# Consumer experiences of tomato quality and the effects of credence

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## Abstract

Tomato (*Solanum lycopersicum)* is one of the most important horticultural crops and is produced, traded and consumed all over the world. For horticultural products, the concept of quality is an indispensably important factor in consumers' decision-making process and choice. While production efficiency and other production and distribution related properties have been in focus within the tomato industry, less focus has been on consumer experiences and satisfaction with, for example, taste. Beside physical properties of a horticultural product, there are also other quality attributes, which are related to personal values or trust: so-called credence characteristics. For example issues regarding morals and ethics, individual considerations such as health and convenience, or preconceptions related to factors such as origin or production method. While the consumers cannot accurately evaluate credence characteristics, the expectations they generate have an effect on consumers' perceived quality and sensory experiences. Labels of various kinds signalling credence characteristics play an important role in the modern food marketing system, as other links of trust and direct relations with the producers have vanished within the globalised food system.

In this thesis, Tomato is used as a reference product with the aim of explaining the multi-faceted notion of quality of horticultural products and its role in marketing. The aim is to provide an understanding of how the concepts of quality and consumer experiences and responses are related, with focus on consumers' experience with taste.

The first paper in this thesis study consumer views on tomato taste and assesses the effect of chilling on taste. The second paper examines consumer views of some of the most common and important credence characteristics; origin and production method; and explores their effect on consumer liking. The third paper delves further into credence and the effect on consumer liking, and correlates consumer attitudes with experienced quality. The fourth paper is a literature review on recent published papers on the topic, and proposes a conceptual framework describing the effect of credence on consumer liking of food

Theoretical, methodological and practical implications are discussed. Possible future directions for horticultural marketing strategies are identified; for the horticultural sector in general and the tomato industry in particular.



*Keywords:* Tomato, Consumer liking, Credence, Quality, Horticultural Economics, Marketing.



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# Dedication

Till Greta

*Himlen har landat på ett grässtrå, därför darrar det.*
Bo Setterlind

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# List of Publications

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

I Fernqvist, F. and Hunter, E. (2012). Who's to blame for tasteless tomatoes? The effect of tomato chilling on consumers' taste perceptions. *European Journal of Horticultural Science*. 77(5), 193-198.

II Ekelund, L., Fernqvist, F. and Tjärnemo, H. (2007). Consumer preferences for domestic and organically labelled vegetables in Sweden. *Acta Agriculturae Scandinavica C – Food Economics*. 4, 229-236.

III Fernqvist, F. and Ekelund, L. (2013). Consumer attitudes toward origin and organic – the role of credence labels on consumers' liking of tomatoes. *European Journal of Horticultural Science*. 78(4), 184–190.

IV Fernqvist, F. and Ekelund, L. (2014). Credence and the effect on consumer liking of food – A review. *Food Quality and Preference*. 32, 340-353.

The contribution of Fredrik Fernqvist to the papers included in this thesis was as follows:

I Project planning, experimental design and implementation, analysis and writing (with contributions from Erik Hunter in the analysis and writing process, and from Matilda Axelson and Mattias Andersson in the data collection process).

II Project planning, experimental design and implementation, analysis and writing (particularly the methodological part and the analysis section).

III Project planning, experimental design and implementation, analysis and writing (with contributions from Jan-Eric Englund in the experimental design and analysis, from Mattias Andersson, Fang Xu and Klara Wallby in data collection, and from Lena Ekelund in writing).

IV Paper concept, idea and the actual literature review process (with contributions from Lena Ekelund in the writing process, discussion and conclusions)

# 1 Introduction

## 1.1 The tomato in the horticultural value chain

This thesis lies within the area of horticultural science, specialising in horticultural economics, and examines consumer views and experiences of a horticultural product, using the example of the tomato. Tomato (*Solanum lycopersicum)* is used as a reference product with the aim of explaining the multi-faceted notion of quality of horticultural products and its role in marketing. This is an issue of great interest to the Swedish tomato industry, the representatives of which took an interest to the research question at an early stage (Tjärnemo *et al*., 2010).

Tomato is one of the most important horticultural crops at present in terms of both production volume and economic value, as described in Chapter 4 below. Tomato is produced, traded and consumed all over the world. However, the tomato also has many of the problems potentially associated with a fresh horticultural product, as it is sold fresh, is sensitive to temperature fluctuations and mechanical injuries, and is difficult to handle in later ripening stages. Due to these characteristics, plant breeding and production work have focused on high yields, pest resistance, production efficiency and suitable tomato handling properties within the distribution system. The objectives underlying this work may have been to improve production and distribution profitability, but there has been less focus on the consumers' quality experience and their satisfaction with the product, for example tomato taste. The tomato thus illustrates how horticultural science and horticultural food production have become distanced from the consumer, which will be further elaborated in Chapter 4.

Horticultural economics is about understanding the economic environment and market, which surrounds and affects all the facets within the horticultural value chain. An exposé over the role of horticultural economics is given in the following subsection. The consumer is the most important step in this value

chain and is the centre of attention, since it is only through satisfying the consumers' needs and wants that the actions taken upstream in the value chain can be justified. Without satisfied consumers, the horticultural chain would not be economically viable. Thus, understanding marketing, how to satisfy consumer needs and wants, is a very relevant component of horticultural economics. A critical aspect is to communicate how these needs and wants can be met with a unique marketing offer. For horticultural products, the concept of quality is an indispensably important factor in consumers' decision-making process and choice. Besides the physical properties of a horticultural product, there are also quality attributes related to personal values or trust which are important to the consumer. For example, issues regarding morals and ethics, individual considerations such as health and convenience, or preconceptions related to factors such as origin or production method; so-called credence attributes. Labels of various kinds often signal such attributes. The theoretical framework on concepts of food quality and consumers' quality perceptions is developed in Chapter 3

One of the most important characteristics of edible horticultural products, *i.e.* fruit and vegetables, is taste. Consumers' quality experience in this context, thus, may be expressed as liking, or experienced taste. Although not fully interchangeable, these terms; quality experience, liking and perceived or experienced taste; are often used with the same meaning. Quality experience is dependent on many factors besides actual taste, not the least contextual factors, such as environment, situation or social setting. Liking comprises more than just taste, it also includes experiences of for example texture and colour. Perceived, or experienced, taste may in turn include flavour and fragrance, and is also affected by surrounding factors, which may distort the sensory experience.

Consumers' previous quality experiences have an effect on future expectations and purchasing behaviour. Thus, a relevant issue is to understand how consumers' experienced quality, *e.g.* as expressed by liking or perceived taste, is affected by various quality characteristics. This type of knowledge is essential in the marketing of fruit and vegetables, as well as of other types of food. While Chapter 3 provides a background to the understanding of consumers' quality experiences, the results (Chapter 7) and discussion (Chapter 9) sections put this in relation to the reference product, the tomato.

## 1.2 Horticultural sciences and the role of horticultural economics

Horticultural science covers numerous aspects of the horticultural value chain. As discussed by Doyle and Kelleher (2009), to increase the understanding of horticulture, the key is to describe its impact on the physiological, psychological and social activities of people. Referring to Tukey (1962), the field of horticultural science includes those concerned with science or biology issues, those concerned with business, and those concerned with the home or aesthetics side. The varied disciplines involved in horticultural science may include *e.g.* '*plant nutrition, soil science, crop physiology, pathology, entomology, crop protection, economics, post-harvest techniques, processing and storage, breeding and genetics*' (Callesen, 2007:495), but it also extends to all related activities; from distribution to IT systems and effects on landscape, the environment and human health, and even into new ventures, *e.g.* horticultural therapy or therapeutic horticulture (Doyle & Kelleher, 2009).

As part of a trans-disciplinary research field, all aspects are interrelated to each other, and the role of economics within the field of horticultural science is as important as all the other aspects. By improving the horticultural production system and understanding the economic world, including the businesses it comprises and the economic activities occurring in the system, horticultural science and horticultural economics contribute to the mutual benefit of all those involved, from producers to consumers. However, they also assist in improving less graspable dimensions of society and the environment. In discussing the scope of economics in horticulture, Folley (1976) suggested that two aspects of horticultural economics in particular, production economics and marketing economics, can allow knowledge to be advanced and passed on to others along recognised lines. However, Folley (1976) also noted that there might be other aspects in the field which are not as apparent (at least at that time). Environmental economics is perhaps one such aspect, regarding the effects of environmental issues related to water and soil management, or the issue of climate change. Nevertheless, the scope of horticultural economics is wide, as '*it may be said that we are working in the sphere of markets;* […] *in the sphere of entire economics, extending to social consideration,* [and…] *in the sphere of international relations as a whole, extending to politics*' (Folley, 1976:13).

As pointed out already by Folley (1976), one of the main ignored aspects in horticultural science appears to be consumer demand as regards the commercial aspects of horticulture and, as discussed by Ekelund *et al.* (2008), is still the case. This could be described as equally being a production and a marketing matter. Advances in horticulture often do not originate from having consumer demand primarily in mind, but rather from biological and

production-related pre-identified research questions. Therefore, it is not uncommon for consumer aspects to be lacking when horticultural science as a field is described, although the aspect of production economics is more frequently addressed. As noted by Shewfelt (1999:197), '*most postharvest researchers, producers and handlers are product-oriented, while consumers, marketers and economists are more likely to be consumer-oriented in that quality is described by consumer wants and needs'*, thus pointing at the problem that not much research does both parts of the chain (*i.e.* production and marketing issues). When the American Society of Horticultural Science celebrated its 100-year anniversary, Janick and Goldman (2003) reviewed the large advances in horticultural science achieved during the 20th century, including those of the mechanical revolution, the chemical revolution and the biological revolution. While production economics was apparently the driver behind these revolutions, the consumer revolution and a consumer focus was absent. Schreiner *et al.* (2013:63) concluded that understanding the diverse quality perspectives, especially understanding the end customer, '*is an essential prerequisite for a successful cooperation within the horticultural supply chain*'. In discussing the future of horticultural science and education from an European perspective, Bogers (2007:4) pointed out that in order to strengthen horticulture, the knowledge base must be sustained and education '*should not only emphasise traditional horticultural science but should also focus on knowledge about the market*'.

The inclusion of the economic aspects into horticultural science would probably not have been possible without the pioneering work of the new horticultural economists appearing in the 1960s and 1970s. The Commission for Economics and Management became active within the International Society for Horticultural Science (ISHS), with its first official meeting organised in 1962 (Bennet, 1969). In particular, the work of Sangers (*e.g.* Sangers, 1969; 1974), Donelius (*e.g.* Donelius, 1973), Carlsson (*e.g.* Carlsson & Ekelund, 1979), Meulenberg (*e.g.* Meulenberg, 1978) and Alvensleben (*e.g.* Alvensleben, 1984) should be mentioned, as they introduced and raised consumer aspects and marketing of horticultural products as a new field within horticultural science and horticultural economics.

Starting from the consumers' viewpoint and having consumers' needs, wants and demands primarily in mind would help horticultural science research to make even greater achievements as regards societal benefits, as well as economic contributions.

# 2 Objectives

The overall aim of this thesis is to provide an understanding of how the concepts of quality and consumer experiences and responses are related. Tomato was used as a reference product and particular emphasis was placed on consumers' experienced taste and the effect of credence characteristics.

Specific objectives were as follows:

1) Chilling has been suggested to be a strong contributor to loss of flavour in tomatoes. There are several occasions in the distribution chain where unwanted chilling can occur, including consumers' own post-harvest behaviour. *The first objective* was to examine whether post-harvest treatment, *i.e*. chilled storage, has a significant effect on consumers' perceived taste.

2) The role of credence characteristics is becoming increasingly important as a means of signalling quality. *The second objective* was to provide insights into how quality can be signalled through so-called credence labels, and how consumer experiences are affected by two of the most common credence cues of food: 'origin' and 'organic'.

3) *The third objective* was to devise a conceptual framework for food in general, explaining consumer quality experiences as dependent on a product's intrinsic and extrinsic characteristics through the intervening roles of mediating and moderating factors. Here, credence characteristics were included as a special case.

Theoretical, methodological and practical implications were analysed. The results were then used to identify possible future directions for horticultural marketing strategies – for the horticultural sector in general and the tomato industry in particular.

# 3 Theoretical considerations

## 3.1 Understanding the food consumer

Consumer demand consists of wants backed up by purchasing power. Wants in turns are expressed as needs, shaped by person and culture. Consequently, to understand consumer behaviour, it is necessary to understand what these wants comprise (Armstrong & Kotler, 2002).

