

An inventory of recent innovations in fruit and fruit products

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(Accepted 18 August 2009)

SUMMARY

The goals of this study were to make an inventory of recent and ongoing fruit and fruit product innovations, to assess what novelty or improvement they offer, and whether consumers could identify and/or recognise them. Researchers from 11 European countries submitted 386 examples of fruit and fruit product innovations. The list of innovations obtained has been coded, categorised, sorted, and reduced in subsequent stages. First, the examples received were categorised according to the Oslo Manual definitions. Second, product and marketing innovations were selected, as they are the only ones that were likely to be recognised by consumers. Next, analysis revealed that the novelties these innovations offered related to Convenience, Health, Differentiation, Target Group, Information, Sensory Characteristics, In Home and/or Out of Home Quality. Some innovations offered only one novel aspect, whereas others offered multiple aspects. Interrelationships between novel aspects are discussed for those innovations that offered a combination of aspects.

A considerable improvement in human health and well-being can be achieved by increasing fruit consumption, since the increased intake of fruits and vegetables prevents certain diseases and contributes significantly to improvements in the human physical and mental condition (Pomerleau *et al.*, 2003; WHO, 2002; 2003; EURODIET, 2000).

However, increasing fruit consumption encounters several critical bottlenecks, as hypothesised in the ISAFRUIT Project (Annex I, 2006). These include:

- insufficient quality of, and safety of, fruits and fruit products for consumption;
- limited availability of certain fruits and fruit products;
- lack of public consciousness of the health benefits of regular fruit consumption; and
- high prices of fruits and fruit products compared to competing products (e.g., snacks and soft drinks).

Fruit and fruit product innovations may play a significant role in the process of eliminating these bottlenecks, as well as in encouraging and enabling consumers to buy and consume more fruit, fresh and processed. To strengthen the potential of future fruit and fruit product innovation, and to increase fruit consumption, it is necessary to understand the successes and/or failures of recent innovations from a consumer's point of view. The purpose of this paper is to present the results of a study that looked into recent fruit and fruit product innovations, to assess whether they could be recognised or identified by consumers, and to define, from a consumer's point of view, what novelty or improvement they brought into the market, what characteristics they had, how these characteristics were interrelated, which of them were common and, finally,

how they corresponded to the above list of four bottlenecks to increasing fruit and fruit product consumption (see Zajac and Kraszewska 2007).

METHODS

Data collection

Gathering examples of all sorts of fruit and fruit product innovations in European countries was achieved by sending a questionnaire (by e-mail) to 168 ISAFRUIT researchers in all European countries participating in the Project. Respondents were asked to give examples of fruit and fruit product innovations that they recognised from their scientific and/or business backgrounds, as well as their experiences as consumers. In addition, they were asked to assign these innovations to four categories: (i) new or significantly improved products (i.e., product innovations); (ii) new marketing methods (i.e., marketing innovations); (iii) new processes (i.e., process innovations); and (iv) new methods in business practices, workplace organisation, or external relations in the fruit and fruit product sector (i.e., organisational innovations) as referred to in the Oslo Manual (2005). Definitions and examples of these four categories were placed at the end of the questionnaire to assist respondents, and to avoid incorrect assignments.

All fruit and fruit product innovations mentioned were collected in a database and verified with respect to whether they were indeed recent and/or ongoing fruit and fruit product innovations. It appeared that some were product innovations not directly related to fruit and fruit products (e.g., tools for cutting fruit, or facilitating fruit preparation), or were simply recommendations for the future (e.g., 'it would be good to breed for cherries without pits'). These and similar innovations were excluded from further analysis.

