

Exploring consumers' health perception across cultures in the early stages of new product development

Dried mango as a case study

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Abstract

Purpose – The purpose of this paper is to explore consumers' health perception and demonstrate its relevance in product and process design in early stages of new product development.

Design/methodology/approach – A dried mango was used as a case study involving three countries: Indonesia, China and the Netherlands. Data were collected from nine focus groups ($n = 53$ participants) and were content-analysed to acquire in-depth insights.

Findings – Four themes of health perception emerged, namely, nutrition, naturalness, taste and well-being, which were all expressed on different levels of abstractness. Participants' health perception of dried mango varied, it is related to the product category it is compared with, e.g. candy or fresh fruit, and the eating context, e.g. position in the diet either as a snack or a meal. In extension participants mentioned product and process characteristics. Application of the insights into product and process design was performed through iterative interactions between consumer scientists and food technologists. The development of two product concepts was elaborated to transform the insights into technical product and process specifications for a natural dried mango product.

Originality/value – This transformation suggests that iterative interactions are necessary to achieve relevant product and process characteristics in the simultaneous design of the technical product and process specifications based on consumer perceptions.

Keywords Focus groups, Health, Consumer-oriented new product development, Dried fruit, Food perception, Product and process design

Paper type Research paper



1. Introduction

Success of new product development (NPD) is determined by degree of fit of the newly developed product to the needs and wishes of consumers (Grunert *et al.*, 1997). Consumers are not attracted to products *per se*, but rather to perceived benefits that the products deliver when consumed (Grunert and Van Trijp, 2014). So the attractiveness of a product depends on how consumers perceive characteristics of a food product, its quality and its benefits. Understanding this perception in early stages of consumer-oriented NPD is necessary to create products with the desired quality (Grunert, 2005b).

Health is one of the often mentioned motives related to consumer's food choice (Cunha *et al.*, 2018). Its importance is also represented as one of the four interrelated dimensions of food quality; sensory (taste and appearance), convenience (easy to be consumed), health and process (at primary production and processing level) (Grunert *et al.*, 1996). There are many consumer perception studies about sensory, convenience and health (Sijtsema *et al.*, 2012; Johansen *et al.*, 2011) and their interrelation, e.g. how do consumers link healthy food to tastiness. Some consumers implicitly associated unhealthy food to tastiness, like German and US-American consumers, but others have a "healthy = tasty" intuition, such as French consumers (Werle *et al.*, 2013; Mai and Hoffmann, 2015). Regarding the process dimension, there are also several studies at the primary production level, e.g. organic production (Lee and Yun, 2015), while there seems less attention to the link between consumer perception and the processing level. A few studies reported consumers' perception of innovative technologies (Perrea *et al.*, 2015; Rollin *et al.*, 2011). Even less attention is given to consumers' perception for low-technology processing. Therefore, we want to explore how consumers perceive product quality related to processing technology as it could provide new and relevant insights for NPD.

Consumer insights need a transformation to be a useful input for designing food products (Grunert *et al.*, 1996). Insights on perceived product quality can consist of both product and process characteristics. It would be valuable for consumer-oriented NPD if the transformation is carried out to guide the design of both product and process specifications. So based on desired product characteristics, a technology is chosen to realise the characteristics (Moskowitz, 2000). Also, the third generation model of product innovation suggests that along with consumer-oriented NPD, a more balanced input from both the consumer and the technology side is necessary throughout the NPD process (Grunert and Van Trijp, 2014). To support these approaches, we focus on transformation of consumer perceptions in early stages of NPD to be used in product and process design, which is predominated by intrinsic characteristics of the product. This transformation requires interaction between consumer science and food technology expertise (Jacobsen *et al.*, 2014).

Average daily consumption of fruit is generally much lower than the WHO-recommended level. Therefore, consumption of fresh and processed fruits should be stimulated (Geeroms *et al.*, 2008). However, increasing fruit consumption by eating dried fruit did not receive much scientific attention yet. Among fresh tropical fruits, mango has the second largest portion in the world market after banana (Altendorf, 2017). It has an attractive colour and flavour, and is an important source of micronutrients (e.g. vitamins and minerals) and phytochemicals (Ribeiro *et al.*, 2010). Yet, mango has a high perishability and a seasonal availability, so, in a dried form, its availability over a longer period of time increases, which potentially contributes to increased fruit consumption. Therefore, we focus on the health perception of a dried mango as a case in our study.