Consumer behaviour depends on a broad array of factors, which affect the consumer in the process of choosing between different products, as well the time and place in which choice occurs. Basically, the product must meet the consumers' wants, to at least be considered as an alternative to be purchased. Consumer behaviour and food choice, and the role of various factors affecting this, have been discussed in numerous model proposals (see *e.g*. Shepherd, 1989; Furst *et al*., 1996; Grunert *et al*., 1996; Sobal & Bisogni, 2009). It is in this context that the concept emerges of quality of horticultural products, such as fruits and vegetables, as quality is linked to food choice and consumer demand (Grunert, 2005). As pointed out by Harker *et al*. (2003), the research on consumer response to fruit has mainly been driven from the perspectives of, firstly, the need for improving the competitiveness of the industry, and, secondly, the need to increase fruit consumption for public health reasons. In both cases, there have been difficulties in evaluating the impact of quality on consumer preferences and choice of product (*ibid*.).

## 3.2 The concept of food quality

In marketing, quality is an essential aspect as it is related to the needs and wants of the consumer (Shewfelt, 1999). The concept of quality of food should be considered multidimensional and multidisciplinary (Köster, 2009). There

are objectively measurable quality factors, relative quality approaches and, from the consumer perspective, subjective quality, as described below.

Two definitions on quality may be taken from the International Standardisation Organisation (ISO): In the ISO 8402 scheme, it is defined as '*the totality of characteristics of an entity that bears on its ability to satisfy stated and implied needs*' (McEachern et al., 2001). In the later ISO 9000 scheme, it is defined as '*the degree to which a set of inherent characteristic fulfils requirements*' (Hoyle, 2001). The idea behind these certification schemes is that these requirements can be measured objectively in different ways, in order to secure certain quality levels, improve management and effective use of resources and, not least, to facilitate trade, as both buyers and sellers have accurate knowledge of the products' characteristics. These popular definitions of quality are used to fulfil the buyers' requirements downstream in the food supply chain (Schreiner et al., 2013).

However, in these and other similar certification schemes, the quality properties measured are objective and mainly connected with management structures within a firm. Consequently, they primarily meet the needs of the producers and the distribution chain, rather than those of the end consumer. Thus, from the consumer perspective, an ISO specification of quality may be both vague and non-specific. Another weakness of this 'objective' approach is that quality within the horticultural value chain may be evaluated differently in the different steps from producer to end consumer.

The 'universal definition of quality' used in the ISO certification schemes aim to take into account of the various quality concepts of all stakeholders (Schreiner *et al*., 2013). Satisfaction of consumer wants or needs through giving value for money, and thus creating a profit, is the sole aim of the marketing chain, as discussed by Ekelund *et al*. (2008). However, as shown, the large-scale system has its own requirements, quality schemes and certifications for the producers to comply with, which implies a conflict in views on quality between different levels within the integrated value chain (*ibid*.).

Alternatively, quality may be seen a comparative concept and on a more general product level, as proposed by Monroe and Krishnan (1985:212) with the definition: '*perceived product quality is the perceived ability of a product to provide satisfaction relative to the available alternatives*'. However, this approach also has its shortcomings, as the subjective experience of a consumer may not necessarily always include a comparison with the alternatives.

A third concept may thus originate from subjective values. As noted by Brunsø *et al.* (2002), the distinction between objective and subjective quality is important when discussing the perception of food quality from a consumer

point of view. The concept of subjective quality includes the consumers' own experiences and their specific needs, wants and demands.

All three approaches (objective, comparative and subjective) contribute important aspects on how to work with 'quality'. Nevertheless, as pointed out by Ekelund *et al.* (2008), in a marketing perspective the *right* quality level is not the same as a *high* quality level in any measurable sense. Through different brands, packaging, labels *etc*., food sellers attempt to differentiate their products, signal quality by different means and increase consumer satisfaction, all in order to gain competitiveness on the market.

## 3.3 Quality cues and attributes

In evaluating a product, consumers' quality perceptions are based upon intrinsic properties related to the physical product and upon extrinsic properties which are related to the product, but not physically part of it (Olshavsky, 1985). The different product characteristics can be divided into *quality cues* and *quality attributes* of the product (Steenkamp, 1990). Quality cues can be assessed before consumption, and may be intrinsic or extrinsic (Olson, 1977). Intrinsic cues are part of the physical product (*e.g*. colour, size, damage), while extrinsic cues are associated with the physical product (*e.g*. brand, label, price, packaging, retailer). The quality cues are defined as informal stimuli related to the quality of the product, which can be ascertained by the consumer through the senses prior to consumption. The accessible information, *i.e*. the quality cues to the consumer work as a signal influencing both food choice and quality perceptions. An overview is presented in the Results section below, visualising the relationship between these intrinsic and extrinsic properties, and their effect on the consumers' quality perception (Figure 2, p. 44).

Quality attributes, on the other hand, are the functional and psychosocial benefits or consequences provided by the product, and represent what the product is *perceived* as doing or providing for the consumer (Steenkamp, 1990). These quality attributes are unobservable prior to consumption. While many of the intrinsic properties of fruit and vegetables are assessable before consumption, *i.e*. intrinsic quality cues such as colour, shape, size, smell, presence of damage *etc*., quality attributes may include *e.g*. taste, texture, juiciness or nutrient content. As reviewed by Schreiner *et al*. (2013), such nutrient compounds may include *e.g*. glucosinolates, flavonoids or carotenoids, and support important functions for human health and wellbeing. However, from the consumer perspective these compounds are rather unknown, and instead fruit and vegetables may be generally associated with being 'healthy', which is the main message of many public health recommendations, such as

the Swedish National Food Agency's 'eat 500 g of fruit and vegetables a day' (Eneroth, 2012), the Danish Ministry of Food, Agriculture and Fisheries' recommendation of '6 a day' (Fødevaredirektoratet, 2012), or the UK government recommendation of 'five a day' (Food Standards Agency, 2006). Nevertheless, as health may be an important factor, sensory perceptions, in particular taste, are generally described as the most important factor for consumers' food choice (Roininen *et al*., 1999; Carrillo *et al*., 2011). Thus, as actual taste cannot be experienced before consumption, expected taste, logically, would be one of the strongest drivers for food choice.

## 3.4 Credence

Another way to describe the constituents of quality is to make a distinction between search qualities, which can be ascertained before consumption, and experience qualities, which can only be ascertained after consumption (Nelson, 1970). A third class of quality properties is '*credence*', which cannot be evaluated in normal use (Darby & Karni, 1973). Credence may involve labels or other kinds of information signalling, *e.g*. nutritional value, food safety, ethics or trust. Credence refers to the credibility of the seller in relation to the buyer (Grunert, 1997), but even after using a product, credence claims cannot be verified by the consumer due to lack of technical expertise or practical possibilities (Ford *et al*., 1988). Consumers' inability to evaluate certain intrinsic qualities, for instance taste, before purchasing increases the importance of credence characteristics (Lobb & Mazzocchi, 2007). These characteristics are thus transformed into search cues, often in the form of labels (Caswell & Padberg, 1992; Caswell & Mojduszka, 1996). The role of credence in the marketing of food is most probably increasing in importance in relation to other search and experience characteristics, as pointed out by Grunert *et al*. (2000).

As discussed by Moser *et al.* (2011), differentiation claims may include factors relating to consumers' experiences of eating quality, as well as credence attributes related to environmental and other social effects. In a review of research on credence-based attributes associated with fruit and vegetables and their role in consumer buying behaviour, Moser *et al*. (2011) identified five categories of credence attributes:

1) Health-related components
2) Production method-related attributes (including organic production)
3) Environmental and socially orientated attributes
4) Local and origin-related attributes
5) Certification and other labels.

It is not easy to determine how the consumer relates all these attributes to each other, given that in an ordinary shopping environment there are no limitations on the amount of information given and it is difficult to conclude which weight each attribute contributes to an actual choice. However, existing knowledge still indicates that certain credence attributes appear to have a significant role both in choice and quality experiences. Previous research has found that in particular, the concepts of organic (*e.g.* Ekelund, 2003; Hughner *et al*., 2007; Aertsens *et al*., 2009) and origin (country or region of origin and locally produced) (Bilkey & Nes, 1982; Al-Sulaiti & Baker, 1998; Verlegh & Steenkamp, 1999) are likely to be associated with high quality, and that consumers prefer domestic products (Juric & Worsley, 1998; Nygard & Storstad, 1998; Henchion & McIntyre, 2000; Sassatelli & Scott, 2001; Frandsen *et al*., 2007). According to Winter (2003), domestic national foods may be regarded as 'local' according to the definition of 'flexible localism', favouring national food over imports, which is also the case for country-of-origin effects. Labels signalling country or region of origin (*e.g.* van der Lans *et al*., 2001; van Ittersum *et al*., 2003; Dransfield *et al*., 2005; Allen *et al*., 2008) or organic production (*e.g.* Johansson *et al*., 1999; Grankvist *et al*., 2007; Poelman *et al*., 2008) have consequently also been shown to have strong effects on consumers' quality perception of food.

Health appears to be less important as an argument in consumer choice, as discussed by Bogers (2007), as health effects are difficult for consumers to determine. However, it could be the case that when it comes to fruit and vegetables, these products are already associated with being healthy and thus health is not an additional argument for increasing demand. Instead, it seems as if 'organic' is a credence attribute signalling health, as the major argument for purchasing organic food is health and taste, and not ethical or moral considerations (Roininen *et al*., 1999; Ekelund, 2003; Aertsens *et al*., 2009).

Thus, as described above, in particular *origin* and *organic* appear to be strong credence cues having an effect on both consumer choice and quality expectations.

## 3.5 Experiencing quality

Experienced food quality is influenced by intrinsic quality attributes of the physical product, which can only be ascertained through consumption (*i.e.* sensory properties, such as taste, leanness, tenderness), and quality expectations (Steenkamp & van Trijp, 1996).

Expectations are generated by various cues, both intrinsic and extrinsic, and influence consumer choice, sensory perception and liking of food, but the expectations also derive from previous experience (Deliza & MacFie, 1996).

Quality perceptions are also influenced by the personal and situational factors occurring in a contextual setting. These include factors such as personal values, beliefs, attitudes and demographics (Steenkamp, 1990). Meal preparation, consumption situation, context and environment can also be grouped into this category of factors (Furst *et al*., 1996; Grunert *et al*., 1996; Bernues *et al*., 2003; Köster, 2009).

The role of attitudes, in particular, is a factor widely discussed as influencing consumer behaviour. The Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the extended Theory of Planned Behaviour (Ajzen, 1991) use attitudes and subjective norms to predict intended behaviour, through the formation of behavioural intentions. An attitude can be described as a learned predisposition and based upon beliefs about the object (Fishbein & Ajzen, 1975). Following the model of consumers' quality perception process (Steenkamp, 1990); it can be assumed that attitudes (or underlying beliefs) can be used to predict experienced quality of food, as shown by the conceptual framework presented in Figure 2 (p. 44). However, a certain attitude does not always ensure a person to perform a specific behaviour (*e.g.* making a purchase), a paradox, which is often referred to as the *attitude-behaviour gap* (Vermeir & Verbeke, 2006).

# 4 Exposition – The case of the tomato

## 4.1 The market for fresh tomatoes

The tomato is one of the most popular vegetables in Sweden and in the rest of Europe (Eurostat, 2013). The total production within the European Union (EU) amounted to 15.9 million tonnes in 2012, with Italy being the largest producer (6 million tonnes), followed by Spain (4 million tonnes) and Portugal (1.4 million tonnes) (Eurostat, 2013). The Swedish production amounted to 15,000 tonnes in the same period, while the Netherlands, the main country exporting tomatoes to Sweden, produced 805,000 tonnes (Eurostat, 2013). The main difference between northern and southern parts of the EU in production is due to climate. In the northern part all tomatoes are grown in greenhouses, while in the southern part they are grown in the field, often in plastic tunnels. The field-grown tomatoes are also used in the processing industry.