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Analysis

All the remaining innovations were coded, categorised [(i) – (iv)] and reduced over three Stages typical in such qualitative research (Miles and Huberman, 1994; Patton, 1990):

Stage I: Respondents' assignments to the four Oslo Manual categories (i – iv) were checked and adjusted where necessary;

Stage II: Innovations were classified based on whether or not they could, or could not be recognised and identified by consumers; assuming that, when a consumer came across a new fruit or fruit product, they could easily assess whether such a product represented any novelty to them as a new characteristic or modification 'visible' in the innovation itself (e.g., new fruit varieties, new fruit products, new packaging, new labelling). Thus, product innovations, as well as marketing innovations, could be recognised and/or identified by consumers. On the other hand, processes (e.g., the use of new methods for fruit thinning at a more appropriate time, or a more efficient way to use chemicals for regulation of the crop load, in a sustainable approach) and organisational innovations (e.g., growers creating formal associations to increase their bargaining and market power) in fruit and fruit products are not 'visible' to consumers, which is why consumers cannot recognise or identify them, unless specific information is provided. Only those innovations that could be recognised and/or identified by consumers were selected for further analysis.

Stage III: Innovations selected at Stage II were verified to find and eliminate examples of the same fruit and/or fruit product innovation submitted by different researchers from the same country. Same examples were found in the lists of innovations submitted by researchers from The Netherlands, France, Poland, Spain, Italy, Switzerland, Denmark, and Greece. Next, the novel or improved characteristic that each studied innovation brought to the market was assessed. Analysis of these characteristics resulted in preliminary categories of innovation, which, in some cases, were too similar to make into separate groups. Such innovations were included as sub-categories in broader, but more mutually exclusive, categories. Definitions for the final categories thus defined were derived by comparing and discussing the whole list of categories. Next, the categories were assigned to the complete inventory of fruit and fruit product innovations, by researchers, according to their knowledge and expertise in this field and according to the original definitions. In addition, examples of fruit and fruit product innovations sent from Poland, for example, were categorised by Polish researchers in order to use their knowledge of the Polish fruit product market most effectively. The same procedure was used for all other

countries participating in ISAFRUIT WP 1.3 (i.e., Greece, Spain, and The Netherlands). Examples of innovations submitted by respondents from Denmark (10), France (17), Ireland (3), Italy (13), and Switzerland (10) were categorised by the first author of this paper.

To summarise, in Stage I and Stage III, recent and ongoing fruit and fruit product innovations were categorised. In Stage II, innovations that were not directly recognisable to consumers were excluded. In Stage I and Stage II, *a priori* criteria were used, while in Stage III, *post hoc* criteria were used, according to the expertise and knowledge of WP1.3 researchers in this field, and to the innovations contained in the database. The criteria for each subsequent Stage were not interrelated; thus, changing the order of the Stages did not influence the result.

Finally, intra-case and cross-case analyses were carried out. Intra-case analysis included both a check on interrater reliability, and the identification of the number of categories assigned to each innovation. This resulted in a distinction between innovations assigned to only one category, and innovations assigned to two or more categories (multi-assignment). Cross-case analysis looked at the interrelationships between multi-assigned categories. It resulted in an overview of the frequencies with which particular category combinations were assigned to fruit and fruit product innovations.

RESULTS AND DISCUSSION

The questionnaire was completed by 60 ISAFRUIT researchers from 11 European countries, which gave a response rate of 64%. In 51% of responses, examples were provided of fruit and fruit product innovations, and, in 13% of cases, the respondent explained that he/she had no experience in this field, and so could not provide any information. The other 36% of e-mails were not answered in any way.

After verification, the survey provided 386 fruit and fruit product innovations: 87 from The Netherlands, 68 France, 56 Poland, 50 Spain, 41 Italy, 34 Switzerland, 18 Denmark, 18 Greece, 7 Slovenia, 5 Ireland, and 2 from Germany.

The innovations mentioned were distributed across all four [(i) – (iv)] of the Oslo Manual categories of innovation as follows (386 = 100%):

- (i) 127 product innovations (33%);
- (ii) 87 marketing innovations (23%);
- (iii) 137 process innovations (35%);
- (iv) 35 organisational innovations (9%).