Perception of food is influenced by many variables, one of which is cultural food customs (Stok *et al.*, 2017). Due to differences in availability and exposure, individuals of different cultures differ in experience and familiarity with specific food products (Wang and Somogyi, 2018). Both product-related experience and product familiarity have been shown to affect how consumers use product characteristics to form their product quality judgment

(Frez-Muñoz *et al.*, 2016). Therefore, in the present study, health perception is investigated involving three countries differing in familiarity with a dried mango: two from Asia (China and Indonesia) and one from Europe (the Netherlands). Levels of the product familiarity between those countries were assessed based on knowing the product, frequency of consumption and product availability on the respective markets. Chinese and Indonesian consumers are most likely to have a higher familiarity than Dutch consumers. In China, a wide range of dried fruits is commonly consumed and is also available as additional ingredients, AOs, in breakfast porridge or baked goods (Wei *et al.*, 2017) or snack. In Indonesia, a dried mango is one of the popular dried tropical fruits that is commonly produced by small-scale industries and is widely available in the local markets. The Dutch are less familiar with a dried mango compared to the Asians and small numbers of dried fruit products are available in the Dutch supermarkets and greengrocers.

The total food quality model (TFQM) links concrete product characteristics, with perceived quality cues, expected or experienced quality and benefits (Grunert, 2005b) (Figure 1). This hierarchical way of defining quality is represented on different levels of abstractness, e.g. a concrete product characteristic “crunchy” links to a perceived intrinsic quality cue at an intermediate level (e.g. has a bite) and perceived benefit at a rather abstract level (enjoying the food).

Within the TFQM, benefits are defined as pleasant consequences perceived when consuming a product, which reflects what the product does for consumers (Van Kleef *et al.*, 2005). Consumers assess benefits from a combination of product cues including intrinsic and extrinsic quality cues (Grunert, 2005a; Van Trijp and Steenkamp, 2005). Intrinsic quality cues are pieces of information about a product (e.g. one or more intrinsic characteristics) which

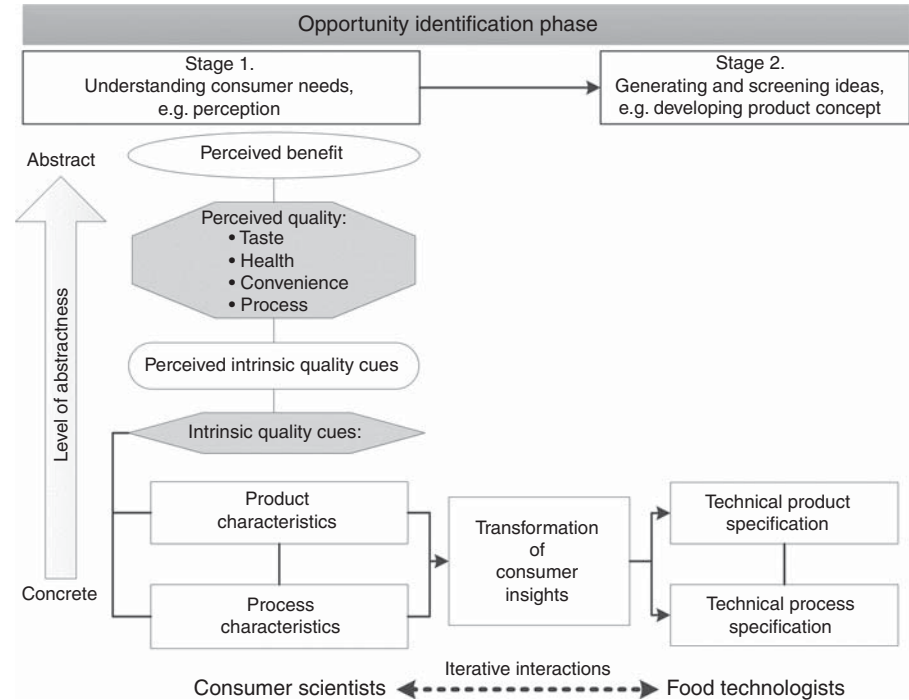


Figure 1.
Overview of consumer
quality perception
and its potential
use within early
stages of consumer
oriented NPD

Source: Adapted from Grunert (2005b)

consumers use to form an inference or an expectation about its quality, such as good taste, natural, healthy (Grunert, 2005a; Lähteenmäki *et al.*, 2010). So products have cues while consumers perceive benefits. Intrinsic characteristics are concrete physical and physiological characteristics of products (Van Trijp and Steenkamp, 2005; Grunert, 2005a), which can be linked to not only product characteristics but also process characteristics. These characteristics are evaluated through the senses, i.e. bright colour but can also be inferred from other cues, such as information like “does not contain fibre”. These characteristics need a transformation to set up technical product and process specifications for product and process design, which requires involvement of consumer science and food technology expertise.