The fresh consumption of tomatoes in Sweden amounted to 9.8 kg per person in 2010, an increase from 8.6 kg per person in 2000 and from 6.3 kg per person 10 years earlier, in 1990 (Swedish Board of Agriculture, 2013). Thus consumption has increased by more than 50 per cent over a period of 20 years. In comparison, in Germany, the largest country in the EU, the annual consumption of fresh tomatoes reached 6.7 kg per person in 2012/13 (German Federal Office for Agriculture and Food, 2013). The latest available data on mean annual tomato consumption in the EU, for the period 2002-2006, show a value of 12 kg per person and year (Eurostat, 2008).

In a Swedish setting, the single round ‘standard tomato’, including ‘on-the-vine’, is the most commonly purchased type of tomato, accounting for around 75 per cent of total purchases measured in volume. However, the ‘single round’ is continuing to lose market share. While cherry varieties accounted for 18 per cent of volume in 2009, they represented 30 per cent of the economic

value, and the differentiated varieties appear to be increasing both in volume and in economic value (Tjärnemo *et al*., 2010).

While Swedish tomato consumption has increased in recent years, the domestic market share during the main production season (April-October) fell from 43 to 26 per cent between 1998 and 2008, with imports coming mainly from the Netherlands making up the shortfall (Tjärnemo *et al*., 2010). Viewed over the whole year, Swedish market share decreased to 14 per cent in 2009, from 28 per cent in 1990 (Swedish Board of Agriculture, 2011). In wintertime, a larger proportion of tomatoes is imported from Spain (*ibid*.). Total imports to Sweden amounted to 85,400 tonnes in 2009, with a value of one billion SEK (Tjärnemo *et al*., 2010). Less than 5 per cent of the Swedish greenhouse tomato area consists of organic production (Swedish Board of Agriculture, 2013).

## 4.2 Tomato taste

Although consumption is increasing, 'lack of taste' in tomatoes has become a reason for consumer dissatisfaction (Hobson, 1988; Bruhn *et al*., 1991; Ratanachinakorn *et al*., 1997; Parks & Newman, 2005; Estabrook, 2011). In the 1990s, tasteless tomatoes received such severe criticism from German consumers that they were given the nickname '*the Dutch Wasserbombe'* (water bomb) (Baldwin *et al*., 1998; Friedland, 2006; Ekelund & Jönsson, 2011; Estabrook, 2011). Reasons for this lack of taste have been widely discussed, and the main accepted explanation is that the industry has been focusing on yields, pest resistance, product homogeneity, durability and low price, while taste parameters have been a lower priority within plant breeding, production and distribution (Hobson, 1988; Baldwin *et al*., 1998; Friedland, 2006; Hongsoongnern & Chambers, 2008; Ekelund & Jönsson, 2011).

Tomato taste is complex. Its characteristic flavour is due to several components, such as reducing sugars, free acids and volatile substances, but also minerals and amino acids. More than 400 volatile substances have been found in tomato (Petro-Turza, 1986). Various factors have been found to have an effect on the taste. The most commonly studied of these factors is the effect of different varieties (*e.g.* Baldwin *et al*., 1998; Verkerke *et al*., 1998; Serrano-Megias & Lopez-Nicolas, 2006), but other studies on taste include the effect of growing method (Zhao *et al*., 2007), use of fertilizers (Heeb *et al*., 2006), ripening in the field or at room temperature (Bisogni *et al*., 1976), storage in controlled atmosphere (Ratanachinakorn *et al*., 1997), fruit maturity (Nelson *et al*., 1972), comparisons of farmers' market and supermarket produce (Sommer *et al*., 1979), salinity treatment (Mizrahi, 1982), maturity stage at harvest

(Watada & Aulenbach, 1979), and storage period (Kader *et al*., 1978; Auerswald *et al*., 1999; Krumbein *et al*., 2004).

The effect of storage temperature on tomato quality has received particular attention, as it has been found that there is a lack of development of volatiles under chilling conditions, indicating that refrigerated storage leads to a loss of fresh tomato flavour by lowering the concentrations of volatiles (Buttery *et al*., 1987; Stern *et al*., 1994). Flavour and aroma are significantly affected by temperatures below 12.5°C (Maul *et al*., 2000), while acid content increases (Farneti *et al*., 2010), and it has been shown that fruits ripened directly at 20°C contain more reducing sugars (Kader *et al*., 1978). All this indicates that refrigerated storage leads to a loss of sensory quality, in particular taste. Tomato skin colour has also been shown to be affected by storage temperature, with normal ripening patterns for colour not occurring below 12°C or above 30°C (Tijskens & Evelo, 1994). Inappropriate temperature treatment in the distribution chain or in store may be one of the reasons behind loss of taste in tomatoes and consumer dissatisfaction. Inappropriate post-harvest treatment in the home may also be a factor to consider, but has received little attention in the literature. Bruhn *et al*. (1991) showed that around half of American consumers refrigerate their tomatoes at home, while in the same study 40 per cent were dissatisfied with quality. Parks and Newman (2005) similarly showed that 70 per cent of Australian consumers stored their tomatoes chilled, while 57 per cent felt that tomato flavour was poor. Studies using trained expert panels have shown that different storage treatments have an effect on taste (Kader *et al*., 1978; Maul *et al*., 2000). These and similar findings have led to the suggestion that consumers should be educated about suitable tomato storage techniques (Sommer *et al*., 1979; Bruhn *et al*., 1991).

Taste loss in tomatoes due to chilling has mainly been demonstrated in previous studies by using chemical analyses and trained descriptive panels. However, while a trained expert panel may be able to taste the difference between tomatoes receiving different storage treatments, a critical issue is whether ordinary consumers actually perceive a difference and thus whether handling procedures both in the distribution chain and in consumers' homes have an effect on consumer taste experience and level of satisfaction. It has not been unambiguously demonstrated that expert panels and consumer panels reach the same results in taste assessments, mainly as expert panels are trained and calibrated for conducting descriptive tasks, while members of consumer panels evaluate subjectively on a hedonic scale and may have different taste preferences (Hersleth *et al*., 2005). The issue of temperature effects on tomato taste, as experienced by consumers, was thus one subject of research in this thesis. As both chemical analyses and descriptive panels in earlier studies have

shown that the taste of fresh tomatoes is affected negatively by chilling, it is reasonable to believe that dissatisfaction with taste among ordinary consumers may depend on chilling of the tomatoes somewhere on the way between the producer and the actual consumption event.

## 4.3 Positioning on a horticultural market, the role of marketing

The fresh fruit and vegetable category stands out as a special case in the food market. Many fresh food products are sold unbranded and are largely treated as commodities (Nijssen & Van Trijp, 1998). Central quality cues such as packaging and brands are often absent in this category (Lejdström & Teytaud, 2007; Grebitus *et al*., 2009), and there is a lack of strong producer brands (Heiman & Goldschmidt, 2004), apart from some multinational brands of exotic fruits, for example the banana industry which is dominated worldwide by the three companies of Dole Foods, Chiquita Brands and Fresh Del Monte Produce (Van de Kasteele, 1998). From this perspective, the fruit and vegetable department is thus an opportunity for differentiation and a possibility to create a store image and identity (Bech-Larsen & Esbjerg, 2006).

According to the generic strategies of positioning on the market (Porter, 1991), there are the options to either head for low-cost production and compete on low price, or to differentiate the products to make them unique in relation to the alternatives, and thus gain a competitive advantage. A third option could be to narrow the target group, *i.e*. to focus (*ibid*.). The case with most edible horticultural products being treated as commodities, means that the suppliers of these products are easily replaceable. There will always be another supplier somewhere to fill the gap if one disappears. The price competition is fierce, which has also led to a great price focus. In this regard, the horticultural industry finds itself at a strategic crossroads on whether to focus on low cost and bulk, or on differentiation by means of, among other things, stronger brands, labels, packaging *etc.* (Ekelund & Fernqvist, 2008). Otherwise, it risks becoming 'stuck in the middle', and thus failing to compete in either way according to the generic strategies of positioning on the market (Porter, 1991). This risk is even more pronounced considering the growth of retailers' own-label brands, where the retailers exercise both sourcing and market control (Wells *et al*., 2007).

The tomato market situation can be described as a state of 'hypercompetition' (Ekelund Axelson & Axelson, 2000), which following the D'Aveni (1994) framework would be defined as a situation of rapidly escalating competition, dynamic movement and constant disequilibrium and change. In such a situation, as discussed by Ekelund Axelson and Axelson

(2000), the industry should work on visions and strategic planning if it is not to be out-manoeuvred by large buyers and pushed out by competitors. Since the publication of the study in 2000 on hypercompetition on the market, one can say that competition has become even stiffer. Swedish tomato producers have continued to lose market share on the Swedish market. The European market is fluctuating, and producers in the main export countries to Sweden have partially met price decreases with increased differentiation (Tjärnemo *et al*., 2010). Thus, several alternative types of tomato varieties to the single round standard tomato have entered the Swedish market, mainly consisting of imports. Examples of these are 'cocktail', 'cherry', 'plum', and 'on-the-vine' tomatoes, and special varieties sold under 'variety brands', such as 'Romantica', 'Fantastica', 'Kumato', 'Chocomato' *etc.*, but still without a strong producer brand or other characteristic that would differentiate one producer from another. An exception would possibly be the strong market position of the national growers' cooperative 'Flandria' in Belgium (see *e.g*. Verbeke *et al*., 2008). When it comes to the increasing organic market, which in Sweden grew with 13 per cent in 2013 to a value of SEK 11.6 billion (EkoWeb, 2014), consumer demand for organic products is increasing, and there is also an increased interest in organic tomatoes from supermarkets (Tjärnemo, 2011).

The role of country of origin is a particular issue. On the one hand, origin appears to be less important with the new varieties, especially when supermarket chains use their own supermarket labels. On the other hand, country of origin is seen as a strong signal to the consumer, which explains why one of the largest Danish tomato producers, Alfred Pedersen & Søn, has taken over and decided to expand Sweden's largest tomato greenhouse, located outside the southern Swedish city of Trelleborg (Campbell, 2013). It may also explain the establishment of a large greenhouse facility by the producer brand 'Thanet Earth' near London, backed by, among others, leading Dutch tomato producers (Thanet Earth, 2014).

To conclude, a number of trends, from the perspective of the Swedish tomato market, influencing the tomato industry's strategic decisions can be distinguished. Empirical examples here are drawn first and foremost from the Swedish market, but it is the hope that readers from other countries may find similarities with the situation there:

1) A continuing focus on low price and price leadership for a homogeneous and standardised product, regardless of origin.
2) Increased differentiation with new varieties claimed to have a better taste, accompanied by various forms of attractive packaging.

3) A trend for signalling country of origin as a way to face increased competition and take advantage of consumers' positive attitudes to domestic produce.
4) An increase in organic food, a credence characteristic signalling either health or ethics.

Trends (1) and (2) focus on signalling only intrinsic quality cues (shape, colour, size), and, in the case of trend (1), an extrinsic cue of low price. Trends (3) and (4) involve signalling of credence cues as a way to attract consumer interest and communicate quality, also possibly with a price focus.

This implies that in order for a marketing strategy to work in practice, it is necessary to understand consumers' behaviour and how they respond to intrinsic and extrinsic quality cues, including credence. This includes how quality is experienced (expressed as consumers' liking or perceived taste) due to these cues, and in the longer run how they affect purchasing behaviour. The studies described in this thesis examined how the concepts of quality and consumer responses are related.

# 5 Outline of the thesis

This thesis is based on the compiled results from four different studies (Papers I-IV), published in the period 2007-2014. The papers are connected by the theme of consumer experiences of quality. In Papers I-III, the tomato is used as a reference product. Consumer responses to different types of quality signals, *i.e*. (extrinsic) credence cues and intrinsic quality attributes (tomato taste) are studied. The studies also gathered data on consumer attitudes and habits. Paper IV provides a conceptual review of studies discussing different food products.

## 5.1 Who's to blame for tasteless tomatoes? The effect of tomato chilling on consumers' taste perceptions (I)

Paper I (comprising objective 1, see p. 13) is based on a quantitative consumer study: a questionnaire survey on consumer views of tomato taste and how tomatoes are treated in the home, and a taste assessment. In the taste assessment, consumers tasted tomatoes which had been chilled or stored at room temperature, in order to study the effect of chilling on consumer liking of tomato taste (*i.e*. an intrinsic quality attribute). As much of the research done to date describes chilling as a fundamental issue in how tomato taste is negatively affected, it was seen as important to study how consumers responded to changes in taste due to chilling, and determine whether chilling really is to blame for tasteless tomatoes.