The analysis at Stage II showed that, among the 386 fruit and fruit product innovations, only the product and marketing categories of innovation could be recognised and/or identified by consumers. These were, for example, seedless fruit varieties, new juice compositions based on exotic tastes, osmotically-dried fruit, fruit salads (i.e., product innovations), and individual or smaller packaging, fruit consumption promotion campaigns, or ecological and regional labelling (i.e., marketing innovations). All process and organisational categories

of fruit and fruit product innovations were unlikely to be recognisable and/or identifiable by consumers, and were excluded from further analyses. These included: club or chain organisational concepts in production and marketing, limiting the number of intermediaries between the orchard and the consumer (i.e., organisational innovations), as well as steam and ultrasound as new methods for cleaning fruit surfaces, biological control agents (i.e., natural substances) reducing heavy losses of fruit crops, and reduced pollution of wash water in fruit packing houses (i.e., process innovations). A closer look at the data revealed that respondents were aware of process and organisational innovations from their scientific and/or business experiences, but not as consumers. This led to the conclusion that, unless specific information is disseminated, consumers will not be aware of such fruit and fruit product innovations. Thus, from the consumers' point of view, process and organisational innovations are unrecognisable and/or unidentifiable. Therefore, they alone do not have the potential to increase consumption of fruit and fruit products. However, it may be assumed that effective process and organisational innovations may decrease the price of fruit and fruit products, and thus have the potential to increase fruit and fruit product consumption, by indirectly influencing consumer purchase decisions.

Stage III began with a verification of the 214 product and marketing innovations selected at Stage II (e.g., 'Santana' anti-allergenic apple was mentioned by five researchers from The Netherlands, and Knorr Vie drinks by two researchers from Greece). This verification resulted in a reduction to a total of 175 different fruit and fruit product innovations. Based on an analysis of all these innovations, the following eight categories were extracted: Convenience, Health, Differentiation, Target Group, Information, Sensory Characteristics, In-home and/or Out-of-home, and Quality. This permitted an assessment of the novelty or improvement that each innovation brought, what its characteristics were, and how its characteristics were interrelated. The following (not necessarily mutually exclusive) categories and sub-categories emerged:

Convenience (including sub-categories such as packaging, fresh cut fruit, fresh, prepared, processed fruit, and shelf-life): any innovation that makes the preparation and consumption of fruit less time-consuming and less work-consuming, or easier to buy, carry, and/or store; also any innovation that extends the shelf-life (guaranteed optimal quality) of a fruit or fruit product.

Health (including such sub-categories as functional foods, organic, natural, allergy-free, and diet): any innovation that makes the fruit or fruit product more health-promoting, and/or disease preventing, and/or better adjusted to the needs of people suffering from different illnesses (e.g., allergies, overweight, or diabetes).

Differentiation (variation; including such sub-categories as snacks, new kinds of juices and drinks, seasonal availability, and new kinds of fruit): any innovation that broadens the range of fruit and fruit products, by

launching new kinds of fruit and fruit products, not offered before, into the market (e.g., new varieties of apples such as 'Juliet' or 'Wellant', new fruits such as 'Actinidia', new kinds of juices and drinks, apple chips).

Sensory Characteristics: any innovation that changes the sensory characteristics of the fruit: taste, smoothness, colour, or the appearance of already-existing fruits and fruit products (e.g., apples that do not oxidise and do not change colour to brown), cocktail apples (small size), as well as fruit and vegetable fruit mixes (new taste combinations).

Target Group: any innovation that provides or adjusts a fruit or fruit product to the needs of a certain target group (e.g., infants, children, elderly people, teenagers).

Information (including such sub-categories as promotion, origin, labelling not required by regulation): any innovation that makes the information about a fruit or fruit product, its origin, its characteristics, or quality, more easily available to the consumer; any information that enables product tracking and tracing.