This study aims to explore consumers’ health perceptions and transform them into technical product and process specifications for product and process design. We used a dried mango as a case study and involved participants from three countries (the Netherlands, China and Indonesia). The questions related to this aim are:

- (1) What are consumers’ perceived benefits, intrinsic quality cues and concrete characteristics of a dried mango?
- (2) What consumers’ health perceptions of a dried mango give relevant insights for product and process specification?

2. Method

Focus group was selected to collect data on quality perception of a dried mango. Focus groups can be used to explore and identify consumers’ perception of product characteristics and accompanying consumer benefits, as well as other potentially relevant issues (Van Kleef *et al.*, 2005).

2.1 Participants

Nine focus groups were held ($n = 53$ participants), three for each of the three countries: Indonesia, China and the Netherlands. Each focus group consisted of five to seven participants (aged 20–40 years). Participants were recruited via e-mail and social media. They were mostly students of Wageningen University, the Netherlands, and were not from food science and nutrition-related programmes. All participants had experience in eating dried fruits at least once a year. In addition, Chinese and Indonesian participants were shortly living in the Netherlands (maximum of four months). The participants were as follows: 18 Indonesian/INA (7 M, 11 F; average age 26 years), 20 Chinese/CHN (6 M, 14 F; 23 years) and 15 Dutch/NL (5 M, 10 F; 25 years).

2.2 Focus group protocol

A semi-structured focus group protocol was developed in English, translated into three respective languages and rechecked by a native speaker. The protocol consisted of two main parts, namely, perception of a dried tropical fruit and perception of a dried mango, and both parts included questions about expected and experienced quality related to health. To ensure commitment to individual opinions, for some questions, participants first recorded their responses in individual booklets, and were asked to read it out to the group before discussing it. The protocol was tested in one focus group pilot for each country and minor adjustments were made. The focus groups were conducted in the native language of the participants and led by a native speaker. The first author was present as an observer in each session to ensure consistency in conducting the protocol. Focus groups were held in November 2015 in Wageningen, lasted approximately 2 h each, were audiotaped for further analysis. In all FGs, a note taker made field notes.

2.3 Data analysis

Data were transcribed verbatim by a native speaker of the language and verified by a second person. Transcripts were translated into English and checked by a second person for translation-accuracy and content-analysed using ATLAS.ti 7.5.12 for Windows. Transcripts were grouped by country and coded according to predetermined coding categories of dried tropical fruit and dried mango. Second-level categories were defined as being reasons to eat or not to eat the products. All quotes related to health perception were put together for further analysis. Four main themes related to perceived quality emerged and were applied as additional coding: nutrition, naturalness, taste and well-being.

Participants of each country were used as one sample to be compared across countries, because the results were generally similar across focus groups within each country. Therefore, these findings showed data saturation and indicated its reliability (Krueger and Casey, 2000).

The main findings are presented and illustrated with quotes by the themes. When the results were similar between countries, results are described in general terms: country-specific differences are mentioned explicitly.

Next, results are graphically presented by level of abstractness to show how consumers link concrete characteristics of a dried mango with their perceived quality cues and perceived benefits.

Finally, to demonstrate the transformation of consumers' perception into technical product and process specifications, we give an example of two product concepts of a natural dried mango.

3. Results

3.1 Nutrition

Mentioned benefits of eating dried fruit were increasing nutritional intake and satisfying hunger. Regarding the first benefit, some participants linked it to calories and nutrients like sugar, fibre, vitamins, minerals and antioxidants. Others linked it to the more abstract "healthiness" of dried fruit. Meanwhile, satisfying hunger was associated with the amount of sugar in it:

It's [dried fruit] quite suitable for satisfying hunger because it contains a lot of sugar, using it as a snack [...]. (INA/FG2-P2F)

On one hand, some participants perceived eating a dried mango as healthier than eating other sugars like candy, honey or syrup because they perceived it to have fewer calories and as it was made of fruit.

On the other hand, some other participants assessed the nutritional value of eating dried fruit by linking it to water or juice content while comparing it with eating fresh fruit. Some participants perceived a dried mango with less moisture negatively because they expect that when the juice evaporated from the fruit during drying, some nutrients were also gone. These participants – who compared a dried mango with a fresh mango – seem to expect the fresh mango's characteristics in a dried mango.