## 5.2 Consumer preferences for domestic and organically labelled vegetables in Sweden (II)

Paper II (comprising objective 2) is based on three sub-studies using different methodologies. Two of these sub-studies are presented in this thesis. The third, a conjoint study on attributes of carrots and their effect on consumer choice, was deemed to lie outside the scope of the thesis.

The two sub-studies included examined consumer attitudes toward labels of credence in more depth and assessed the effect of labels on consumer liking of tomato taste. A structured (explorative and qualitative) consumer survey gathered consumer associations toward two common credence cues; origin (domestic/imported) and production method (organic/conventional), and thus also probed consumer attitudes towards these concepts. A simple taste assessment was conducted, where consumers were asked to taste tomatoes with different labels (domestic, imported and organic), in order to study whether labels affected liking of taste.

In chronological order, Paper II was the first to be published. The results indicated that the effects of credence on consumer liking needed to be further studied, and thus opened the way for the subsequent research trajectory. Paper II is presented second in this thesis, as it is a deeper study than Paper I and directly precedes the work described in Paper III. Paper II introduces external cues, credence cues, as having an effect on consumer liking of tomatoes. The results confirm that consumer liking is based on more than just the intrinsic quality attributes of a fruit or vegetable. The rather simple taste assessment implied that the methodology should be more refined in future assessments with consumer panels.

## 5.3 Consumer attitudes toward origin and organic – the role of credence labels on consumer liking of tomatoes (III)

Paper III (comprising objective 2) used the findings from Papers I and II as its point of departure to examine in more depth the issue of credence labels and their effect on consumer liking. The study included a questionnaire survey including questions on consumer views on tomato taste, treatment of tomatoes in the home, purchasing habits and a range of questions measuring consumer attitudes towards a range of concepts related to taste and labels of credence. Paper III also included a taste assessment in a more controlled environment, where a consumer panel tasted tomatoes with different types of labels. Experienced liking of taste was then correlated with stated attitudes towards two core concepts (origin and production method). Paper III thus used more

sophisticated methodology than Paper II, and also examined consumer liking based on a moderating variable, *i.e*. attitudes. However, Paper III has a shortcoming in the statistical processing of the data, which was discovered after publication. The inaccuracy does not change the direction or conclusions of the results, *i.e*. significant findings are still significant with the correct analysis. However, with the correct statistical analysis the results would have been stronger than presented in the paper. In presentation of the results below, the correct analysis is provided, while the difference between the analyses is shown in Appendix 1.

## 5.4 Credence and their effects on consumer liking of food, a review (IV)

The results from Papers I-III and the work of writing the papers led to a conclusion that a more thorough review of how consumer experiences of food are affected by credence cues was needed. This was especially the case since some years had passed since the start of this PhD project and the body of research had increased significantly during the period. In addition, a more easily accessible model of consumer responses to credence cues would facilitate future research and practice. Thus, this review and conceptual model of the phenomenon studied are presented as the final piece of the thesis in order to tie the constituent components together and identify trends for the future.

In Paper IV (comprising objective 3), papers published in the period 2003-2012 and studying the effects of credence on consumer liking of food were reviewed. The paper presents a conceptual model of how consumers respond to quality attributes and cues, through the mediating factor of expectations, and moderating factors, such as personal factors, situation, environment, *etc*. The review was not restricted to studies on specifically horticultural products, but included studies on food in general. Therefore, the conclusions reached are not only applicable to horticultural products, but may also be generalised to food in a broader perspective. Paper IV draws together the main conclusions on credence and the effect on consumer liking of food.

# 6 Materials and methods

## 6.1 Taste evaluation of the effect of chilling on tomato taste, and consumer survey (I)

Paper I consisted of a survey and a taste assessment. The objectives of the work were to describe consumers' post-harvest treatment of tomatoes at home and to test the effect of temperature on taste perception. The hypothesis was that a consumer panel consisting of ordinary consumers would prefer tomatoes stored at room temperature to those chilled under ordinary refrigerated conditions (*i.e.* 7°C), regardless of variety. This temperature was chosen as the average refrigerator temperature in Swedish households is between 4 and 8°C and 60 per cent of Swedish consumers maintain a storage temperature of between 6 and 10° (Konsumentföreningen Stockholm, 2011), which is well below the recommended 11-14°C storage temperature for tomatoes given by the National Food Agency (Livsmedelssverige, 2009). Empirical data were obtained in a consumer survey that combined questions on consumer handling procedures at home with data from a within-group experiment where consumers evaluated chilled and unchilled (room temperature) tomatoes. The questionnaire is presented in Appendix 2.

The experimental conditions in the taste assessment varied, with the most commonly grown commercial variety of tomato in Sweden during 2010, 'Arvento', and another less common variety, 'Tiësto' being used. The tomatoes were harvested at red ripening stage. Tomatoes of the variety 'Arvento' (Rijk Zwaan Seeds) were obtained directly from a Swedish grower (Assarsson Trädgård AB, Motala) and half of them stored at 7°C, representing an ordinary household refrigerator temperature, and the other half at room temperature (21°C) for 48 hours before serving (all tomatoes were served at red ripening stage). Immediately before serving, the chilled tomatoes stored at 7°C were taken into room temperature, so that serving temperature was the same for both

varieties. The tomatoes were each cut into 12 slices (intended for four servings per tomato) and served on paper plates marked *x* and *y*. The consumers were asked to indicate their judgement of the tomatoes on a 9-point Likert scale ranging from "not at all tasty" to "very tasty", following the method described by Lawless and Heymann (2010). The survey and taste assessment with the variety 'Arvento' took place in the cities of Linköping and Norrköping and included 364 respondents. The second experiment followed the same design, using tomatoes of the variety 'Tiësto' (De Ruiter Seeds), obtained from another grower in Southern Sweden (Vikentomater, Viken). The assessment with the variety 'Tiësto' was conducted in Helsingborg and included 103 respondents.
In all cases, volunteers participated in the studies without any form of payment and three Swedish shopping centres were the location for the activities. The survey questions were the same in all cases. Shopping centres and supermarkets have previously been used for taste assessments and consumer surveys (Collins *et al*., 1990; Lusk *et al*., 2001; Luckow & Delahunty, 2004), and it has been shown that the choice of environment for consumer testing and degree of social interaction in consumer taste assessments has no effect on hedonic rating of the products (Hersleth *et al*., 2005). The data were analysed using descriptive statistics in the case of the survey and paired-sample t-tests in the case of the taste assessments using SPSS.

## 6.2 Consumer attitudes toward credence of origin and production method, and taste evaluation (II)

The first sub-study in Paper II examined the associations consumers hold towards Swedish, imported, organic and conventional food. Qualitative data were obtained by letting the respondents state their associations to four different concepts related to origin and production method, namely Swedish, imported, organic and conventional. Four open questions were included in a questionnaire and formulated in the following way: "What is the first thing that comes to your mind when you hear the concept…?" The main interest was in the subjective meaning behind the four concepts and the written account became the object of study (Alvesson & Sköldberg, 1994). Some respondents answered in terms of full sentences, but most respondents gave only fragmented sentences or single words as answers. A textual analysis was carried out on the written associations. Qualitative analysis of texts is concerned with identifying and understanding categories and how they are used (Silverman, 1993). Thus, the analysis was based on identifying key words for each of the four concepts and grouping those key words into categories

without the use of any sophisticated and computerised device. The method, which is an example of text analysis in its simplest form, was used in order to get a more nuanced view of consumers' associations to the four concepts. A total of 145 consumers were recruited at the central railway station in Malmö and at a shopping centre outside the city, two places where it is possible to recruit a variety of people.

The second sub-study, the taste assessment, was an experimental study where 186 consumers were asked to taste and grade tomatoes labelled with two different country-of-origin denominations, Swedish and Dutch, as well as one particular production method, organic. In the case of organic, the official label, KRAV, was used (www.krav.se), but no country of origin was presented. The tomatoes were served on plates and the respondents were asked to taste one tomato slice from each of three plates. They then recorded how they perceived the taste, *i.e.* liking of taste, on a five-point hedonic scale ranging from 1 (not tasty) to 5 (very tasty). A total of 186 questionnaires were completed. An average grade was calculated for each of the three labels and compared using an ANOVA test.

The labels were chosen as they were the most commonly available labels on tomatoes at the time of the study. No 'anonymous' tomatoes were tested, as the tomatoes were intended to reflect the supply in a shop. The study took place at an open day on the university campus of the Swedish University of Agricultural Sciences in Alnarp, Sweden, in 2004. Respondents were predominantly aged around 40-50. The aim was to examine whether and how the labels influenced respondents' opinion of taste of the tomatoes, which all came from the same Swedish producer.

## 6.3 Consumer attitudes towards origin and organic – The role of credence labels on consumer liking of tomatoes (III)

Paper III consisted of a consumer survey including background data on the respondents and a set of questions regarding consumer attitudes, and a consumer panel taste evaluation of tomatoes. The assessments were made at a central location on the campus of the Swedish University of Agricultural Sciences in Alnarp in 2010, and a convenience sample was recruited from the general public and university staff and students. In total 97 respondents, none of whom was involved in vegetable production or research, completed the tomato taste evaluation and questionnaire.

The consumers in the panel received a questionnaire including questions regarding: a) gender; b) age; c) consumption frequency; d) general satisfaction with purchased tomatoes; and e) reasons for dissatisfaction with tomato purchases. Following the usual supply in an ordinary supermarket during the Swedish season, the respondents also marked; f) which type of tomato (*i.e.* 'on-the-vine', 'cherry and cocktail varieties', 'single round', 'organic', 'plum varieties') they usually buy. The final part of the questionnaire was a set of 17 attitude items (statements) to be graded on a 9-point hedonic scale where the end-points were marked (1) totally disagree and (9) totally agree. The set comprised aspects such as attitudes towards taste, appearance, colour, origin, production method, price and place of purchase. The specific questions are presented in Appendix 3.

Four tomatoes were part of the experiment evaluating the effects of different labels on hedonic liking. These were labelled 'Organic', 'Swedish' and 'Dutch', while a fourth (reference) tomato received a randomised three-digit number. The tomatoes were all of the same variety, 'Arvento' (Rijk Zwaan). They were identical, single round tomatoes harvested in the red ripening stage, collected from a local grower (WP-Grönt, Malmö) and stored for two days at room temperature (20°C). In addition to these four tomatoes, the participants received four samples of another variety, so that identical tomatoes were not presented after each other. The tomatoes were tested in a design made up of two blocks consisting of A-D (four varieties of an variety trial) and E-H (the four 'Arvento' tomatoes of the same origin, but with different labels), which were altered so that two tomatoes from the same block were never presented right after each other. The serving order was altered between six groups/sessions to overcome order and learning effects and the probability of sensory fatigue. All tomatoes except the three tomatoes labelled 'Swedish', 'Dutch' and 'Organic (KRAV)' were given randomised three-digit numbers, which differed between the serving rounds. The tomatoes were served separately on paper plates marked with labels or numbers. Each panellist received a quarter of a tomato cut into three slices, and each tomato was judged separately. Parameters analysed were: (a) liking of the tomato taste; (b) overall impression of the tomato. The attributes were evaluated on a 9-point hedonic scale (Lawless & Heymann, 2010). The panellists had a break between each serving, during which they received water and unflavoured crackers to neutralise the taste. After the sensory evaluation, the respondents filled in the form on background and attitude questions. A one-way ANOVA with repeated measures was made on the results from the taste assessments, and correlation analysis was used to correlate the panellists' perceived liking of

the labelled tomatoes with the graded attitude statements regarding the two types of credence (*i.e.* origin or organic production).

## 6.4 Review – Credence and the effect on consumer liking of food (IV)

In Paper IV, a search of the literature was conducted for papers relating to credence attributes and their effects on consumers' perceived quality of food. A broad search was conducted for relevant papers in the period 2003-2012 using major databases, *e.g.* Web of Science/CAB abstracts and Scopus, and three general categories of search words, which were combined: i) parameters indicating consumer 'liking', 'acceptance' or 'hedonic' evaluation; ii) parameters indicating the presence of 'information', 'extrinsic' cues, 'label' or 'credence' (including refinements of the results based on the most common credence cues 'health', 'organic', 'brand', 'origin', 'tradition', 'fair trade' and 'production method'); and iii) a refinement based on the words 'consumer' and 'food' in some searches. Related literature cited in the reference list of papers found in the search was also reviewed and added if relevant. Only research papers written in English and published in scientific journals were included. Studies which did not separate the component parts of a bundle of factors (*i.e.* several credence cues presented at the same time) were not included. To further delimit the results and reduce the initial large amount of papers, only studies describing consumer panels using hedonic liking scales were included, as hedonic scaling is a widely used method to measure consumers' experienced quality of food (*i.e.* liking and acceptability) (Lawless & Heymann, 2010). Other practical limitations, such as time and budgetary constraints, ultimately ended the active search for further papers.

