer demands (corresponding to the rows in the matrix). The cells in this part of the HoQ will be filled in based on discussions between natural and social scientists, to identify which product characteristics influence the satisfaction of which consumer wishes, in a positive or negative way. The ceiling of the ISAFRUIT HoQ has been constructed using an inventory of pre- and post-harvest experiments (including a list of the quality traits addressed by each experiment), and the walls by an initial inventory of consumer demands. Both these sets of data have been used to construct the skeleton of the HoQ. The roof of the HoQ consists of a triangular matrix, whose cells reveal (in)compatibilities between product characteristics. The links between the characteristics of the product and the pre- and post-harvest experiments will be defined in another ‘house’. In the basement of the HoQ, an assessment is made of the importance of each of the product characteristics to meet consumer demands, and target values are specified (Figure 1).

As the results from cross-cultural and cross-situational consumer segmentation studies become available, additional, segment-specific HoQs will be established, in which more quantitative assessments are given for the relative importance of various consumer demands and for consumer perceptions of fruit (products) relative to competing products.

Knowledge transfer

Pre- and post-harvest scientists within ISAFRUIT generally have a good insight and knowledge of the fruit production and supply chain, and know which quality parameters are considered to be important by retailers and other partners in the chain. However, current expert views on how a fruit trait (e.g., firmness as influenced by crop load) contributes to increased fruit consumption are often based on implicit and interpretative conclusions about the relationships between the trait, consumer preferences, and explicit fruit consumption,

¹The “innovativeness” of consumers is defined as their tendency to buy new products in a particular product category soon after they appear in the market and relatively earlier than most other consumers in the market segment. See Foxall *et al.* (1998).

rather than on explicit and stringent studies that directly relate scientific findings on consumer behaviour with those issues addressed in the pre- and post-harvest technology studies. The “Vasco da Gama” process aims to address this lack of knowledge and to provide evidence that ISAFRUIT is working in line with the main project objective, to increase fruit consumption in Europe. In order for the “Vasco da Gama” process to achieve its aims, the HoQ must be used as a tool with which to communicate the outcomes of ISAFRUIT research to the key stakeholders. It is imperative that the findings of this publicly-funded research are transferred to consumers, to all members of the supply chain, and to policymakers, so that they can be translated into effective new policies and new behaviours that will lead to increased fruit consumption.

Bracken and Oughton (2006) state that interdisciplinary researchers need to imagine themselves explaining their knowledge outside their usual working context, in order to communicate their meaning effectively, and that ‘active listening’ should accompany the formation of a common language between disciplines, which could lead to a common understanding of a shared vocabulary. In the process of creating this common language and this shared understanding, added value evolves; the research becomes more understandable by policymakers and non-scientific stakeholders, such as consumers.

Within ISAFRUIT the “Vasco da Gama” process was designed to reflect how the outputs of the social and natural (or technical) scientists have worked together to meet the needs and wishes of the consumer. The HoQ will be used as a tool to produce “key messages” from the combined information and, once these are known, the knowledge transfer team in ISAFRUIT can devise ways to disseminate these messages. In the first instance, key messages will be disseminated to the funders of the project in the European Commission. This will enable DG Research to validate the work that has been carried out within the ISAFRUIT Project and to assess if ISAFRUIT has met its objectives. This will also form the basis for sound policymaking to encourage increased consumption of fruit, by providing useful information to underpin strategies designed to bring about changes in both the fruit supply chain and in consumer behaviour.

The process of creating the HoQ has already encouraged, and will continue to encourage, social and natural scientists to come together and to create a common language or, at least, to understand each others’ languages. As stated above, this will provide the messages that are more readily transferable to the consumer and which can be incorporated more readily into the knowledge transfer activities of ISAFRUIT that are designed to communicate directly with the consumer.

This work will parallel and complement other activities to disseminate the results of ISAFRUIT to the fruit industry. For this, a range of modes of dissemination have been identified and are being pursued, from traditional grower/stakeholder days, Symposia and Conferences, articles in the scientific, industry, or popular literature, demonstration tours and prototypes, to more innovative modes such as internet-based newsletters, podcasts, and blogs.

FIRST RESULTS AND DISCUSSION

The actual state of the art

At the 3rd General Assembly of ISAFRUIT, in November 2008, the aims, methodology and procedures of the “Vasco da Gama” process were brought to the attention of all project members by presenting and explaining the process to all participants from all Project Pillars in a plenary session. A follow-up workshop, aimed at completing the still empty HoQ, was also held. An inventory of pre- and post-harvest studies within ISAFRUIT was prepared to support the next steps of the “Vasco da Gama” process. This inventory listed the experiments and the technical quality traits measured in each experiment (one line = one experiment). Likewise, an initial inventory of consumer demands was provided. Those ISAFRUIT Project participants conducting pre- and post-harvest studies were encouraged to place their ISAFRUIT experiments in the HoQ and to relate the quality traits being measured to those consumer terms that were associated with increasing fruit consumption.

At the end of the Workshop, the first proposals to link the quality traits studied or influenced by ISAFRUIT pre- and post-harvest technology to those terms that relate to consumer behaviour with regard to fruit consumption were available. These propositions need to be verified and the “rooms” in the HoQ (i.e., the cells of the HoQ Table, as defined by the ‘consumer behaviour terms’ vs. ‘quality traits studied in the pre- and post-harvest experiments’) need to be completed during the next steps of the “Vasco da Gama” process. Workshop participants from all the different ISAFRUIT Pillars made useful suggestions, some quite motivating and providing new “angles”, which were collected to advance the documentation and quantification of the impact of ISAFRUIT.

During the Workshop, it became clear, however, that the ISAFRUIT HoQ needed clarification and proper, well-considered definition, before the correct placement of particular pre- and post-harvest experiments into “rooms” of the HoQ could proceed.

Next Steps

The next step in the “Vasco da Gama” process entails an evaluation, by consumer scientists, of the links between the technical quality traits and consumer demands as hypothesised by the technical researchers. This evaluation will require a number of iterative rounds, in which mutual questions to clarify the assessments will be asked between consumer researchers and technical researchers. As mentioned, the list of consumer demands will, in the meantime, be updated and enlarged by the results from two consumer surveys and one consumer-choice experiment. The process will be finished and validated by the end of the Project (2010).

CONCLUSION

The ISAFRUIT experience of the “Vasco da Gama” process, launched in March 2008, has been two-fold: first, some of the social and natural scientists have an eminent and creative interest in participating in the process, which is encouraging. Second, a sustained effort is recognised as being required to drive the “Vasco da Gama” process forward.

The “Vasco da Gama” process is innovative and unique. If it can be implemented successfully, it could also become the standard method of validation for other inter- and trans-disciplinary research projects. The link between the natural (or technical) sciences and the social sciences is a demand of our times. Food production needs to respond to markets and to consumer demands with available technical and information technologies. To develop truly sustainable food systems, innovations created by both the consumer sciences and the

technical/natural sciences must be linked.

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