Meanwhile, some others perceived a dried mango positively by stating that some nutrients still remained in dried fruit and they can get more nutrients from it. The drying process seemed to be one of the considerations taken into account when assessing the healthiness of eating a dried fruit:

I can imagine that if the juice leaves the [fresh] fruit, some nutritional value is lost. (NL/FG3-P4F)

[...] when you eat dried fruits [...] you will double the [amount of] nutrients [...]. vitamins, fibres, [...]. (CHN/FG3-P1M)

3.2 Naturalness

Participants linked eating dried fruit with the naturalness of the ingredients or with processing, and they all related it to health (Figure 2). They felt more positive and less worried toward the healthiness of eating dried fruit compared to eating other snack foods, like potato crisps, since they are familiar with ingredients of dried fruit or they perceive it as having no additives:

[...] For candied fruit or fruit crisps, we know what the ingredients are, unlike for example for potato crisps [...]. (INA/FG1-P6F)

AOs that they often mentioned were food additives such as preservatives, colourants, flavour enhancers and sweeteners. They inferred these ingredients from perceived characteristics of dried fruit like colour, smell or taste. Furthermore, some participants experienced the sweetness of dried fruit as artificial because they perceived it to contain added sugar or additives like artificial sweeteners:

P6F: But somehow when I eat candied fruit, there is something that you can feel in your throat, so I want to eat candied fruit with fewer additives.

P2F: Colourants, I think? [...] Artificial sweeteners. (INA/FG2)

Some participants used colour (e.g. faded colour, too light colour, colourful) or dryness resulting from drying process of fruit to make inferences about the presence of colourants and preservatives. Both perceived characteristics seem to influence their health perception, especially regarding the presence of food additives:

I think the colour of dried tropical fruits shall not be too light or too colourful. It will make me feel that there are too much additives. (CHN/FG1-P1M)

The colours [of dried fruit] will fade, but that's the real colour of the fruits which are dried. (INA/FG2-P5M)

3.3 Taste

Some participants related the taste of dried fruit to health. Participants considered eating a dried mango as tasty and they made an inference about healthiness from several intrinsic characteristics such as specific nutrients, taste, smell, dryness, and chewiness. Dutch participants expressed that eating dried fruit as such was tastier when sugar was not added. They also mentioned that rather plain food products (e.g. yogurt and muesli) became tastier

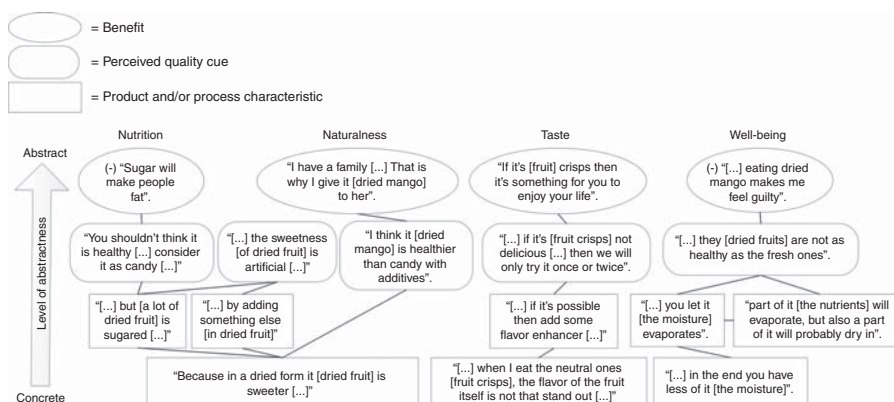


Figure 2. Example of health perception of dried mango grouped according to the four emerged themes of nutrition, naturalness, taste, and wellbeing and depicted along the level of abstractness. (-), refers to a negative benefit i.e. a disadvantage

when dried fruit was added as a healthier choice than other sugars like syrup or honey. They also expressed the taste together with inferred (e.g. presence of natural sugar and flavour) and perceived (e.g. sweet taste) characteristics:

P2F: Without the [added] sugar it [dried fruit] is tastier.

P5M: They contain a lot of natural sugars. (NL/FG1)

[...] If I eat muesli I think it is tasty that there are dried [fruit] pieces in it for the taste. Otherwise, you are inclined to add syrup or honey to the yogurt. Then I would consider it [dried fruit] to be healthier than other additions [...]. (NL/FG2-P2F)

Different from Dutch participants, some Chinese and Indonesian participants linked perceived characteristics like sweet taste and flavour of a dried mango to the presence of additives. They expressed the characteristics in both positive and negative ways:

I think the sweetness [of dried fruit] is artificial, due to adding more sugar or something else [sweeteners]. I dislike food being too sweet. (CHN/FG1-P7F)

It [dried salted mango] contains a lot of preservatives so I can't really taste the real [mango] flavour. (INA/FG3-P3F)

Indonesian participants only mentioned their experience of eating dried fruit as a snack, while some Dutch and Chinese participants also mentioned eating it as an ingredient of a product or by adding it into a meal, such as yoghurt, mixed with nuts, muesli, porridge (as a snack or a meal, e.g. breakfast). These results suggest that participants from different countries have different perceptions due to different consumption situations of the dried fruit.