In-home and/or Out-of-home [including such sub-categories as new market places, availability (i.e., location)]: any innovation that enables the consumer to consume fruit or fruit products in-home and/or out-of-home, (e.g., at work, at school, in sports facilities, on-the-go, at gas stations, cafés and bars, restaurants, hotels, institutions (hospitals), airports, etc.) either because they can be bought, or because they are properly prepared to be carried to and consumed in such places.

Quality: any innovation that improves or produces new, higher quality fruit or fruit products (e.g., premium quality).

Subsequently, all 175 innovations were assigned to these categories.

The intra-case analysis revealed that 94 (54%) of the innovations could be assigned to only one category. For instance, 'more exclusive packaging' was assigned only to Quality, and 'apple chips' were categorised only as Differentiation. The other 81 (46%) of innovations were assigned to a combination of two, three, or four categories. For instance, the new fruit 'Actinidia' was assigned to three categories: Sensory Characteristics (because it has a new look and a new taste), Health (as it is rich in potassium, micro-elements, and vitamin C), and Differentiation (as it is a new fruit).

The single-category group was dominated by innovations classified as Differentiation (31%), Information (26%), and Convenience (23%). The other fruit and fruit product innovation categories were of little significance in the structure of this group; none of them exceeded 7.5%, and Sensory Characteristics and Target Group made up $\leq 1.0\%$ each of the overall group. The eight categories above were assigned to the following fruit and fruit product innovations:

Differentiation was assigned to 29 (31.0%) of the innovations [e.g., new varieties of fruit, new drink products (juices, milk and fruit drinks, vegetable and fruit

drinks), new fruit products (e.g., soluble fibre from apple or blackcurrant), apple cider, blackcurrant wine, fruit extracts, vinegars, and balsamic vinegars of fruit, etc.];

Information was assigned to 24 (26.0%) of the innovations [e.g., integrated control labels, regional labels, ecological labels, information on healthy ingredients, promotion campaigns informing consumers about the amount of fruit that should be eaten to assure a healthy diet, citrus promotion campaigns, products that had a code which allows consumers to find a website with information about the product (Internet traceability), etc.];

Convenience was assigned to 22 (23.0%) of the innovations (e.g., fresh cut salad mixes, fresh cut fruit slices, diversified sizes and easy-to-open packages for juices, packages for multiple closings, fruit drink 'Fruit2Day', ready-to-eat fruit combinations, etc.);

Health was assigned to 7 (7.5%) of the innovations, [e.g., organic fruit, functional (anti-oxidant) fruit, low sugar jams, fruits with anti-allergenic and health protecting characteristics, fruit drinks with phytosterols, less allergenic apples, etc.];

In-home and/or Out-of-home was assigned to 5 (5.3%) of the innovations (e.g., fruit sold in entertainment parks, by vendors, in-home sale, juices sold in specialised shops, or fruit that could be bought directly from the orchard);

Quality was assigned to 5 (5.3%) of the innovations (e.g., better looking, more exclusive packaging, high quality fruit for consumers willing to pay a higher price, quality and quantity management through Club concepts, etc.);

Target Group was assigned to 1 (1.1%) of the innovations (e.g., anti-allergenic 'Santana' apples for individual consumers, etc.);

Sensory Characteristics was assigned to 1 (1.1 per cent) of the innovations (e.g., seedless grapes or watermelons etc.).

Comparisons of the assignments of similar innovations submitted by the different participating countries indicated that there were no mismatches in the category assignments, which showed that all eight categories were implemented in a consistent way (i.e., very high interrater reliability). Thus, the new cherry cultivar 'Lala Star' from Italy, the new sweet cherry variety 'Folfer' from France, and the new apple variety 'Wellant' from The Netherlands, were all assigned to Differentiation, as were all other new varieties of fruits that did not represent any special feature, for example, functional foods.