# 7 Results

## 7.1 Taste evaluation of the effect of chilling on tomato taste, and consumer survey (I)

In total, 467 consumers participated in the study. Mean age was 46.5 years and the gender distribution was 60 per cent female and 40 per cent male. While 83 per cent of all respondents bought tomatoes at least once a week, 76 per cent consumed tomatoes three times a week or more, 17 per cent once or twice a week and the rest more seldom. This shows that tomato is a frequently purchased and used product.

The most common home storage method was the refrigerator, for a little more than half (54%) of the sample (≤8°C); a pantry (approximately 10-12°C) was used in 20 per cent of cases and 26 per cent stored their tomatoes at room temperature (~20°C). A subset of 396 of the respondents were asked the question 'If you are dissatisfied with the quality of the tomatoes you buy, what attributes are you dissatisfied with?' (not all respondents received this question in the first questionnaire). The respondents could mark three alternatives from a list of eight common attributes (Figure 1) and had the possibility to answer 'other'. Two thirds (66%) indicated that they were sometimes dissatisfied with the quality and the most frequently stated reason was 'too little flavour' (53%), followed by 'too soft' (31%) and 'too expensive' (20%) (see Figure 1).

Ordinary 'single round' tomatoes and 'tomatoes on-the-vine' were the most purchased types of tomatoes, representing 30 and 31 per cent of the respondents, while 'cherry tomatoes' were stated by 23 per cent to be the most commonly purchased varieties. Eleven per cent stated that they preferred to buy 'organic' tomatoes.

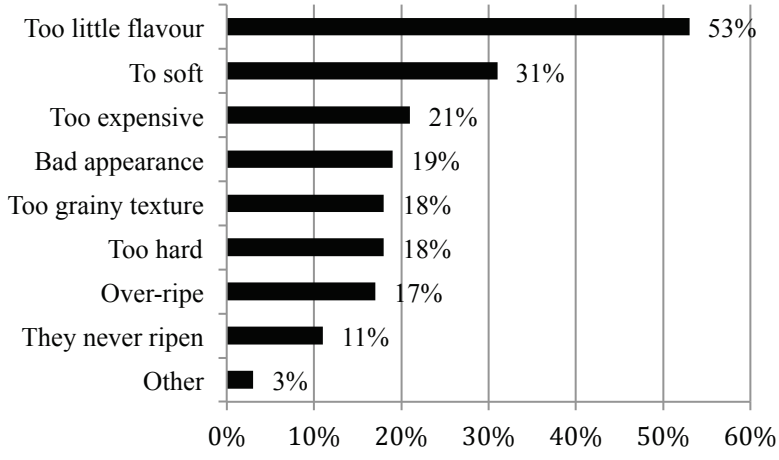


*Figure 1.* The most common reasons cited for dissatisfaction with purchased tomatoes, n=396.

In the taste assessments, there were 352 completed questionnaires for the 'Arvento' variety experiment and 101 for the 'Tiësto' variety. Incomplete questionnaires as regards the dependent variable (*i.e.* the respondent did not answer, or only graded the taste of one of the two tomatoes) were not included.

In order to test the hypothesis that chilling affects tomato taste negatively, a paired-sample t-test was conducted to evaluate the impact of a tomato being chilled or unchilled on taste. In the first experiment there was a statistically significant difference in taste between tomatoes of the variety 'Arvento' that were unchilled (M=6.443, SD=1.765) and chilled (M=5.849, SD=1.894), $t(351)=4.270$, $p<0.001$ (two-tailed). Compared with unchilled tomatoes, there was a mean decrease in reported liking for chilled tomatoes (mean value = 0.594; 95% confidence interval 0.320-0.867). The eta squared statistic (Cohen's d=0.049) indicated a small effect size (Cohen, 1988). Thus the first experiment in Paper I supported our hypothesis that chilled tomatoes are, statistically speaking, significantly less tasty than those previously unchilled. However, given the small effect size, the difference in taste was very small.

In the second experiment, the hypothesis was replicated by once again conducting a paired sample t-test. The data indicated that there was no significant difference between the tomatoes of the variety 'Tiësto' that were unchilled (M=6.287, SD=1.796) and chilled (M=6.366, SD=1.617), $t(100)=-0.328$.

## 7.2 Consumer attitudes toward credence of origin and production method, and taste evaluation (II)

In total, 145 respondents participated in the qualitative study concerning attitudes to four common labels of credence: 'Swedish grown', 'imported', 'organic' and 'conventional'. The results revealed that the most frequently used words associated with Swedish were positive and also quite similar to the associations to organic products. Swedish products were considered as being of high quality in various aspects and were also connected to local production and short transportation distances. Imports had a negative image, with a quarter of the consumers associating them with chemicals. In addition, 21 per cent of the respondents associated imported vegetables with long transportation and nearly 30 per cent expressed doubts about safety or had negative opinions of the quality of imports.

Little more than one quarter of the respondents associated organically grown with expensive (27%) and 'non-toxic' (26%), and 12 per cent associated organic with nature or the environment. Quality was also a frequent association and 'tastier' was often specifically mentioned. Some 16 per cent associated organic with health, a connection that was not made for the other attributes. As regards conventionally grown, a quarter (24%) of the respondents did not give any associations. A little over a quarter (26%) associated conventional with poison, while 16 per cent found this production method acceptable and 12 per cent considered it normal or traditional.

The results showed that the respondents associated the concept grown in Sweden with quality and security. However, the associations used for Swedish-grown were more general (good, reliable) than those for organically grown. For organic, respondents tended to use words that suggest it has a value because of what it is not (for instance, non-toxic) rather than because of what it is. Otherwise, the associations were similar. Table 1 shows the most common associations.

In the taste assessment, 185 respondents tested identical tomatoes with different labels. The ANOVA test showed that there was no significant difference between tomatoes labelled 'Swedish' (M=3.665, SD=1.025) or 'organic' (M=3.541, SD=1.005), but both differed significantly from tomatoes labelled 'Dutch' (M=2.519, SD=0.962), $F(2, 552)=73.50$, $p<0.001$. The eta squared statistic (Sum of squares between groups/Total sum of squares) gave $\eta^2=0.21$, indicating a large effect size (Cohen, 1988).

*Table 1.* The most frequent associations to the four attributes by 145 respondents, with number of answers in round brackets and per cent of answers in square brackets

| **Swedish grown** | **Imported** | **Organically grown** | **Conventionally grown** |
|---|---|---|---|
| Good, best (37) [24.2%] | Spraying, chemicals (38) [24.8%] | Expensive (41) [26.8%] | Poison (40) [26.1%] |
| Quality (35) [22.9%] | Long transportation (32) [20.9%] | Non-toxic (40) [26.1%] | Acceptable (24) [15.7%] |
| Grown locally, short transport (31) [20.3%] | Doubt, unsafe products (23) [15.0%] | Good quality, more tasty (33) [21.6%] | Normal, traditional (19) [12.4%] |
| Safe, reliable (16) [10.5%] | Bad, worse, uneven quality (22) [14.4%] | Healthy (24) [16.3%] | Cheaper (12) [7.8%] |
| Less chemical spraying (13) [8.5%] | Cheap (13) [8.5%] | Environment, nature, clean (18) [11.8%] | Good if Swedish (9) [5.9%] |
| Tasty, fresh (10) [6.5 %] | Depends on what origin (10) [6.5%] | Lower quality (7) [4.6%] | No answer, don't know (37) [24.2%] |
| Controlled (10) [6.5%] | Exploited workers (4) [2.2%] | Doubt about trust (6) [3.2%] | "Immoral" (8) [5.5%] |

## 7.3 Consumer attitudes towards origin and organic – The role of credence labels on consumer liking of tomatoes (III)

Of the 97 respondents, 64 were female and 33 male. Mean age was 54 years, ranging between 19 and 80. Three quarters (75%) indicated that they consumed tomatoes three times a week or more and 96 per cent that they consumed tomatoes at least once a week, while 88 per cent reported purchasing tomatoes at least once a week. The most common place of purchase stated was the supermarket (88%), followed by the open-air market (18%) and a specialist greengrocer (13%), and six per cent purchased direct from the grower (more than one alternative was allowed to be chosen, so the total number exceeded 100 per cent).

The majority of the consumers indicated that they were very satisfied (11%) or satisfied (70%) with their tomato purchases, while 18 per cent were generally dissatisfied. Two thirds (66%) of the respondents indicated too little taste as the main reason for their dissatisfaction. Tomatoes 'on-the-vine' were the most frequently purchased type of tomato, indicated by 48 per cent, followed by cherry and cocktail varieties (24%), single round (21%), organic (13%) and plum varieties (5%) (up to two alternatives could be chosen).

The respondents graded 17 attitudinal questions on a hedonic scale between 1 (totally disagree) and 9 (totally agree) (all questions are presented in Appendix 2). Not all of them are presented here in detail, but for a full overview see Paper III. The statement receiving the highest grades in terms of agreement was that 'Good taste is important' when purchasing tomatoes (M=8.46, n=94), followed by 'It is important to buy local' (M=7.48, n=91) and 'It is important to buy Swedish' (M=7.41, n=91). Five statements concerned attitudes towards origin and two specifically concerned organic, and these formed two combined factors 'Attitude towards Swedish' and 'Attitude towards organic (Table 2).

The taste assessment showed clear significant differences in liking between tomatoes with a label signalling imported origin (Dutch) and tomatoes labelled Swedish or organic. A one-way repeated measures ANOVA was conducted to compare scores on 'liking of taste' and 'overall impression' with a statistics test regarding the effect of three labels and one unlabelled reference tomato (all being of the same variety, '*Arvento*'). Liking was indicated on a hedonic scale ranging from 1 (strongly dislike) to 9 (strongly like). The means and standard deviations are presented in Table 3.

The one-way repeated measures ANOVA showed a significant effect of label on consumer 'liking of taste', Wilks' Lambda=0.568, F(3, 94)=23.84,

$p<0.001$, multivariate partial eta squared=0.43, suggesting a large effect (Cohen, 1988). For the 'overall impression', Wilks' Lambda=0.550, $F(3, 91)=25.13$, $p<0.001$, multivariate partial eta squared=0.45, suggesting a large effect (Cohen, 1988). No significant effects of gender and age, which were included in the questionnaire, could be found for either 'liking of taste' or 'overall impression'.

One of the hypotheses in this study was that a positive attitude towards credence attributes (*i.e*. country-of-origin and organic) is positively correlated with liking in taste and overall liking for tomatoes labelled with the same credence ('Swedish' and 'Organic'). To test this hypothesis, correlations were made between the new factors of attitude towards Swedish, 'SWE', and towards organic, 'ORG' and the results from the taste assessment.

The results (Table 3) showed a significant correlation ($p<0.05$) between attitude towards Swedish and liking of taste of tomatoes labelled 'Swedish' and labelled 'organic'. The attitude towards Swedish and the experienced overall impression were significantly and positively correlated with the tomatoes labelled 'Swedish' and those labelled 'organic' ($p<0.01$) and negatively correlated with the tomatoes labelled 'Dutch' ($p<0.05$). The correlation in these cases was below 0.3, indicating a weak correlation. In one case, the organic label concerning overall impression, the r-value was between 0.3 and 0.5 (0.35), indicating a moderate correlation. The combined factor of attitude towards organic 'ORG' was positively correlated with experienced taste and overall impression of tomatoes labelled 'organic' ($p<0.01$) (Table 3). In all cases, though the hypothesis could be accepted, the strength of the relationships was weak, with an r-value below 0.3.