3.4 *Well-being*

Participants mentioned that eating a dried mango would influence their body weight that they assessed as either positive or negative:

It [dried mango] contains too much sugar [...] Sugar will make people fat. (CHN/FG2-P7F)

I often buy candied fruit with the thought of "Ah I want to gain weight". So I bought candied fruit, like that. (INA/FG2)

Some participants also mentioned other physical concerns of eating dried fruits such as causing toothache, mouth pain, and inflamed throat. They inferred these concerns from the presence of added sugar and perceived characteristics like hardness, dryness and a sweet taste. It is very likely that the mentioned concerns were perceived based on past experience of eating a dried fruit in general:

But will you get shang huo[1] if you eat too much dried fruit? (CHN/FG2-P6F)

For the candied fruit [...] because you add sugar to it, it's too sweet and causes a toothache. (INA/FG2-P2F)

Participants also expressed their emotional experience of eating a dried mango both in a positive and negative way. Some Indonesian participants mentioned that eating fruit crisps were for their enjoyment; in contrast, some Chinese participants perceived the less juicy characteristic of a dried mango – due to drying process – as less healthy than eating a fresh fruit, which leads to a guilty feeling:

If it's [fruit] crisps then it's something for you to enjoy your life. (INA/FG3-P6M)

But actually I prefer fresh mango [...]. [It is] juicy. This gives you a feeling of healthiness. While [eating] dried mango makes me feel guilty. (CHN/FG2-P2F)

3.5 Representation of consumer's health perception of a dried mango

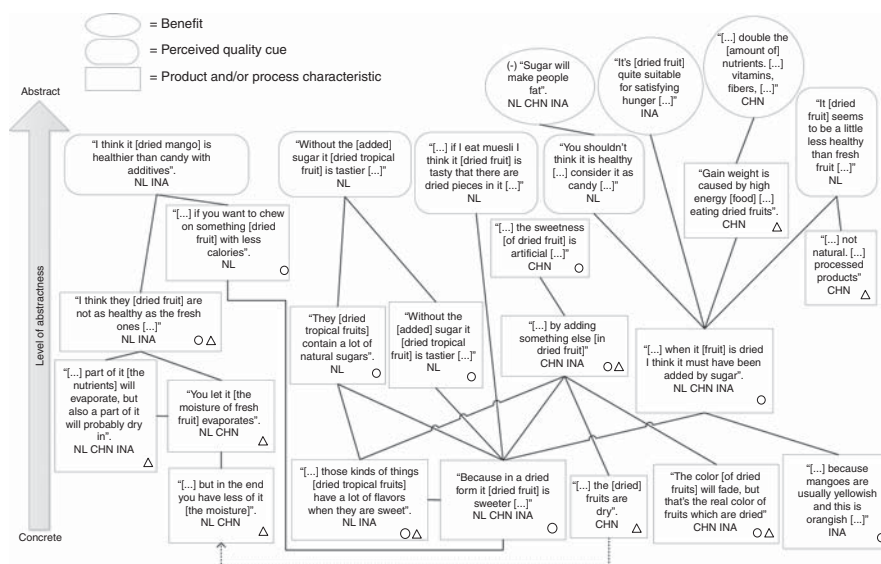
Figure 2 shows that health was perceived at each level of abstractness in each emerged theme. The figure also shows that consumers' thinking about the healthiness of a dried mango not only covers nutrition, which commonly influences health perception, but also naturalness, taste and well-being.

4. Transformation of the results and its application for new product and process design

This section demonstrates how the in-depth consumer insights of product and process characteristics could be applied to achieve technical product and process specifications. This demonstration is built upon a multidisciplinary approach between consumer science and food technology.

As shown in the results, naturalness was one of the often mentioned themes. Therefore, we choose a "natural dried mango" product concept for this demonstration. Participants discussed naturalness in terms of two definitions (Figure 3): what does the product contain (hereafter, product characteristics), and how does processing affect the expected beneficial nutrients (hereafter, process characteristics). These definitions become relevant in product and process design of the product concept.

In all three involved countries, participants often mentioned product characteristics like the flavour or the sweet taste of a dried mango and linked them with "contains natural sugar" or "no added sugar" (Section 3.3 and Figure 3). Others linked flavour or sweet taste with "does not contain artificial substances" or "fewer additives". Chinese and Indonesian participants also linked product colour like "too light or too colourful" with "too much additives". These results show that perception of a natural dried mango was influenced by the perceived presence of sugar and additives. It implies that a natural dried mango should contain the mango material with natural sugar, and should not contain added sugar and no or fewer additives.