In the multi-category group, we observed a structure quite similar to that in the single-category group. Thus, Differentiation (44 cases) and Convenience (35 cases) dominated once again. Only Information (17 cases) was less significant here than in the single-category group. It was replaced by Health (39 cases), which appeared more frequently instead. The other categories were not so frequent. The multi-category group included 81 innovations (= 100%), of which: 61 (75%) were assigned to two categories, 17 (21%) were assigned to three categories, and 3 (4%) were assigned to four categories.

Cross-case analysis of the multi-category group of innovations indicated that Differentiation (44 cases) was most often connected with Health (19 linkages). For example, new fruit varieties which contained fluorizine, new juices enriched with OMEGA 3 (for improvement of the blood circulation system), osmotically-dried fruit with new functional properties, apple purée desserts containing healthy functional ingredients such as oligofructose (Beneo™ HIS, a prebiotic and dietary fibre) or alcohol-insoluble solids (AIS) to lower serum cholesterol in humans and help modulate late-onset diabetes, sugar-free ready-to-drink blackcurrant juice made directly from fruit (not concentrate) sweetened with apple or pear juice, etc.

Health (39 cases) was most often connected with Differentiation (19 linkages; see above).

Convenience (35 cases) most often connected with Differentiation (15 linkages). For example, small one-person fruit drinks, fruit still with their stalk (ready for dipping or for fondues), and fresh-cut fruits served with cream or chocolate (in a separate compartment in which to dip the pieces). Convenience was also connected with the Health category (14 linkages). For example, fruit juices with added vitamins, organic apple juice, fresh fruit salads with anti-oxidant properties, and fresh-cut apple slices that contain a prebiotic and calcium. It is worth highlighting that fruit and fruit product innovations assigned to this category were frequently linked with Differentiation and Health at the same time, thus representing a significant share of all those innovations assigned to three categories.

Target Group (19 cases) was most often connected to Convenience (10 linkages). For example, Knorr's Vie, targeting the diet-sensitive who do not have enough time to peel and cook (e.g., full-time workers, business people, modern yuppies sensitive to health matters), and packaging that improves the accessibility of fruit and fruit products (e.g., at school, targeting students with more attractive packages for kids with a small present inside, etc.).

Information (17 cases) was most often connected with Health (8 linkages). For example, information on fibre content, on healthy ingredients, on prebiotics, the '5-a-day' promotion, and information campaigns.

Sensory Characteristics (17 cases) was most often connected with Differentiation (14 linkages). For example, new apples that do not oxidise (go brown), cocktail apples, iced teas with fruit tastes, new fruit varieties with new tastes, new juices with different tastes and smoothness, and dried fruits with different flavours such as orange or lemon.

Quality (7 cases) was most often connected with Convenience (4 linkages). For example, better packaging that improved shelf-life and fruit sensory qualities, easy-to-handle plastic foil packages for fruit, and the high-quality apple variety 'Juliet' that can be cultivated exclusively by farmers who belong to the 'Les Amis de Julieta' organisation and only cultivated by means of organic farming.

In-home and/or Out-of-home (6 cases) was most often connected with Convenience (4 linkages). For example, true "fruit" machines instead of candy bar machines in schools and Universities, and the "6-a-day" programme for fruit consumption in the workplace.

Comparisons of the assignments submitted from the participating countries, however, showed slight differences: 'fruit juices enriched with vitamins' was assigned to a combination of three categories (Convenience, Health, and Differentiation) in Greece, but to only two categories (Health and Differentiation) in Poland. There were few such cases, so the interrater reliability remained high.

In general, the results of Stage III showed that Convenience and Differentiation were the two dominating categories assigned to a wide range of fruit and fruit product innovations in both groups.

A cross-classification between Stage III and Stage I categories showed that product innovations dominated (63%) in the group of 175 innovations selected after Stage II. Product innovations were distributed across the single (45%) and multi-category (55%) group, where they were most often classified under Differentiation.

Sixty-five marketing innovations made up 37%, of which 44 innovations (68%) were assigned to one category, and 21 innovations (32%) were assigned to two or three categories. None of the marketing innovations selected was assigned to four categories. Marketing innovations in both groups were most often classified under Information.