*Table 2.* Attitude statements: Swedish and organic

| Statement | Mean±SD | Valid N |
|---|---|---|
| **Origin-related** | | |
| 1) Swedish tomatoes taste better than imported | 6.38±2.45 | 92 |
| 2) I prefer imported tomatoes to Swedish ones | 2.58±1.94 | 91 |
| 3) There is no taste difference between Swedish and imported tomatoes | 3.91±2.16 | 90 |
| 4) I primarily choose Swedish tomatoes if I can | 7.18±2.24 | 91 |
| 5) It is important to buy Swedish | 7.43±2.04 | 91 |
| SWE) Attitude towards Swedish (mean of statements 1-5, reversed scale on statements 2 and 3) | 6.91±1.56 | 89 |
| **Organic-related** | | |
| 6) Organic tomatoes taste better than conventional | 5.21±2.37 | 92 |
| 7) It is important to buy organic | 6.07±2.46 | 91 |
| ORG) Attitude towards organic (mean of statement 6 and 7) | 5.63±2.16 | 89 |

*Table 3.* Consumer assessment. Experienced taste and overall impression of labelled tomatoes and the relationship between attitudes towards Swedish and organic and liking of assessed tomatoes.

| **Dependent variable in consumer assessment** | **Tomato label** | **Mean grade on a hedonic scale (1-9)[a]** | **Correlation with attitudes, using n=89 [b]** | |
|---|---|---|---|---|
| | | | Attitude towards Swedish 'SWE' (Mean=6.91) | Attitude towards Organic 'ORG' (Mean=5.63) |
| Liking of taste | Organic | 6.05±1.70b | **.258*** | **.288**** |
| (Valid n=97) | Swedish | 5.88b±1.70b | **.263*** | .045 |
| | Reference | 5.55±1.61b | .170 | -.034 |
| | Dutch | 4.54±1.68a | -.206 | -.123 |
| Overall impression | Organic | 6.01±1.63c | **.350**** | **.276**** |
| (Valid n=95) | Swedish | 5.64±1.68bc | **.296**** | -.060 |
| | Reference | 5.36±1.80b | .094 | -.079 |
| | Dutch | 4.24±1.75a | **-.236*** | -.123 |

[a)] Different letters indicate a significant difference in pairwise comparisons ($p<0.05$), Bonferroni adjustment.
[b)] *: Correlation is significant $p<0.05$ (2-tailed); **: Correlation is significant at $p<0.01$ (2-tailed).

## 7.4 Review – Credence and the effect on consumer liking of food (IV)

One of the objectives with this thesis was to propose a conceptual framework explaining the consumer quality perception as dependent on the physical products intrinsic and extrinsic characteristics. The framework developed (Figure 2) is based on existing theories on consumer quality experiences and was adhered to in the review process. The framework shows how consumers' quality experience, in this case taste, is affected by expectations formed by intrinsic and extrinsic cues, and actual sensory properties, *i.e.* intrinsic attributes, of the product.

The expectations are also shaped by previous quality experiences, and moderating variables, such as personal factors, attitudes and values, but also context and environment.

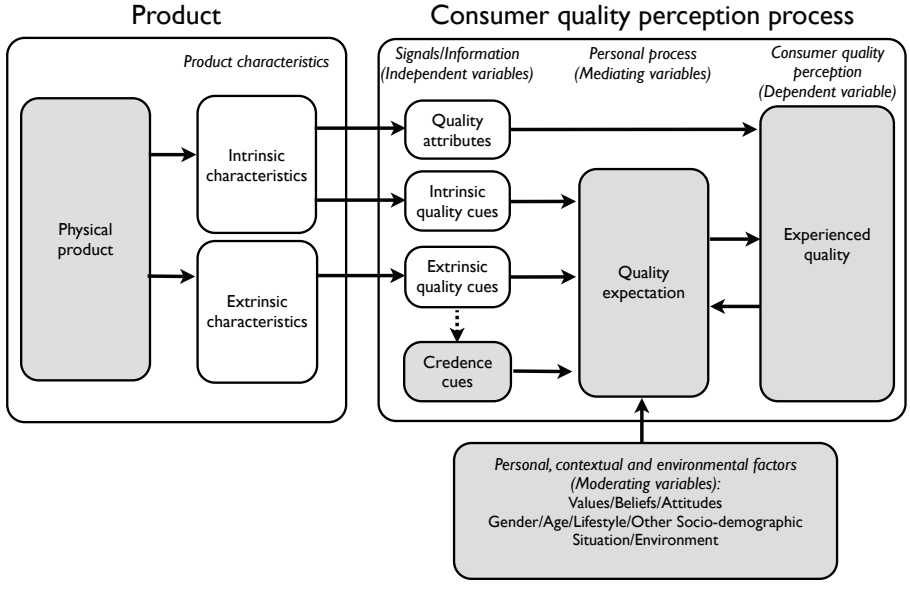


*Figure 2.* Conceptual framework explaining consumers' experienced sensory quality of food. Grey areas represent factors covered by the studies reviewed in Paper IV.

The literature review included 66 papers published 2003-2012, distributed over seven credence categories (Table 4): 1) Health-related components; 2) organic; 3) origin; 4) brands; 5) production method-related; 6) ethics-related; and 7) descriptive food names and ingredients. Of the papers reviewed, only three used unprepared fruit and vegetables as test products. Most frequently,

the effect of different labels of credence was tested using meat products (13 papers); dairy products (9 papers); bread and flour products (8 papers); different types of beverages (except fruit juices) (8 papers); and processed fruit and vegetables (predominantly fruit juices) (8 papers).

A conceptual model on consumers' perception of food in relation to quality attributes and cues was presented and adhered to while reviewing each paper to check its relevance. Three different types of papers were distinguished: i) Papers including one or several credence cues and a consumer evaluation; ii) papers including a mediating variable, following expectation theory (which includes both evaluation of expectations of liking and hedonic liking under blind and informed conditions); and iii) papers including moderating factors, either through analyses of consumer sub-groups or the use of multivariate analyses, and possibly also including expectations. The majority of the papers confirmed effects of credence on consumer liking (Table 4).

*Table 4.* Reviewed papers: credence categories

| **Credence category** | **Number of papers** | **Number of papers showing significant effects of credence** | **Number of papers showing significant effects of a mediating variable (expectations)[1]** | **Number of papers showing significant effects of moderating variables[1]** |
|---|---|---|---|---|
| Health | 30 | 23 | 5 (7) | 13 (17) |
| Organic | 9 | 9 | 2 (3) | 4 (5) |
| Origin | 8 | 8 | 3 (3) | 4 (4) |
| Brands | 9 | 8 | 4 (4) | 3 (5) |
| Production method | 7 | 7 | 4 (4) | 4 (5) |
| Ethics | 6 | 6 | 4 (4) | 3 (4) |
| Descriptive food names | 10 | 10 | 2 (2) | 2 (2) |
| Total[2] | 66 | 59 | 22 (24) | 27 (37) |

[1]Number of papers including mediating and/or moderating variables showing significant effects on liking (total papers including mediating and/or moderating variables)

[2]Total number of papers in the review. One paper may appear in several credence categories, thus the total number may be less than the sum of papers in the column.

# 8 Methodological issues

Before going into the discussion of the results, some methodological issues need to be commented upon. In Paper I, the treated tomatoes were only stored for two days, which may limit the generalisability of the findings. Parks and Newman (2005) showed that the majority of Australian consumers store their tomatoes for longer than two days, while Farneti *et al*. (2010) indicated that consumers often store tomatoes for even longer periods. Thus further studies that test the effects on taste of various storage periods seem warranted. It is also difficult to conclude from the studies conducted what the effect of chilling would be on other varieties of tomato.

Paper II included a qualitative survey collecting consumer associations with different credence attributes. The method appears to be a good way to study consumer views. However, the study could not explain the values behind the attitudes towards the attributes. To understand the underlying mechanisms, an even deeper approach would be required, for example using in-depth interviews, focus groups or similar, and using qualitative approaches such as means-end or grounded theory (Bryman, 2008). The taste assessment in Paper II was rather simple. It reflected the options normally met in a purchasing situation and thus lacked a reference tomato without a label. Furthermore, in both taste assessments (Papers II and III), only actual liking was measured and not expected liking following expectation theory (Deliza & MacFie, 1996). The results could possibly have contributed more to the understanding of the mediating effect of expectations on consumer liking if expected liking had been included.

In both taste assessments (Papers II and III), ordinary 'single round' tomatoes of a commercial variety were used. For just assessing the effect of labels, this type of tomato worked well. However, it is possible that the results would have been different if other varieties (*e.g*. 'cocktail', 'cherry' *etc*.) had been used, especially if consumers are searching actively for intrinsic cues, due

to negative experiences with the 'single round' tomato. Nevertheless, the results from the taste assessments provide insights into how consumer perception of quality (*i.e*. taste) is affected by two of the most common and perhaps strongest credence attributes, 'origin' and 'organic'. There may also be a bias in selection of subjects participating in the tomato taste assessments. Participation was voluntary, and possibly individuals more positive attitudes toward tomato accepted the offer to participate, while persons who do not consume tomatoes at all did not.

Consumer quality perception of food products is part of a complex process, and all parts are not fully understood. Paper IV only included studies using consumer panels and hedonic evaluations of food in combination with exposed credence cues. Studies using other methods, such as conjoint analysis (Deliza *et al*., 2003; Cox *et al*., 2011; Hoppert *et al*., 2012), which ranks different credence cues, or methods using willingness to pay (*e.g*. Napolitano *et al*., 2008), combined with tasting, were excluded. Most of the evidence in the review was based upon short-term studies (using no more than one trial). A few studies were based upon repeated exposure, although within at most a couple of weeks. The long-time perspectives needed when establishing new products, brands or certifications to build consumer trust and relationships indicate that the effects of such signals on consumer responses, *e.g.* taste perceptions of food products, need to be studied over longer periods.

# 9 Discussion and conclusions

The studies presented in Papers I-IV scrutinised consumer quality experiences of food. Papers I-III used fresh tomatoes as the reference product, while Paper IV reviewed recent research of consumer experiences related to all types of food and the effect of credence labels on consumer liking. Tomato was chosen as a reference product, as the issue of lack of taste in modern tomatoes is widely discussed.

## 9.1 Searching for taste

The most important factor for consumers in their choice of tomatoes, as presented in Paper III, is taste. It has been shown (*e.g*. Papers I and III) that consumers are often dissatisfied with tomato quality and that the main reason for dissatisfaction is lack of taste. This is well in line with previous findings (*e.g*. Hobson, 1988; Bruhn *et al*., 1991; Ratanachinakorn *et al*., 1997; Parks & Newman, 2005; Estabrook, 2011), confirming that the problem still persists.

The decline of the single round 'standard tomato' and the increase in market share for new tomato varieties, *e.g*. 'cherry', 'cocktail', 'plum' and different special varieties with recognisable names, *e.g*. 'Romantica', 'Fantastica' *etc*., imply that consumers are turning their backs on a tomato they find has no taste ('the standard tomato') and choosing varieties that are perceived to have better taste.

Papers I and III showed that around 20-25 per cent of consumers prefer 'cherry' or 'cocktail' varieties. This is also confirmed in actual purchasing statistics, in 2009 these varieties represented around 20 per cent of the domestic market in terms of purchased volume (Tjärnemo *et al*., 2010). However, the economic value of these varieties represented 30 per cent the same period, which shows that there is a higher willingness to pay for the new varieties claimed to have a better taste. In this perspective, in combination with

fluctuating market prices, the market situation for the 'standard tomato' appears disadvantageous and it is probable that it will continue to lose market share.

## 9.2 The effect of chilling on tomato taste

A commonly stated reason for lack of taste is chilling of tomatoes. There is a patent risk of chilling throughout the value chain: in transportation, in storage and in post-harvest treatment in consumers' homes. The majority of Swedish consumers store their tomatoes in too cold an environment to retain optimal taste. However, Paper I showed that while there is a significant effect on experienced taste of tomatoes due to chilling, at least when it comes to the most common variety on the Swedish market, 'Arvento', the effect can be interpreted as rather small. The other variety tested, 'Tiësto', showed no difference in consumer liking in chilled or unchilled condition. However, the 'Tiësto' variety is no longer in commercial production due to unstable quality. The conclusion from these taste assessments is that chilling probably has an effect on taste, and the recommendations not to store tomatoes chilled can be seen as correct. However, the negative effect in Paper I was perhaps not as strong as suggested. There are most likely other factors which may explain the diminished taste of the modern 'standard tomato', for example the fact that taste has not been an issue in previous plant breeding, where the focus has been on yield and pest resistance. The production method may also have an effect, as the main focus in production has been on high yields. Another issue may be that the tomatoes are often harvested at an early stage of ripening, to better endure transportation and storage. This suggests that there is a need to study actual treatment throughout the whole value chain and, in addition, search for other effects in the value chain which might have an impact on tomato taste. The issue of taste should preferably receive more attention already in the breeding stage of new varieties.