Notes: ..., the transformation from a technological perspective; Δ, process characteristics; ○, product characteristics

Figure 3. Consumer insights for "natural dried mango" product concept

Chinese and Indonesian participants related the colour of a dried mango also to processing such as “the colour will fade but that’s the real colour of fruits which are dried” (Section 3.5 and Figure 3). This implies that colour changes due to drying process are one of the considerations taken into account to assess naturalness of a dried mango.

On one hand, some Chinese participants mentioned a perceived characteristic “dry” and linked it with the absence of preservatives in the product: “there won’t be many preservatives in dried fruits [...] the fruits are dry” (Figure 3). On the other hand, from a technological perspective, the term “dry” of dried fruit could also mean a lack of juice or moisture. Some Chinese and Dutch participants linked “juice” or “moisture” with how the drying reduced vitamins and antioxidants in dried fruit (Section 3.1 and Figure 3).

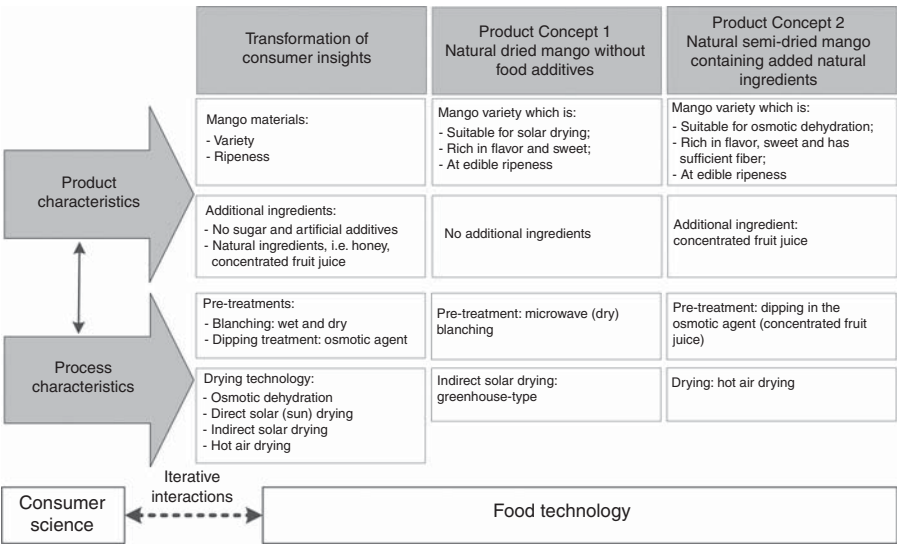
The abovementioned transformation of the results was used to develop technical product and process specifications for the “natural dried mango” product concept (Figure 4).

4.1 Technical product specification

The technical product specification was set up from product characteristics covering all possible ingredients to be used for product formulation:

- (1) Mango material: to have a sweet taste, a lot of flavour and a preferred colour for a dried mango, variety and ripeness of the mango should be taken into account (Van Buggenhout *et al.*, 2009). Varieties of mango that have the ascribed characteristics when ripe should be used for providing the preferred flavour and appearance (e.g. colour, texture).
- (2) Additional ingredients: sugar and artificial additives should not be added to the product. Alternatively, both taste and colour of the product could be tailored to the consumer perceptions using natural ingredients like concentrated fruit juice (contains vitamin C and natural sugar) or honey (contains antioxidants and natural sugar) (Chen *et al.*, 2000; Konopacka *et al.*, 2009).

Figure 4. Development of two natural dried mango concepts in which consumer insights and technological insights are combined: (1) Natural dried mango without food additives; (2) Natural semi-dried mango containing added natural ingredients



4.2 Technical process specification

The technical process specification was set up from the mentioned process characteristics into possible processing technologies to be applied to produce a dried mango. To have a lesser processing effect on a dried mango which is not too dry but juicier and having a preferred colour, some processing technologies are preferred, including the following.

Pre-treatment technology prior to drying. Prior to drying, sliced fruits are pretreated to inactivate enzymes responsible for undesirable changes and to modify the tissue. This pre-treatment improves drying performance, colour, flavour, and texture of the products (Reis, 2017). The pre-treatment technologies include among others wet and dry blanching, and dipping treatment, e.g. using osmotic agents (Pan *et al.*, 2003). Dry blanching such as using a microwave is preferred over wet blanching for fruit processing due to its high nutrient retention capacity (Guiamba *et al.*, 2018).