CONCLUSIONS

The fruit and fruit product innovations collected represented a wide range of improvements which could be categorised into four main groups: product, marketing, process, or organisational innovations. However, only product and marketing innovations can be recognised and/or identified by consumers. Thus, only these two categories can influence a consumer's fruit and fruit product purchase decisions, and may have the potential to increase fruit and fruit product consumption by directly influencing a consumer's choice. According to the criteria applied, process and organisational fruit and fruit product innovations were not recognised or identified by consumers. However, as they can often result in price reductions, they may affect consumer purchase decisions indirectly, thus increasing fruit and fruit product consumption.

Analysis of all 175 innovations showed that almost 50% of them could be assigned to just one of the following eight categories: Convenience, Health, Differentiation, Target Group, Information, Sensory Characteristics, In-home and/or Out-of-home, or Quality. The other 50% could be assigned, mostly, to a combination of two, three, or four categories. Recent innovations aimed at improving two characteristics of a fruit or fruit product are as common as those aimed at changing only one characteristic. Fruit and fruit product innovations seeking to improve three characteristics are relatively rare, while those changing four characteristics are very rare.

Among the innovations analysed, most were aimed at Differentiation. This shows that the majority of fruit and fruit product innovations cited were aimed at broadening the range of fruit and fruit products offered in the marketplace. As this included such sub-categories as fruit snacks, new kinds of juices, and new kinds of fruits to increase seasonal availability, Differentiation

may increase the availability of certain fruit and fruit products. The latter was hypothesised, in ISAFRUIT, to be one of the critical bottlenecks to increase fruit consumption, provided that such innovations were distributed *via* several routes.

Convenience was the second most common category of innovation, and may play the same role, increasing the availability of fruit and fruit products. All innovations of this kind make fruit and fruit products either less time-consuming or less work-consuming during their preparation or consumption, easier to buy, to carry, and to store.

Health and Convenience were the two other significant categories of recent fruit and fruit product innovations. Health was more frequent, with recent innovations assigned to two categories, where Health was most often combined with Differentiation. Innovations aimed at Health represented such sub-categories as functional, organic, natural, allergy-free, and diet fruit products. Thus, they may have the potential to increase food safety at the point of consumption, which corresponds to another bottleneck to increasing fruit consumption, as hypothesised in the ISAFRUIT Project.

Some of the recent innovations in Information such as 'information on healthy ingredients', or 'promotion campaigns informing consumers about the amount of fruit that should be eaten to assure a healthy diet', are obviously aimed at increasing consumer consciousness of the health benefits of regular fruit consumption, but they were rarely mentioned. There is a need to take more actions of this kind in order to increase the positive influence on consumers.

Most of the remaining recent fruit and fruit product innovations were categorised as Target Group, Sensory Characteristics, In-home and/or Out-of-home, as well as Quality, and had a very minor share of the total list of innovations collected. At present, these do not seem to play a crucial role in increasing fruit and fruit product consumption.

Subsequent research should define and understand those factors that determine the success or failure of these innovations, referring to theories on consumer adoption, in order to provide advice and further guidance for the fruit industry and other stakeholders.

The authors would like to thank M. Kraszewska and J. Bartels for elaborating the questionnaire, and researchers from the Universidad Politécnica de Madrid, Spain; the Agricultural University of Athens, Greece; the Agricultural Economics Institute, Wageningen University, The Netherlands; and from Warsaw University of Life Sciences, Poland, for their contributions to the study. The authors would also like to thank those ISAFRUIT researchers who submitted examples of recent fruit and fruit product innovations.

The ISAFRUIT Project is funded by the European Commission under Thematic Priority 5 – Food Quality and Safety of the 6th Framework Programme of RTD (Contract No. FP6-FOOD-CT-2006-016279).

Disclaimer: Opinions expressed in the publication may not be regarded as stating an official position of the European Commission.

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