## 9.3 Consumer attitudes towards credence of 'origin' and 'organic'

Products in the fruit and vegetable department of supermarkets are often treated as commodities, without the presence of strong brands and sophisticated packaging. Two of the most common types of information, besides price and brands, are credence cues of *country of origin* and, to a smaller extent, *organic*. As shown in Paper II, Swedish consumers generally have positive associations with the credence attribute of 'Swedish' and

'organic'. 'Swedish' products are seen as being better quality, good, locally produced and safe. In contrast, 'imported' products are generally associated with negative properties (often the opposite to the domestic label). 'Organic' is associated with high price, but also with better taste and health, whereas 'conventional' is associated with the opposite. In the study of consumer attitudes towards the concepts 'origin' and 'organic (Paper III), a majority, 57 per cent showed a strong positive attitude towards 'Swedish', and 37 per cent showed a strong positive attitude towards 'organic'. 'Imports' was considered more negative.

The results in Papers II and III support the findings from previous studies, namely that consumers prefer domestic products (Bilkey & Nes, 1982; Al-Sulaiti & Baker, 1998; Juric & Worsley, 1998; Nygard & Storstad, 1998; Verlegh & Steenkamp, 1999; Henchion & McIntyre, 2000; Sassatelli & Scott 2001; Frandsen *et al*., 2007), and that 'organic' is associated with health (Ekelund, 2003; Hughner *et al*., 2007; Aertsens *et al*., 2009), or more specifically in this case to being 'non-toxic' (Bonti-Ankomah & Yiridoe, 2006; Roininen *et al*., 2006).

Although consumers have strong positive attitudes towards the concepts of 'Swedish' and 'organic' (Papers II and III), this does not reflect actual behaviour. While the attitudes towards 'Swedish', in many aspects, are very positive, only 14 per cent of the total annual supply of tomatoes on the Swedish market is produced in Sweden (Swedish Board of Agriculture, 2011). Most consumers claim that they mostly prefer special varieties (*i.e*. 'on-the-vine', 'cherry' and 'cocktail' varieties) (Papers I and III), which are mainly imported from the Netherlands or Spain. The 'organic' consumers, *i.e*. the frequent buyers of organic tomatoes, comprised 13 per cent of the respondents in Paper III, while at the same time 37 per cent had strong positive attitudes towards organic. These patterns confirm the so-called attitude-behaviour gap (Fishbein & Ajzen, 1975; Vermeir & Verbeke, 2006).

## 9.4 The effect of credence labels on consumer liking of tomatoes

Papers II and III showed that credence labels have an effect on consumer liking of tomatoes. In the more simple experiment (Paper II), consumers rated tomatoes labelled 'Swedish' and 'organic' significantly higher than 'Dutch' tomatoes, with no difference between 'Swedish' and 'organic'. The following study (Paper III) produced similar results for both 'liking of taste' and 'overall impression' of the tomatoes. This corresponds with the associations expressed in Paper II, where both 'Swedish' and 'organic' were stated to have better

quality and taste. There is a clear negative country-of-origin effect when it comes to imports, in this case 'Dutch' tomatoes. The experienced taste due to labels can be explained by correlating attitudes towards what these labels represent. The correlation analysis (Paper III) pointed at significant correlations between stated attitudes and experienced taste both for 'Swedish' and 'organic'. In this case, attitudes may be a predictor of how the product will be experienced in a similar setting. However, this may not apply to a situation where the same products are tested over time (repeated exposure), as expectations are affected by previous experience. According to expectation theory (Deliza & MacFie, 1996), available cues generate expectations of taste, which in turn affect the experience. For credence to work as a taste signal towards the consumer and to influence quality experiences from a marketing perspective, it is necessary to meet consumer expectations with high sensory qualities of the food product, so as not to erode positive associations and expectations. The issue of tomatoes and 'lack of taste' would suggest that consumers no longer have positive associations with 'the standard tomato', regardless of origin, and thus choose the alternative newer varieties. The strong credence signals, especially of 'Swedish', may already have weathered as consumers have turned to searching for other quality cues, most likely intrinsic quality cues, such as colour, shape, size and tomatoes 'on-the-vine', which attract the consumer with a fragrance of tomato.

Comparing the results from Papers II and III, both studies show distrust of imported vegetables, as expressed by a low ranking, negative associations and low marks for taste of domestic products labelled as imported. The results are remarkable, as they reveal a discrepancy: despite the fact that the image of Dutch tomatoes is continuously low, Dutch tomatoes have a major and still increasing market share on the Swedish market, even during the domestic season.

## 9.5 A conceptual framework for credence and the effect on consumer liking of food

One of the objectives in this thesis was to propose a conceptual framework explaining the consumer quality perception as dependent on the intrinsic and extrinsic characteristics of the physical products. The framework shows how consumer quality experience, in this case taste, is affected by expectations formed by intrinsic and extrinsic cues, and actual sensory properties, *i.e.* intrinsic attributes, of the product. Expectations were shown to have a significant strength in predicting consumer responses and the majority of the papers reviewed in Paper IV provided clear evidence of how sensory

expectation is generated by external cues and how it affects perception and hedonic ratings of liking (taste). As shown (Figure 2), the framework is a general model applicable not only to horticultural products, but also to all types of food products.

As one can conclude from the conceptual framework and the review of the literature (Paper IV), credence characteristics are only one part of the consumer experience. However, combined with good sensory properties, credence labels may be strong marketing tools for signalling taste.

The two credence attributes examined in this thesis both showed strong effects on consumer liking. The credence category of 'organic' contains health-related components, but also includes an ethical dimension. Consumers generally associate organic food with better taste, and signalling of 'organic' has a high impact on consumer liking. All studies including 'origin' as a credence cue report a strong country-of-origin effect and regional effect on consumer liking, favouring domestic and regional food over imports. The more regional or local the product is believed to be, the higher the evaluation scores. This effect is moderated by origin or belonging to the specific area, which tends to increase liking for products from the same region. This would explain why a label signalling 'Swedish' affects Swedish consumers.

The findings in Paper IV confirm that labels signalling country or region of origin (*e.g.* van der Lans *et al.*, 2001; van Ittersum *et al.*, 2003; Dransfield *et al.*, 2005; Allen *et al.*, 2008) and organic production (*e.g.* Johansson *et al.*, 1999; Grankvist *et al.*, 2007; Poelman *et al.*, 2008) consequently have strong effects on consumer quality perception of food.

However, a label does not necessarily mean only that the consumer responds in a specific way. It has been shown that symbols can be learned and associated with specific tastes and that generated expectations due to a learned signal have the greatest effect on liking if the food product is already liked (Kuenzel *et al.*, 2011). This implies that associations are learned, but also that a product must have good sensory properties to have a positive impact on future expectations.

## 9.6 Implications for the horticultural sector

As discussed in the introduction, past horticultural research on product quality has focused primarily on events in the early steps in the horticultural value chain, whereas consumer aspects have been treated with less interest. The results presented in this thesis indicate that credence has an impact on consumer experiences, and that credence attributes may be important factors for signalling quality. Understanding what should be signalled, to whom, and how to provide consumers with products which live up to their expectations,

are the most vital questions to be asked by the industry. However, credence is not enough to make consumers choose a product, particularly if they have had negative previous experiences with product quality. As shown, positive attitudes are not the only predictor of consumer choice, as the attitude-behaviour gap implies.

Fruit and vegetables are generally treated as commodities, lacking the presence of strong brands, and, at least in a Swedish setting, lacking sophisticated packaging. Both brands and packaging are important factors in consumer choice. When treated as commodities, there is the typical feature of the commodity that the producers want to be able to produce as large a quantity as possible at the lowest possible price, in order to generate maximum revenue. There is a strong price focus, as quantity and economies of scale have been prioritised previously, not only in the fruit and vegetable category, but also in the whole food sector. Following the generic strategies of Porter (1991), the options to position on a market are through cost leadership or differentiation, in addition with a focus on a narrower target market. It is possible that the emphasis on low cost in the tomato industry has led to important sensory qualities having been lost. As a consequence, consumers have begun to search for other alternatives, which has led to a wave of differentiation and product development of tomatoes. Competing with other quality cues and attributes, the new products gain market share, while the 'traditional' products suffer under price pressure. At the same time, labels of credence, in particular 'origin', are not enough to attract the consumer when the intrinsic quality attributes, *i.e.* taste, are perceived as not very good. Swedish growers are continuing to lose market share, despite positive attitudes among Swedish consumers. This conclusion calls for changed marketing strategies in the Swedish tomato industry, as well as a product development process with more of a consumer focus and satisfaction of consumer demand for tasty tomatoes. In such a strategy both intrinsic and extrinsic characteristics should be emphasised, and combining existing labels, for example 'organic', with less used labels, such as particular 'health benefits' could possibly increase consumers' interest.

## 9.7 The contribution to science and future research

The studies presented in Papers I-IV strengthen previous assumptions that credence affects consumers' perceptions of quality. However, very little research has been carried out to date on unprocessed fruit and vegetables. These are currently treated as commodities and there is a lack of research in the horticultural marketing field, especially regarding consumer views and

experiences of quality fruit and vegetable products. However, this thesis will hopefully increase research interest in the topic.

There is evidence that 'country-of-origin' and 'organic' are strong credence cues, but more up-to-date research is needed to understand their impact and how they work. The common notion that 'organic tastes better' also needs to be verified or disproved through consumer assessments covering a broader range of food products.

Little is known about the intrinsic quality cues, such as size, colour and shape, sought for by consumers, and which are actually decisive in their choices. A future research direction may be to examine how consumers respond to these cues, also in combination with extrinsic cues, and how these signals influence expectations and perceived quality of tomatoes, and of other fresh horticultural products.

However, a setting in a controlled environment does not reflect an actual real world situation, where consumers face several different types of labels and other extrinsic cues, such as price, shopping environment, sound environment, *etc*. More complex multivariate approaches, such as conjoint analysis, would be necessary to examine this issue.

How consumers would respond to a larger range of intrinsic quality cues in combination with labels is a complex issue calling for future studies. The conceptual framework of consumers' experienced quality of food presented in this thesis can hopefully act as a basis for future research in horticultural marketing.

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# Appendices

## Appendix 1 – Statistics Paper III

The statistical analysis in Paper III of consumer 'liking of taste' and 'overall impression' was made with a one-way ANOVA between groups, whereas it should have been a one-way repeated measures ANOVA.

In Paper III, there was a statistically significant difference in 'liking of taste' at the $p<0.05$ level in grading between the four tomatoes: $F$ (3, 384)=15.9, $p<0.001$, with a calculated eta square=0.11 showing a medium effect (Cohen, 1988). For 'overall impression' of the tomato, there was significant difference between the tomatoes ($p<0.05$): $F$ (3, 384)=18.0, $p<0.001$, with an eta square=0.12, showing a medium, near large, effect (Cohen, 1988).

The one-way repeated measures ANOVA, the more proper analysis presented in the results section, showed a significant effect of label on consumer 'liking of taste', Wilks' Lambda=0.568, F(3, 94)=23.84, $p<0.001$, multivariate partial eta squared=0.43, suggesting a large effect (Cohen, 1988), and for the 'overall impression', Wilks' Lambda=0.550, F(3, 91)=25.13, $p<0.001$, multivariate partial eta squared=0.45, suggesting a large effect (Cohen, 1988).

Pairwise comparisons (Table 3) were made to compare the different labelling conditions, and are presented both in Paper III and in the Results section of this thesis. They were not affected by the ANOVA.

The main difference between the analyses is that the correct one provides a larger effect size, *i.e*. stronger effects. This is due to the analysis being made by comparing 'liking of taste' and 'overall impression' on an individual level (df=94 and 93 respectively), whereas in Paper III they are compared on group level (df=3). Further, the wrong symbol for eta was printed in Paper III, as it should be 'η' and not 'ε'.

## Appendix 2 - Questionnaire, Paper I

*Tomato survey*

1. Kön / *Gender*
☐ Kvinna / *Female*
☐ Man / *Male*

2. Ålder / *Age*

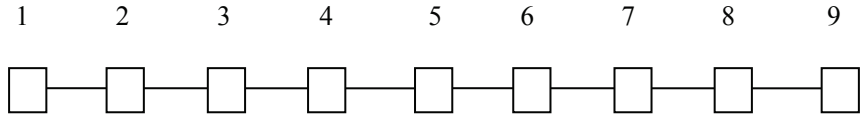
Jag är _____ år.