Drying technology. Several drying technologies are available for drying fruits, including solar drying, osmotic dehydration (OD) and hot air drying. Solar drying technology covers direct and indirect solar drying (Belessiotis and Delyannis, 2011). Indirect solar drying results in improved product quality in terms of sensorial characteristics and improved shelf-life, compared to direct solar drying (Patil and Gawande, 2016).

OD can provide fruit with fresh-like characteristics for colour, texture, and flavour (Sulistyawati *et al.*, 2018; Ciurzyńska *et al.*, 2016). OD involves partial water removal from fruit by soaking it in a concentrated solution which may contain natural ingredients (Shi and Xue, 2009). OD could serve as a treatment preceding drying or can be used as the main dehydration processing technology (Chandra and Kumari, 2015). OD followed by hot air drying can preserve the desired texture and colour of the fruit (Rodríguez *et al.*, 2015; Roopa *et al.*, 2014).

From the above described technical product and process specifications, it can be learned that various combinations can be made to develop a natural dried mango product concept. We elaborated two product concepts as examples: natural dried mango without food additives and natural semi-dried mango containing added natural ingredients.

Product concept 1 – natural dried mango without food additives. This concept would suit consumers who consider a dried mango as a healthy snack or a healthy ingredient for yogurt or muesli. They have an interest in health and avoid products which have added sugar and additives. They prefer a dried mango which is sweet, dry, rich in flavour and has a natural colour. Insights used for this product concept are no use of added sugar and additives. Based on these preferences, the product concept uses solely ripe mango material. Mango varieties with a sweet taste and rich flavour are preferred. No AOs are used, and to preserve the colour, pre-treatment using microwave (dry) blanching is chosen (Guiamba *et al.*, 2018). Subsequently, greenhouse solar drying is used as drying technology with mango varieties, Amélie and Kent, as the most suitable to realise a natural dried mango (Dissa *et al.*, 2011).

Product concept 2 – natural semi-dried mango containing added natural ingredients. This product would suit consumers who consider a dried mango as a sweet, healthy candy when consuming it as a snack. They have an interest in health and want to get beneficial nutrients especially vitamins and fibre from a dried mango. They prefer a sweet taste and moist characteristic. Based on these preferences, mango varieties with sufficient ripeness, a sweet taste, rich in flavour and sufficient fibre are preferred.

Insights used for this product concept are no use of added sugar and artificial additives, and the use of natural ingredients. So, in addition to the mango material, natural de-acidified concentrated apple juice containing healthy compounds was chosen to tailor the taste (Konopacka *et al.*, 2009). Subsequently, mild processing should be applied to maintain fresh fruit's colour and flavour (Kowalski and Mierzwa, 2013). Ideally, OD as pre-treatment using the concentrated juice as an osmotic agent, followed by hot air drying at a relatively low temperature.

5. Discussion

Participants expressed their health perception of a dried mango in relation to four themes, namely, nutrition, naturalness, taste and well-being, all on each level of abstractness and interrelated. These different levels of expressing quality perceptions gave valuable insights into the concrete product and process characteristics, as elaborated for two “natural dried mango” product concepts. The results confirm previous findings that health-related quality perception of food included themes such as nutrition, naturalness and well-being (Asioli *et al.*, 2017; Sijtsema *et al.*, 2007). Moreover, health perception is interrelated with taste, *e.g.* naturalness was frequently linked to sweet taste and mango flavour. This supports the fact that quality dimensions are interrelated and exchangeably used by consumers to build their perceptions (Grunert *et al.*, 1996). The acquired data from the focus groups gave more insights into how participants perceived healthiness of a dried mango from its concrete characteristics, quality cues and benefits and how they are interrelated.

5.1 Variability in consumers' health perception of a dried mango

Participants vary in health perception of a dried mango, linked to product category and the eating context.

On the one side, they compared a dried mango either with a fresh mango or with high sugar products; see Section 3.1 and Figure 2. When compared with a fresh fruit, participants expect to find fresh-like characteristics, *e.g.* yellow-orange colour, sweet taste and fruity flavour. They link these concrete sensorial characteristics to the presence of nutrients like vitamins, minerals and antioxidants, and use them as a cue to define the healthiness of the product. Those participants who tend to search fresh-like characteristics in processed fruits think that a dried mango product should have characteristics as close as possible to fresh mango. These results support a previous perception study on vegetables which found that “sensory oriented” consumers require the product to be very close to its original form in terms of sensory properties, like appearance and freshness (Dinnella *et al.*, 2014). Thus, this should be taken into consideration when choosing a processing technology for products for targeting these consumers.