3. Hur ofta äter du tomater? / *How often do you consume tomatoes?*
☐ Fler än 5 gånger i veckan / *More than 5 times a week*
☐ 3 – 4 gånger i veckan
☐ 1 – 2 gånger i veckan
☐ Några gånger i månaden / *A couple of times a month*
☐ Mer sällan / *More seldom*

4. Hur ofta handlar du tomater? / *How often do you purchase tomatoes?*
☐ Flera gånger i veckan / *Several times a week*
☐ 1- 2 gånger i veckan
☐ Någon gång i månaden / *A few times (once) a month*
☐ Aldrig / *Never*

5. Jag handlar främst tomat (du kan välja upp till två alternativ)
*I primarly purchase tomatoes in (up to two alternatives may be chosen)*
☐ I en vanlig dagligvarubutik / *Supermarket*
☐ i en särskild frukt- och grönsaksbutik / *Fruit- or vegetable shop*
☐ på torget / *Farmers' market or market square*
☐ direkt hos odlaren / *Farm shop*
☐ annat / *other*

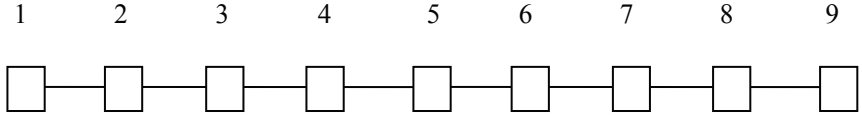
6. Bedöm smaken hos tomat X / *Judge the taste of tomato X*




Mindre god /
*Less (not) tasty*

Mycket god /
*Very tasty*

7. Bedöm smaken hos tomat Y.




Mindre god

Mycket god

8. Om du varit missnöjd med de tomater du köpt, vilken den vanligaste anledningen? Du får rangordna tre alternativ med siffrorna 1-3, där 3 är den allra vanligaste orsaken, 2 den näst vanliga orsaken och 3, den tredje vanligaste orsaken / *If you have been dissatisfied with the tomatoes you have purchased, what has been the most common reason? You can choose three alternatives and rank them 1-3.*

____ De har för lite smak / *Too little taste*
____ De är för mjuka / *Too soft*
____ De blir aldrig mogna / *Never ripens*
____ De ser dåliga ut / *Bad appearance*
____ Annat / *other*: _____

____ De är för hårda / *Too hard*
____ De är mjöliga / *Too mealy/grainy texture*
____ De är övermogna / *Over ripen*
____ De är för dyra / *Too expensive*

9. Var förvarar du tomater hemma? / *Where do you store tomatoes at home?*

☐ I rumstemperatur / *In room temperature*
☐ I skafferiet eller svalen (10-14°C) / *In the pantry*
☐ I kylskåpet (4-8°C) / *In the refrigerator*

10. Hur hanterar du tomaterna direkt efter att du köpt dem? / *Where do you put your tomatoes immediately when you arrive at home?*
☐ Jag låter dem mogna och förvarar dem i rumstemperatur / *Let them ripen and store them in room temperature*
☐ Jag låter dem mogna i rumstemperatur och lägger dem sedan i kylskåpet / *Let them ripen in room temperature and then put them in the refrigerator*
☐ Jag lägger tomaterna direkt i kylskåpet/svalen / *Put them directly in the pantry.*

11. Hur använder du vanligtvis tomater? (du kan välja upp till två alternativ) / *How do you normally use tomatoes? (you can choose two alternatives)*
☐ I salad / *In salads*
☐ Som tillbehör till maten / *As extras to the food*
☐ I tillagad mat / *In cooking*
☐ Skivad på smörgås / *On the sandwich*
☐ Som ett snacks/mellanmål / *As a snack*
☐ Annat / *Other*: _____

12. Vilken typ av tomater köper du helst? / *Which type of tomatoes do you prefer to purchase?*
☐ ”Vanliga” tomater i lösvikt / *Single round tomatoes loose*
☐ Kvisttomater / *On-the-vine*
☐ Ekologiska tomater / *Organic tomatoes*
☐ Plommontomater / *Plum varieties*
☐ Körsbärs- och cocktailtomater / *Cherry or cocktail varieties*
☐ Annat / *Other*: _____

# Appendix 3 - Questionnaire, Paper III

**Del 1: Bakgrundsfrågor** / *Part 1: Background questions*

**1. Kön** / *gender*
☐ Kvinna / *Female*
☐ Man / *Male*

**2. Ålder** / *Age*

Jag är _____ år.

**3. Hur ofta äter du tomater?** / *How often do you consume tomatoes?*
☐ Fler än 5 gånger i veckan / *More than 5 times a week*
☐ 3 – 4 gånger i veckan
☐ 1 – 2 gånger i veckan
☐ Några gånger i månaden / *A couple of times a month*
☐ Mer sällan / *More seldom*

**4. Hur ofta handlar du tomater?** / *How often do you purchase tomatoes?*
☐ Flera gånger i veckan / *Several times a week*
☐ 1- 2 gånger i veckan
☐ Någon gång i månaden / *A few times (once) a month*
☐ Aldrig / *Never*

**5. Jag handlar främst tomat (du kan välja upp till två alternativ)** /
*I primarly purchase tomatoes in (up to two alternatives may be chosen)*
☐ I en vanlig dagligvarubutik / *Supermarket*
☐ i en särskild frukt- och grönsaksbutik / *Fruit- or vegetable shop*
☐ på torget / *Farmers' market or market square*
☐ direkt hos odlaren / *Farm shop*
☐ annat / *other*

**6. När du köpt tomater de senaste gångerna, hur nöjd har du varit med de tomater du valt bland?** / *How satisfied have you been with you purchase the last times you bought tomatoes)*
☐ Mycket nöjd / *Very satisfied*
☐ Nöjd / *Satisfied*
☐ Missnöjd / *Dissatisfied*
☐ Mycket missnöjd / *Very dissatisfied*

**7. Om du varit missnöjd med de tomater du köpt, vilken den vanligaste anledningen?** Du får rangordna tre alternativ med siffrorna 1-3, där 3 är den allra vanligaste orsaken, 2 den näst vanliga orsaken och 3, den tredje vanligaste orsaken / *If you have been dissatisfied with the tomatoes you have purchased, what has been the most common reason? You can choose three alternatives and rank them 1-3.*

____ De har för lite smak / *Too little taste*
____ De är för mjuka / *Too soft*
____ De blir aldrig mogna / *Never ripens*
____ De ser dåliga ut / *Bad appearance*
____ Annat: _____
____ De är för hårda / *Too hard*
____ De är mjöliga / *Too mealy/grainy texture*
____ De är övermogna / *Overripen*
____ De är för dyra / *Too expensive*

**8. Var förvarar du tomater hemma?** / *Where do you store tomatoes at home?*

☐ I rumstemperatur / *In room temperature*
☐ I skafferiet eller svalen (10-14°C) / *In the pantry*
☐ I kylskåpet (4-8°C) / *In the refrigerator*

**9. Hur hanterar du tomaterna direkt efter att du köpt dem?** / *Where do you put your tomatoes immediately when you arrive at home?*

☐ Jag låter dem mogna och förvarar dem i rumstemperatur / *Let them ripen and store them in room temperature*
☐ Jag låter dem mogna i rumstemperatur och lägger dem sedan i kylskåpet / *Let them ripen in room temperature and then put them in the refrigerator*
☐ Jag lägger tomaterna direkt i kylskåpet/svalen / *Put them directly in the pantry.*

**10. Hur förvarar du främst tomaterna?** / *How do you store you tomatoes?*

☐ I plastpåse / *In plastic bag*
☐ I papperspåse / *In paper bag*
☐ I plasttråg / *In plastic tray*
☐ I en täckt skål/annat förvaringskärl / *In a covered bowl or other container*
☐ Jag täcker inte tomaterna på något sätt / *I do not cover them in any way*

**11. Hur använder du vanligtvis tomater?** (du kan välja upp till två alternativ) / *How do you normally use tomatoes? (you can choose two alternatives)*

☐ I salad / *In salads*
☐ Som tillbehör till maten / *As extras to the food*
☐ I tillagad mat / *In cooking*
☐ Skivad på smörgås / *On the sandwich*
☐ Som ett snacks/mellanmål / *As a snack*
☐ Annat / *Other:* _____

**12. Vilken typ av tomater köper du helst?** / *Which type of tomatoes do you prefer to purchase?*

☐ ”Vanliga” tomater i lösvikt / *Single round tomatoes loose*
☐ Kvisttomater / *On-the-vine*
☐ Ekologiska tomater / *Organic tomatoes*
☐ Plommontomater / *Plum varieties*
☐ Körsbärs- och cocktailtomater / *Cherry or cocktail varieties*
☐ Annat / *Other*: _____

**Del 2: Provsmakning** / *Part 2: Tasting*

Provsmakningen består av åtta olika sorters tomater. Fem av tomaterna är ”anonyma” med ett slumpmässigt tresiffrigt nummer. Tre tomater är inköpta och presenteras med sin respektive märkning. /
*You will taste eight different tomatoes. Five are “anonymous” presented with a random number. Three are purchased tomatoes from a supermarket and presented with their labels respectively.*

**Prov nr** / Sample: _____

**Tomatens smak** / Tomato taste
Markera med ett kryss på skalan (1-9) nedan hur du upplever tomatsmaken
*Rate with a X on the scale (1-9) how you experience the tomato taste*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Tycker mycket illa om | | | | | | | | | | Tycker mycket bra om |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

*(Disslike (1)– Like very much (9))*

**Totalt intryck av tomaten** / *Overall impression of the tomato*
Markera med ett kryss på skalan (1-9) nedan hur ditt totala intryck av tomaten är

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Inte alls ett bra intryck | | | | | | | | | | Mycket bra intryck |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

*(Not a good impression at all (1)– Very good impression (9))*

**Svara på följande påståenden på skalan 1-9** / *Please answer the following statements on the scale 1-9 (Disagree – Agree)*

A. Jag föredrar söta tomater / *I prefer sweet tomatoes*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

B. Jag föredrar syrliga tomater / *I prefer acidic tomatoes*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

C. Det är viktigt för mig att tomaterna är riktigt röda när jag väljer i butik / *It is important that the tomatoes are fully red when I buy*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

D. Ett lågt Pris är viktigt när jag handlar tomater / *A low price is important*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

E. Det är viktigt att jag vet hur tomaterna är odlade / *It is important that I know the production method*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

F. Det är viktigt att tomaterna jag köper har en god smak / *Good taste is important*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Håller | | | | | | | | | | Håller |
| inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | helt med |

G. Ett fint och attraktivt utseende på tomaterna är det viktigaste när jag handlar tomater */ A nice and attractive appearance is important*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

H. Jag tycker att svenska tomater är godare än importerade /
*Swedish tomatoes taste better than imported*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

I. Jag tycker att ekologiska tomater är godare än konventionellt odlade / *Organic tomatoes taste better than conventional*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

J. Jag tycker att tomater man köper på torget/saluhallen/specialbutik är godare än de man köper i dagligvaruhandeln / *Tomatoes from the open air market taste better than from the supermarket*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

K Jag tycker kvisttomater är godare än ”vanliga” tomater / *Tomatoes ‘on-the-vine’ taste better than ‘ordinary’*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

L. Jag föredrar importerade tomater framför svenska / *I prefer imported tomatoes before Swedish*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

M. Det finns ingen smakskillnad mellan svenska eller importerade vanliga tomater i lösvikt / *There is no taste difference between Swedish and imported loose tomatoes*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

N. Jag väljer främst svenskodlade tomater om jag har möjlighet / *I primarily choose Swedish tomatoes if I can*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

O. Jag tycker det är viktigt att handla svenskodlat / *It is important to buy Swedish*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

P. Jag tycker att det är viktigt att handla ekologiskt / *It is important to buy organic*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

Q. Jag tycker det är viktigt att handla närproducerat / *It is important to buy local*

| Håller inte med | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Håller helt med |
|---|---|---|---|---|---|---|---|---|---|---|

TACK FÖR DIN MEDVERKAN! / *Thank you for participating!*