On the other side, participants considered the eating context, *e.g.* the position of a dried mango in the diet, either as a snack or as part of a meal (see Section 3.3. and Figure 2). When eaten as a snack, it was perceived as healthier than other non-fruit based snack foods, but less healthy than fresh fruits, in accordance with Jesionkowska *et al.* (2007). In this regard, there also seems to be a difference in health perception between countries. Indonesian participants mentioned more often negative quality cues and characteristics. This might be owing to Indonesian participants regarded a dried mango only as a snack, which often is perceived as indulgence and comfort food (Jack *et al.*, 1997).

When using a dried mango as part of a meal (an ingredient in muesli or added to yogurt or porridge), it was perceived as healthier by Chinese and Dutch participants than adding syrup or honey because it was perceived to contain vitamins and minerals. In this respect, a dried mango appears to be regarded as a healthier replacement of sugar to sweeten muesli or yoghurt. This supports Adams and Savage (2017), who revealed that the difference in the categorisation of a food product in the diet could influence the perceived healthiness of the product. This implies that product and process designers should be aware of where consumers position a product in their diet. Moreover, these results suggest that consumers may differ in their health perception, depending on the type of food product they compare with and the eating context they think of.

We chose three countries (NL, CHN and INA) differing in the amount and variety of dried fruits products on their market, assuming that these countries have a different familiarity with eating dried fruit. In accordance with the expectation Chinese and Indonesian participants were more familiar and mentioned more concrete characteristics

than Dutch participants. This is in line with a previous study which found that consumers with a higher product familiarity have been associated to having a more informed product evaluation on its characteristics, quality and benefits (Banović *et al.*, 2012). This suggests that consumers who are more familiar with the product might be more helpful to provide characteristics for product and process design.

Taken together, these results suggest that variability in consumers' health perception in terms of intrinsic characteristics, quality cues and benefits are relevant to be taken into account in the early stages of NPD.

5.2 Application of insights from consumers' health perception of a dried mango into product and process design

The TFQM of Grunert (2005b) provides a tool to structure and level the perceptions expressed by the participants. We added to this tool interrelation between product and process characteristics and showed how consumer perception is linked to this. Using natural dried mango product concepts as examples, we demonstrated the usefulness of insights in consumer perception for product and process design. Specifically, we were able to address how participants defined healthiness of dried mango in terms of what the product can or should contain and how processing affects the expected beneficial nutrients. The latter is in agreement with a previous study which found that, to some consumers, information about process technology is considered as an important factor during product evaluation (Deliza *et al.*, 2003).

The two presented product concepts show that consumer insights can be used in different ways to select product formulations and processing technologies and combine these when targeting specific consumers' perceptions. Based on the rich data, different selections and combinations could be made in order to develop several product concepts. Food manufacturers should further test, develop and optimise these concepts toward specific target groups.

The demonstrated transformation and application of the acquired product and process characteristics show the relevance of consumer insights on health perception to guide the design of the interrelated technical product and process specification in NPD. Using the guidance from consumer insights – instead of just trial and error – a product and process design team which ideally consists of consumer scientists and food technologists can “mix and match” the options for product formulation and processing technology to develop new product concepts.

5.3 Methodological considerations and future research

To the best of our knowledge, previous consumer perception studies scarcely explored the relevance of consumers' health perception of products in association with process design, especially in terms of established processing technology. Understanding how consumers perceive healthiness of a food product, from its product and process characteristics, quality cues and benefits might result in a more effective way to take the relevant characteristics for product and process design into account in NPD. Further research is required to assess whether the application of these insights increases the effectiveness of NPD. Follow-up research is needed to confirm that the developed product concepts are perceived as more healthy than the current products on the market.

6. Conclusions

This exploratory qualitative study illustrates an approach to identify differences in health perception among consumers having different familiarity levels with a dried mango and how to apply this knowledge in early stages of NPD. The healthiness of a dried mango was perceived in

four themes (nutrition, naturalness, taste and well-being) and on different levels of abstractness. At the same time, this perception is linked to and depending on the product category it is compared with (e.g. candy or fresh fruit) and to the eating context (e.g. position of the product in the diet). Chinese and Indonesian participants – who are relatively more familiar with a dried mango – mentioned more concrete characteristics than the Dutch participants.

It was shown that consumer insights in health perception of a product not only relates to product characteristics but also to processing and its characteristics. Natural dried mango product concepts were used to demonstrate the relevance of these insights into product and process design. Transformation of consumer insights and its application into product and process design requires iterative interactions between consumer scientists and food technologists.

Note

1. Shang huo is defined as inadaptability symptom of the body, e.g. inflamed throat, bleeding gums, etc., which can be caused by consuming certain foods (Rongrong and Hiroshi, 2008).

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